

## 2 The Concept of Potential Output: A History of Origins

### 2.1 Introduction

This chapter outlines the economic conditions and theoretical ideas prevailing at the times of origin of the concept of potential output. In general, Okun (1962) is considered as the starting point for the development of methods for calculating potential output and output gaps (Section 2.2). However, the standard methods have been heavily criticised by proponents of the New Neoclassical Synthesis who in turn refer to Wicksell's theory of interest rate gaps, which dates back as early as 1898 (Section 2.3). Accordingly, this chapter outlines the extensive history of potential output concepts before Okun (1962), especially with respect to the development of Wicksellian and Keynesian "gap theories" since the late 1920s (Section 2.4). Since controversies about the existence of a trade-off between full employment and price-level stability are of central importance for the discussion of potential output, the different stages of the Phillips curve debates are described in Section 2.5. The development of systems of national accounting, which began in the 1930s and culminated after World War II, did also play an important role. Based on national accounting, numerous methods of calculation have been developed since the 1960s for purposes of political advisory. At the end of this chapter, it is discussed to what extent connections can be made between concepts of potential outputs and the macroeconomic framework conditions prevailing at their respective times of origin (Section 2.6). When gap theories were developed around 1930, circumstances were, after all, very different compared to the heyday of potential output concepts in the 1960s and 1970s. The corresponding macroeconomic framework conditions are captured in terms of growth regimes that give priority to the relationship between real growth rates and real interest rates – two key determinants of investment.

The various strands of evolution presented in chapter 2 amount to a chronological survey. Against this background, chapter 3 analyses key positions and controversies revolving around concepts of aggregation, the notion of non-inflationary unemployment, the interaction of growth trends and business cycles and the neutrality of monetary policy. It should be noted that in both chapters the history of economic thought is employed as a map that helps to determine the present state of theory. On the basis of earlier positions and controversies, crossroads in the

evolution of economic thinking are identified. Not all turn-offs that have been abandoned by *mainstream* economics have been convincingly proven to be dead-ends or detours. Some alternative routes that have been discovered but only partially explored in the past may still contribute to further advancements in the determination of potential output. The current reconsiderations of Wicksellian gap theories indicate that investigating theoretical developments of the past need neither be an end in itself nor worship of ancestors, but may prove to harbour valuable analytical potential.

## 2.2 Okun's Contribution

It is commonly held that the concept of potential output was born at the annual conference of the American Statistical Association in 1962, when Arthur Okun, the US President's chief economic adviser, spoke on the significance and measurement of potential GNP.<sup>1</sup> Okun defined potential output as the level of macro-economic output attainable without triggering inflation. He, thus, linked the idea of maximum potential output with the criterion of an unemployment rate consistent with zero inflation quite a number of years before the term NAIRU became popular.<sup>2</sup> In the same essay, Okun devised the well-known "Okun's law", assuming a linear negative relationship between the GNP growth rate and the change of the unemployment rate as an empirical regularity. When economic growth recedes, unemployment increases and vice versa (Okun, 1962, 1983: 148f).<sup>3</sup>

Okun's law was actually a by-product of Okun's key proposition concerning the relationship between current output and potential output: If current output diverges from potential output, output gaps emerge from over- or underutilisation of productive capacities. Potential output becomes the pivotal factor of orientation for stabilisation policy because the existence of gaps implies macroeconomic inefficiency. As today's current output affects tomorrow's potential output, the dynamics of the inefficiencies require special attention. In the case of negative gaps (underutilisation), entrepreneurial profits and household incomes, and with them long-term oriented investments in production facilities, instalment, research and development, fall short of the level attainable in a situation of full utilisation. In the case of positive gaps (overutilisation), replacement investment for extra wear-out of personnel and material reduce the scope for net investment. Consequently, an effective stabilisation policy not only mitigates cyclical fluctuations in the utili-

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<sup>1</sup> See Okun (1962); with respect to Okun's work in the Council of Economic Advisers and the application of the concept of potential output during the early stages see Prachowny (2000, ch. 2).

<sup>2</sup> The term NAIRU is the abbreviation for "Non-Accelerating Inflation Rate of Unemployment".

<sup>3</sup> Okun's law, amongst other things, allows the determination of so-called employment thresholds, i.e. GNP growth rates that need to be transcended before an increase in employment can occur.

sation of the current output potential but also furthers economic growth (Okun, 1962, 1983: 147).

Okun's 1962 essay drew up a double-track approach for assessing potential output. On the one hand, Okun's characterisation of output gaps as cyclical deviations from the growth trend fostered the application of statistical methods for trend adjustments, for instance, by applying so-called filters. On the other hand, his benchmark of an unemployment rate that is consistent with stable inflation formed the basis for estimating production functions or Phillips curve equations. Both types of methods are criticised as inappropriate by proponents of the "New Neoclassical Synthesis", the current mainstream of macroeconomic theory.

## 2.3 The New Neoclassical Synthesis

The critique of common practices for calculating potential output is best illustrated by taking recourse to Michael Woodford's "Interest and Prices" (2003) – a standard reference on monetary theory that has advanced to the position of a "bible for central bank economists" (Green, 2005: 121). The core model of this book is a special version of the New Neoclassical Synthesis' three-equations system. In comparison with the traditional synthesis as represented by the IS-LM model, its major differences are considered to be the micro-theoretical foundations of macroeconomic relationships as well as the endogenisation of aggregate supply and of monetary policy. The core model of the new synthesis can be labelled as an IS-AS-MR model describing the dynamics of short-term fluctuations of production, inflation and interest rates:<sup>4</sup>

- The *IS equation* describes a negative relationship between the output gap and real interest rates, resulting from the intertemporal optimisation of the representative household. It is assumed that the household has rational expectations concerning the development of future income and inflation levels. If income is expected to rise, current demand for goods also increases. By contrast, rising real interest rates (nominal interest rates net of expected inflation rate) induce increased saving and a reduction of current aggregate demand.
- The *AS equation* establishes the interaction of aggregate supply and inflation in terms of a New Keynesian Phillips curve. Current inflation is determined by expected inflation and the current output gap. The latter results from profit maximisation of price-setting enterprises under monopolistic competition. If energy prices or nominal interest rates unexpectedly rise or if other shocks occur, a number of firms will prefer to reduce supply rather than increasing prices.
- The *MR equation* describes the reaction function of monetary policy makers in terms of a Taylor rule: Short-term nominal interest rates are set by the central

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<sup>4</sup> See Woodford (2003: ch. 4). For a less demanding and more graphically oriented description, see the textbook by Carlin and Soskice (2006). An introduction to a similar kind of modelling in German language is given by Spahn (2006: ch. 4).

bank in such a way that they positively fluctuate (with specific weights) with the deviations of inflation and the output gap from their target value. If current inflation exceeds the target value, nominal interest rates are raised, according to the Taylor principle even overproportionally, in order to reduce inflation.

Combining intertemporal optimisation, monopolistic competition and price rigidities, the IS-AS-MR model embodies a synthesis of New Classical and New Keynesian approaches. Woodford's approach, however, refers further back in history labelling his version of the IS-AS-MR models as "Neo-Wicksellian". It refers to Knut Wicksell's (1898) work on interest and prices, which can, for good reasons, be considered as a stepping stone in the development of both Neoclassical and Keynesian macroeconomics. Woodford's output-gap concept in the IS equation refers to a "natural rate of output" that corresponds to the "natural rate of interest" – a term coined by Wicksell (1898). Furthermore, Woodford's "welfare-analytical foundation" of monetary policy (2003: ch. 6-8) refers to Wicksell's simple rule of interest: According to that rule, changes in the price level of goods need to be answered only with parallel changes of money interest rates until the changes in the price level come to a standstill since the money rate of interest coincides with the natural rate (which is not directly observable).

Woodford's benchmark variable in terms of natural output is the notional output level in an environment of monopolistic competition and perfectly flexible prices. In this case there would be welfare losses due to monopolistic price-setting that, compared to perfect competition on the supply side, reduce demand. However, there would be no additional welfare losses resulting from price rigidities that reduce supply and distort the price structure. Since it should not be expected that prices are perfectly flexible under monopolistic competition, output gaps are best reduced by ensuring that the price level remains largely stable and price rigidities cannot take effect. As a typical "second best" solution to the welfare theoretical problem of optimisation (as opposed to the utopia of perfect competition), the Taylor rule, thus, forms a modern version of Wicksell's rule for monetary policy.

Woodford's approach and further developments of the New Neoclassical Synthesis lead to criticism concerning the two standard methods for calculating potential output, namely trend-filtering and estimations of production functions (e.g. Andrés, López-Salido, & Nelson, 2005). Statistical methods that extrapolate potential output as a growth trend based on past output developments generate results that coincide with analytically determined values by accident at best. Trend-oriented methods project past developments without considering the influence of future expectations on potential output. On the other hand, methods solely based on production functions or Phillips curve equations and embedded NAIRU estimations bring about logical short-circuits as potential output is identified on the basis of the unemployment rate that is consistent with stable inflation. According to the logic of the New Keynesian Phillips curve (the above-mentioned AS equation), however, low inflation can, in the case of nominal rigidities, be associated with inefficiently high unemployment rates due to output adjustments. Secondly, stable inflation is achieved only as a result of monetary policy, which in turn requires that potential output is determined independently. Within the framework of New

Neoclassical Synthesis, the conclusion that minimising inflation by means of monetary policy keeps current output close to potential output strictly holds only if purely nominal rigidities exist. As Woodford (2003) and Blanchard and Gali (2005) show for the case of real rigidities (when prices and nominal wages are both inflexible or shift at the same rate), supply shocks (e.g., rising energy prices) can revive the classical Phillips curve trade-off. In this case, strict inflation control is bound to generate output gaps and involuntary unemployment in the sense of Keynes (1936), at least in the short run. If the model is extended to include investment (Woodford, 2003: ch. 5.3), potential output might even be permanently reduced. The framework of the New Neoclassical Synthesis, thus, opens avenues to the explanation of long-term real effects of monetary policy.

One need not agree with all of the current criticism concerning the standard methods of estimating potential output. The new synthesis itself creates problems by defining the benchmark variable as output in an environment of monopolistic competition and perfectly flexible prices. This does not only carry the usual problems of dealing with unobservable quantities. It is also theoretically dubious: If enterprises are able to set prices and, faced with the choice of either adjusting prices or quantities, opt for the latter, one cannot assume that price adjustments would “actually” be the optimal solution. At least it cannot be claimed that this version of macroeconomic theory has micro-foundations superior to traditional IS/LM analysis. The discrepancy between individually and macroeconomically optimal behaviour is explained *ad hoc* by introducing specific assumptions concerning sticky prices rather than deriving it from the model. The new synthesis has, nevertheless, made progress over the old with respect to its dynamic analysis of inflation, output gaps and interest rate policy. Exactly in these features, however, the new synthesis refers to approaches that shaped macroeconomic theory before Okun’s (1962) contribution and are associated with Knut Wicksell and John Maynard Keynes.<sup>5</sup> The following section outlines those early Wicksell and Keynes connections of modern macroeconomics.

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<sup>5</sup> There are, however, fundamental differences between the new synthesis and Keynes’ and Wicksell’s theories, especially with respect to coordination failures of the interest rate mechanism. In the new synthesis coordination failures are disregarded due to the assumption implicit in the *IS equation* that investment invariably equals the intertemporal optimum of the representative consumer. For differences between Wicksell and current approaches, see Boianovsky and Trautwein (2006a) and the response by Woodford (2006); concerning Keynes, see van der Ploeg (2005).

## 2.4 Wicksell and Keynes Connections

### 2.4.1 Interest Rate Gaps and Inflation

Wicksell (1898) developed a theory of inflation based on the gap between the money rate of interest and the “natural rate of interest”. The natural rate of interest is the rate of return on capital that equalises savings supply and planned entrepreneurial investments – irrespectively of influences stemming from the loan supply of commercial banks and the monetary policy of the central bank. The most important forces affecting this equilibrium rate include technical progress and demographic change but also institutional changes, natural disasters and war. Because of these various and continuously varying influences on aggregate saving and investment, the “natural interest rate” is highly variable. By contrast, the money rate of interest that commercial banks demand from their customers – and that Wicksell defined as the representative market rate of interest – is sticky in the short run and adjusts only laggingly to changes in the market conditions. The main reasons for this lack of flexibility are contract obligations, conventions and other aspects of tending to customer relationships. If the profit expectations of entrepreneurs suddenly improve substantially, for instance, due to the opening-up of new markets by way of innovations or reforms, the natural rate of interest rises to exceed the market rate. The demand for loans increases and is normally met by commercial banks, owing to their own interests in increasing revenues.<sup>6</sup> As a consequence of the credit expansion, aggregate demand begins, sooner or later, to exceed available output. Excess demand leads to a rise in the general price level, which continues in a cumulative inflationary process for as long as the gap between the natural rate of interest and the money rate prevails.<sup>7</sup>

In Wicksell’s view, market forces cause the money rate of interest sooner or later to adjust to the natural interest, thus, restoring the original equilibrium state of the economy.<sup>8</sup> While the interest rate structure is stable in this sense, there are no market forces that would automatically return the price level to its original position. The price level is meta-stable, i.e. its index value at the end of the cumulative process differs from the initial value. The interaction of stable and meta-stable movements in a system of interdependent markets is the trademark of all macro-economic theories that developed from Wicksell’s monetary theory: The failure of

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<sup>6</sup> It is presupposed that sufficient collateral is provided. However, the value of the collateralised assets is itself indirectly dependent on the level and growth of the aggregate loan supply.

<sup>7</sup> In Wicksell (1898), the same logic applies to the process of disinflation that starts whenever the natural rate of interest falls short of the money rate.

<sup>8</sup> However, Wicksell’s hypothesis that the money rate adjusts to the natural rate of interest cannot be conclusively deduced in a modern credit economy that is not restricted by a gold standard, an assumption that Wicksell himself made in terms of the “pure credit economy” in his theory of cumulative processes; see Trautwein (1996).

the interest rate mechanism to coordinate savings and investments in the capital market forces prices – and sometimes also quantities – in other markets (in this case, the goods market) to adjust as well. Temporary coordination failures of the interest rate mechanism can, thus, induce permanent changes of prices (and quantities) in other markets.

Wicksell considered inflation to be a social grievance, as it gives rise to distributional conflicts and particularly puts recipients of nominally fixed incomes, who have little bargaining power, at a disadvantage. This way it undermines social peace. However, inflation can be avoided quite easily, if the central bank reacts quickly to price-level increases by raising interest rates until price-level stability is regained.<sup>9</sup>

Wicksell's interest-rate gap theory of inflation contains the core of a theory of potential output and output gaps. Wicksell himself, however, was merely looking for an explanation of inflation. He proceeded on the assumption that the economy is in a state of full employment and full utilisation of capacities at all times. Although he conceded at times the possibility that inflation and disinflation, through distributional effects, may cause investment and output capacities to change (e.g., 1898), he dismissed these effects as non-cumulative and hence insignificant. It was not until the 1920s and 1930s that Wicksell's interest gap theory was systematically extended by economists in various places who endeavoured to develop business cycle theories and models of macroeconomic dynamics. Particularly noteworthy are the contributions by Cambridge economists Dennis Robertson (1926) and John Maynard Keynes (1930), by Friedrich August von Hayek, Vienna/London (1929, 1931), and by the Stockholm School, led by Erik Lindahl (1930) and Gunnar Myrdal (1931). The contributions by Johan Åkerman, Lund (1928) and Ragnar Frisch, Oslo (1933), who were both inspired by Wicksell's (separate) theory of the business cycle, are also of relevance with regard to the relationship between growth trends and cyclical fluctuations. In the following, the focus is set on approaches that formed the base for subsequent discussions on potential output and, at the same time, provided valuable insights nowadays neglected.<sup>10</sup>

### 2.4.2 Impulse Propagation Mechanisms

As noted above, Wicksell considered his interest-rate gap model to be a theory of inflation rather than an explanation of business cycles. In his view cyclical fluctuations are caused solely by changes in the natural rate of interest, not by deviations of the market rate.<sup>11</sup> He explained the variability of the natural rate of interest

<sup>9</sup> Wicksell's simple rule of interest in the combat of inflation constitutes the core of the Taylor rule in the MR-equation described in Section 2.3.

<sup>10</sup> We present only a rough outline of a selection of evolutionary strands. Some of these contributions are addressed in more detail in chapter 3.

<sup>11</sup> In Wicksell's view, interest rate gaps are at best a reinforcing element in the progression of prices, and while they might aggravate speculative hyperboles and crisis, they cannot

as a result of asynchronous changes in the economy's set of fundamental data: While labour supply and the demand for consumption goods grow more or less steadily, technical progress in the form of new products and production processes occurs irregularly and by leaps and bounds. The corresponding increases in productivity raise the returns on investment projects and, thereby, the equilibrium rate of interest because saving does not adjust immediately, given that income and the demand for consumption goods change more slowly. Once the peak in investment activity that was caused by the leap in technology has been passed, output falls until the investment goods acquired at those peak times need to be replaced. Output oscillates until the system returns to its equilibrium state or further technological progress occurs. Wicksell (1918) compared the business cycle mechanism to a rocking horse that pushed by means of a stick, starts to sway strongly. If the horse is built solidly, it will gradually return from vigorous rocking to a state of rest unless it is pushed again. The push is the external impulse that sets the horse off, but the horse's movements are independent of the shape and further movement of the stick. They are solely determined by the strength of the impulse and the shape of the horse.

Wicksell's rocking horse metaphor gave rise to the famous dichotomy of impulse propagation mechanisms that characterises macroeconomic and econometric thought in various areas.<sup>12</sup> Fluctuations of real economic activity and other processes are, thus, defined as adjustments of the system in question to changes in exogenous variables. Like waves, external impulses diffuse across the system according to its laws of motion. The dissemination of this idea was promoted especially by Åkerman (1928) and Frisch (1933).

Åkerman (1928) attempted to reconcile the observation of seemingly irregular fluctuations in crude steel production and other business cycle indicators with general equilibrium theory by developing a method for empirical analysis of the cycle.<sup>13</sup> He proceeded from Fourier's theorem, which states that any curve, no matter how irregular its appearance, can be decomposed into a specific number of mutually overlapping sinus curves. Accordingly, Åkerman developed a hydrodynamic model of the economy based on the idea of a normal output capacity in the hypothetical equilibrium state. The normal capacity forms the motionless water surface at "sea level". Changes in productivity, due to technical progress and population growth, occur sometimes more and sometimes less intensively and give rise to "long waves", causing the normal capacity to fluctuate over decades. The interaction between long-term, short-term and very short-term waves induced by techni-

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generate business cycles. Concerning Wicksell's distinction between business cycles, crises and cumulative processes, see Boianovsky (1995) and Boianovsky and Trautwein (2001).

<sup>12</sup> Changes in GDP growth, inflation rates and other variables are routinely analysed as sequences of "shocks" in terms of comparative statics as well as dynamics. The effects of policy measures and other "shocks" are frequently represented using impulse response functions in structural vector autoregressive models (SVAR); see also section 2.6.2.

<sup>13</sup> Consistent time series of changes in national income were not available at the time; see section 2.6.1.



cal innovation cycles as well as by psychological and seasonal fluctuations in the degree of utilisation creates regular economic cycles lasting three and a half to six years depending on their position within the long wave. By treating business cycle impulses as the result of overlapping effects of various exogenous but more or less regularly occurring factors, Åkerman attempted to endogenise the timing of the occurrence of impulses and to render it accessible for business cycle forecasting.

Frisch (1933) developed Wicksell's rocking horse metaphor into models of impulse propagation mechanisms, drafting a system of difference and differential equations that describe the aggregate production of capital and consumption goods. By means of modelling a mechanism of acceleration (overproportional reactions of investment in response to changes in consumption) that works in the presence of liquidity constraints for consumption, Frisch was able to explicitly describe and consistently quantify the dynamics of investment and consumption activities as well as to make rigorous distinctions between competing business cycle theories on the basis of differences in their functional design and parameter magnitudes. Unlike Åkerman's spectral analytical approach, however, in Frisch's model impulses do not lead to permanent fluctuations, owing to their irregular nature. After a time, their effects peter out because the system's fluctuations are dampened by frictions (mainly inelasticities of demand and supply). In the absence of impulses (in modern terms: "shocks"), no difference between potential and current production exists.

### 2.4.3 Monetary Policy and the Formation of Expectations and Capital

All over Europe the early 1920s were marked by discussions on whether and under what circumstances the gold standard prevailing before World War I could be revived. When, in 1925 and after, the gold convertibility of most currencies was re-established but shortly afterwards called into question by the onslaught of the Great Depression (1929-33), the issue of manipulating aggregate output by means of interest rate policy came to the fore. During this period, it seemed consequent to extend Wicksell's interest rate gap theory of inflation to construct monetary theories of the business cycle and macroeconomic theories of economic policy. With regard to systematic investigations of the relationship between potential output and monetary policy, the approaches developed by the Stockholm School are particularly noteworthy. Path-breaking contributions were made by Lindahl (1930) and Myrdal (1931).

Lindahl (1930) as well as Myrdal (1931) subjected Wicksell's concept of the natural rate of interest to critical examination. Both of them demonstrated that in a modern monetary economy with a multitude of products no equilibrium interest rate can be conceptualised independently of the money rate of interest and monetary policy (see also Trautwein, 2005; Boianovsky & Trautwein, 2006b). They re-defined the equilibrium rate of interest as the expected rate of return on real investment (purchases of durable means of production) that equals the planned savings of households and enterprises. For these definitions of the "real interest rate", expectations concerning the future development of the value of investment

goods are of crucial importance. Similar to modern rentability concepts that proceed from the present value of an investment project, Lindahl (1930: 248) and Myrdal (1931: 32) considered the real interest rate to be the “relation between the expected future value of output (net of fair risk-premium)” and “current invested values“. These current invested values depend on investment demand, which in turn is affected by lending rates and, hence, in the end, by the central bank’s monetary policy.

Lindahl (1930: 167 and 249) and Myrdal (1931: 164), thus, concluded that the real interest rate tends to adapt to the current money rate rather than the reverse. Lindahl (1930: ch. II) substantiated this conclusion by constructing various scenarios of cumulative processes that emerge in response to a cut of nominal interest rates by the central bank. For this he varied certain assumptions in the basic model, such as the degrees of capacity utilisation and employment, the intersectoral mobility of capital goods and labour, as well as incomplete foresight with regard to changes in the price level. He showed that, in an environment of under-utilisation and unemployment, the decrease in the central money rate of interest (in those days: the discount rate) brings about an expansion of output until potential output is completely utilised. However, under certain conditions the decrease in interest rates may serve to expand potential output itself: if, due to interest rate cuts, aggregate demand exceeds supply while the emerging inflation is not perfectly anticipated by lenders and jobholders, enterprises earn so-called “windfall profits”. They gain returns that result solely from the redistribution of purchasing power away from consumers with comparatively fixed incomes. Since the entrepreneurial propensity to reinvest retained earnings is normally higher than the households’ propensity to save, it is safe to assume that the extra profits caused by inflation enhance entrepreneurial investment activity. With the extension of productive capacities potential output grows, and, open competition provided, inflation decreases as supply adapts to demand.

In this scenario as well as in the multitude of other designs of cumulative processes that abound in the key works of the Stockholm School (especially Lindahl, 1930; Myrdal, 1931, & Lundberg, 1937), disequilibria of aggregate supply and demand that give rise to inflation or disinflation are explained by deficiencies in the coordination of planned investments and planned savings by way of the interest rate mechanism. When discussing these kinds of coordination failures, the Swedish tradition particularly emphasised the formation of expectations in an environment of imperfect foresight. *Ex ante* disequilibria in the sense of incompatible plans bring about adjustments of prices and quantities that result, *ex post*, in equilibrium states of investments and savings, which differ from the original full-employment equilibrium.<sup>14</sup> In the above-mentioned scenario of inflation-driven growth aggregate saving deviates from the level that was originally planned, adjusting to entrepreneurial investments. Eventually, the real interest rate coincides with the decreased money rate since the formation of extra capital tends to in-

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<sup>14</sup> The famous distinction between *ex ante* and *ex post* values in macroeconomics originates in Myrdal (1933).

crease productivity and thereby lower prices such that aggregate real income may increase.

Lindahl (1930 and 1961) was nevertheless quite sceptical with respect to efforts of fostering economic growth by means of reducing interest rates (under conditions of full employment). He assumed that, sooner or later, inflation expectations adapt to actual inflation and eventually accelerate the inflationary process by inducing interest rate-price and wage-price spirals. In the course of these processes, the income rigidities that produce windfall profits are dissolved. Furthermore, social conflicts may develop as well as a decline in saving. For both reasons, the central bank may be forced to increase interest rates in order to dampen inflation without enterprises, lenders, and jobholders being prepared for this. In any case, not only a decrease in current output but also a decline of capital stocks and, thus, potential output is imminent. Like Wicksell, Lindahl, therefore, advocated a rule-bound interest rate policy. He argued that, by stabilising expectations on inflation, the central bank should be able and obliged to stabilise capital formation as well.<sup>15</sup>

Lindahl and Myrdal were aware of the fundamental problem associated with a consistent definition of the equilibrium “real” interest rate – and, therewith, implicitly of the “normal” capital stock and potential output. To serve as a benchmark for evaluating measures of monetary policy, the equilibrium interest rate has to be determined independently of the impact of monetary policy. The only solution to this problem is to define the equilibrium interest rate as a path-dependent variable: Past influences of monetary policy are co-determinants of the current equilibrium interest rate.

#### 2.4.4 The Term Structure of Interest Rates and the Business Cycle

It is considered a “stylised fact” that the central bank’s monetary policy is capable of directly influencing the short-term interest rate in the money market. However, entrepreneurial investment activity – and thus the formation of capital that is decisive for potential output – primarily depends on the long-term interest rate in the capital market. How are short-term and long-term interest rates connected? Is the central bank in a position to influence the term structure of interest rates? Is it possible to extrapolate from the term structure to future potential output?

The first building blocks for answering these questions were provided by US economists Irving Fisher (1896) and Wesley Mitchell (1913). Mitchell promoted the concept of the yield curve as a representation of interest rate term structures. He observed that the yield curve is normally sloped upwards, the long-term interest rates being higher than the short-term interest rates. By contrast, in the case of

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<sup>15</sup> Lindahl went even further and in a separate book on the rules of monetary policy (Lindahl, 1929) advocated the rule of targeting a nominally constant national product, i.e. the price level should be allowed to decline if labour productivity rises and vice versa. Given the relative rigidity of nominal wages, risks for profits and employment are evenly distributed evenly between employers and employees. For Lindahl’s views on various rules for monetary policy, see Boianovsky and Trautwein (2006b).

imminent recession the yield curve is frequently inverse, the short-term interest rates being higher than the long-term interest rates. In his subsequent contributions (e.g., Burns & Mitchell, 1946), Mitchell concluded that the yield curve might be employed as a leading indicator for the course of the business cycle.<sup>16</sup>

Fisher (1896) postulated that it is possible to decompose the long-term interest rate observable as a nominal quantity into the expected real interest rate and the expected rate of inflation (at the time of payment). Given a constant real interest rate, if inflation expectations change, the nominal interest rate is adapted. If, however, a credible monetary policy manages to keep inflation expectations stable (or otherwise known), this hypothesis known as the “Fisher effect” can be employed for forecasting economic progression.

However, concerning the deduced changes of the real interest rate, there is scope for interpretation with respect to the progression of potential output. For instance, increases in real interest rates may be caused by improved revenue expectations on the part of enterprises and, thus, signalise an expansion of potential output, but they may also be due to a declining capital supply and, thus, imply at least stagnating potential output. Powerful forecasts based on the yield curve, therefore, require additional “identifying” information.

The difference between nominal and real interest rates in terms of the Fisher effect needs to be distinguished from the difference between the monetary and real interest rates in Wicksellian theories of interest rate gaps. Fisher’s “real interest rate” denotes Wicksell’s “money rate of interest” in terms of a rate of return on financial assets in the capital market – as opposed to the expected rate of return to real investments, as understood by Lindahl and others (see section 2.4.3). Fisher’s real interest rate is an *inflation-adjusted* money rate. The actual real interest rate may differ from the “natural” or equilibrium interest rate. A general connection between interest rate theories in the style of Fisher and Wicksell is that intertemporal equilibrium prevails if the nominal rate of interest equals the real interest rate plus the inflation expectations of both lenders and borrowers. A fundamental difference between them is the notion that, according to the Fisher effect, intertemporal equilibrium is, in principle, consistent with any rate of inflation. By contrast, in Wicksell’s view intertemporal equilibrium is characterised by zero inflation (price level stability).<sup>17</sup> From the viewpoint of more recent macroeconom-

<sup>16</sup> With respect to this and similar recommendations, mockers like to annotate that financial markets have predicted eleven of the last seven recessions. Concerning the forecasting power of the term structure of interest rates see, however, chapter 7 of the present study.

<sup>17</sup> However, Lindahl (1930), von Hayek (1931), and Myrdal (1931) criticised Wicksell’s fixation on price level stability as an equilibrium condition; see Trautwein (2005). As pointed out by Hayek and Myrdal, disequilibria may prevail even with zero inflation. Lindahl demonstrated that high and accelerating inflation can be reconcilable with intertemporal equilibrium, provided that it is foreseen. In his examination of the relationship between interest and prices (1930), he took account of both Wicksell’s and Fisher’s interest rate theories.

ics following Woodford (2003), “quasi-zero inflation” is required for maximum convergence of current output to potential output.<sup>18</sup>

Theories inspired by Wicksell (including Woodford, 2003) assume – more or less simplifying – that the central bank is in a position to control the money market rate of interest and, thereby, also affect the long-term interest rates. Thus, the existence of an interest rate term structure does not change the reasoning put forward in the previous sections. The influence of monetary policy on capital market interest rates was analytically substantiated by Keynes (1930, ch. 37) and Lindahl (1930, ch. III). Both lines of argument were fully developed by Hicks (1939, ch. XI) to form the now well-known theory of expectations of the term structure. Keynes and Lindahl demonstrated the possibility that measures of open market policy (purchases and sales of long-term loans) by the central bank might directly affect interest rates in the capital market. But both they and Hicks put even more emphasis on the significance of the so-called “expectations channel” of transmission. They reasoned that long-term interest rates ought to be primarily considered as the average value of current interest rates and expected short-term interest rates over the relevant time horizon (see, e.g., Hicks, 1939: 145). Due to the existence of a risk premium, which takes account of the probability of illiquidity and credit default, the yield curve is sloped upwards. However, if future short-term interest rates are expected to be lower, current long-term interest rates decrease – perhaps even below the current short-term interest rates. In such periods the yield curve’s shape is inverse.

Various causes may give rise to an inverse interest rate structure. Lindahl (1930: 190-194), however, stressed the importance of monetary policy for the formation of expectations and the yield curve. By means of a thought experiment he demonstrated the central bank’s potential to influence the time path of inflation by affecting the term structure of interest rates. According to that, the announcement of a temporary rise in the discount rate and subsequent decrease below the current level gives rise to a distinct inversion of the yield curve. As short-term investments are now discounted by a higher interest rate while long-term investments have become more profitable due to a lower interest rate, reallocations of credits and resources (fixed capital, labour, stocks of inventory) to longer-term projects occur. In the real world, smooth reallocations of resources from one sector of the economy to another cannot be expected. Therefore, prices for inputs in short-term investments deteriorate initially leading to deflation. Then, due to the increase in the demand for inputs in long-term investments, the price level rises albeit not steadily. At the point of completion of those investment projects to which the same interest rate applies as at the original point on the inverse yield curve, the increase of the price index subsides. Thereafter, due to the excess demand for inputs in long-term investments inflation starts to accelerate.

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<sup>18</sup> “Quasi-zero inflation” means that the New Neoclassical Synthesis does not consider perfect price stability as optimal in all events. Especially in the aftermath of supply shocks, tolerating a temporary minor price drift may be a superior solution from a welfare-theoretical perspective.

Purely hypothetically, by announcing changes in refinancing terms, the central bank would be able to affect not only the term structure of interest rates and investment activity but also the progression of inflation and (in the case of frictions in the reallocation process) of macroeconomic output. The central bank would, thus, be in a position to generate business cycle fluctuations by means of term structure policies. Since such policies would have destabilising effects, Lindahl (1930: ch. IV) advocates a rule-bound monetary policy that averts inflation by stabilising the market participants' formation of expectations (see section 2.4.3). The nowadays-common argument that the combat of inflation may require an inversion of the term structure by means of monetary policy was part of Lindahl's argument. Unlike his thought experiment of inversion, the general idea does not refer to announcements of a specific interest rate cut at a certain point in time but on making interest rate reductions dependent on the progression of the rate of inflation.

### 2.4.5 Effective Demand and Unemployment

The publication of *A General Theory of Employment, Interest and Money* by John Maynard Keynes (1936) changed the perspective of macroeconomic thinking considerably, although Keynes tied in with the Wicksellian tradition in many ways. In his *Treatise on Money* (1930), Keynes had, similar to many other economists, attempted to construct a monetary theory of the business cycle using his specific version of Wicksell's interest rate gap theory. Like Wicksell, he set the focus on cumulative processes of inflation but even more of deflation. Like Wicksell, he explained cumulative processes as results of coordination failures of the interest rate mechanism and associated disequilibria in the product market. Faced with the Great Depression, Keynes (1936) altered his perspective in many regards. Emphasis now lay on equilibrium constellations in goods markets and financial markets which, given constant prices, emerge from cumulative processes of *quantities* and result in involuntary mass unemployment. The focus, thus, changed from price adjustments to quantity adjustments and from dynamic analysis of disequilibria to comparative-static analysis of equilibria characterised by full- and underemployment. This change of perspective was reinforced by Hicks' (1937) attempt at reconciling the static core of Keynes' theory with the "classical" views held by Arthur Cecil Pigou and others. IS/LM analysis as developed by Hicks (1937) has significantly promoted the popularity of Keynes' theory. It forms the core of the traditional Neoclassical Synthesis, which is still part of most macroeconomic textbooks and, despite all criticism, has survived in some realms of political advisory.

Keynes (1936: ch. 3) emphasised the principle of effective demand, which states that aggregate demand may fall short of potential output. Keynes (1936: ch. 5-10) considered the general reason for this gap to be the interest rate mechanism's failure to coordinate investments and savings, causing it to be replaced by a mechanism of aggregate income adjustments. In Keynes' view, the capital-market equilibrium of investments and savings is not generated by adjustments of interest rates that would reconcile the planned investments of the firms with the intertem-

poral consumption plans of the households. Rather, autonomous changes of aggregate investment via multiplier processes give rise to cumulative changes in national income and consumption expenditures. With income and consumption, the volume of savings also adapts.

The hypothetical starting point of a typical multiplier processes according to Keynes is a full employment equilibrium with aggregate saving equalling aggregate investment and current output coinciding with potential output.<sup>19</sup> A decline of the demand for investment goods, thus, gives rise to a loss of national income that adds up to a multiple of the investment decrease because the corresponding employment reduction goes with a cut of the demand for consumption goods. Even though this cut is underproportional, it results in additional income losses. Due to the cumulative income losses the volume of saving also decreases until it equals investments once again. The corresponding income level is associated with a new equilibrium in the markets for investment and consumption goods while excess supply prevails in the labour market. In its simplest form the investment multiplier can be written as follows:

$$1/s = \Delta Y/\Delta I \quad \text{and} \quad \Delta Y = (1/s)\Delta I, \quad (2.1)$$

$s$  being the marginal savings rate ( $s < 1$ ),  $\Delta Y$  the change in aggregate income and  $\Delta I$  the change in investment between the initial and the final equilibrium state.

Ever since Hicks (1937), Keynes' theory is usually presented in a simplified version that explains decreases of investment that lead to underemployment by referring to "investment traps" or "liquidity traps".<sup>20</sup> Investment traps are constellations in the product market where enterprises expect their net revenues to be that small that the investment activity required for full employment could be achieved only if interest rates in the capital market were distinctly *negative* – and, thus, it cannot be achieved at all. Liquidity traps are constellations in the financial market where most asset holders speculate for an increase in interest rates and, because of the associated fall in asset prices, substitute circulating bonds or shares with highly liquid assets or money. Due to liquidity preference and low demand for less liquid assets, the level of interest rates in the capital market will indeed remain high and cause investment activity to fall short of the volume required for full employment. In both cases, measures of monetary policy take no effect whatsoever on the funding of investments because the demand for investments is inelastic or the demand for money is perfectly elastic with regard to the interest rate, respectively. According to Keynes (1936: ch. 19), wage cuts do just as little to fix the misery because they curtail effective demand and negatively affect macroeconomic revenue expectations. Thus, as a last resort for stabilising national income

<sup>19</sup> Keynes (1936: ch. 10) basically adopted the concept of the investment multiplier from Kahn (1931).

<sup>20</sup> Whether this canonical interpretation does justice to Keynes' (1936) intentions need not be gone into. The case of "sticky wages" mentioned in textbooks as the third cause of underemployment equilibria in Keynes (1936) plays a far less important part compared to explanations referring to pessimistic entrepreneurial revenue expectations and liquidity preference on the part of wealth owners.

and employment, from a (traditional) Keynesian viewpoint only effective demand management by means of fiscal policy remains.<sup>21</sup>

Keynes' theory and its Keynesian standard interpretation in terms of IS/LM analysis have come under much criticism during the course of time. In the context of the present study, however, the bottom line is that Keynes (1936) has substantially contributed to the idea that market processes do not automatically ensure a national income level measuring up to potential output. Keynes considered sub-optimal curtailments of production and employment by effective demand as the normal case and, thus, saw a chronic need for action on the part of stabilisation policy. With decreases of investment activity, involuntary unemployment emerges. In such underemployment equilibria the unemployment rate is consistent with stable inflation (or rather with stable deflation). In the course of the multiplier process quantities react prior to prices. Due to adjustments of aggregate supply to the decrease in aggregate demand, price adjustments may not occur at all. However, Keynes only analysed the impacts of investment changes on national income and treated adjustments of aggregate supply in the course of the multiplier process essentially as unplanned reductions of inventory stocks (negative investments). Effects of investment changes on the capital stock were mostly disregarded in his primarily short-term-oriented theory. They were not investigated until the business cycle theories of the 1930s were further developed into growth theories.

#### 2.4.6 Business Cycles and Economic Growth

Apart from Wicksellian cumulative processes and Keynesian multiplier analysis, the accelerator principle played an important part in business cycle theories of the interwar period.<sup>22</sup> According to this principle, investment demand overproportionally responds to a change in the demand for consumption goods and thus, by means of "accelerating" aggregate demand, generates corresponding fluctuations in macroeconomic production. Roy Harrod (1936) and Erik Lundberg (1937) almost synchronously discovered that a dynamic theory of the business cycle could be designed by combining the accelerator and the Keynesian investment multiplier. Lundberg (1937) developed formal models of sequences that couple both mechanisms by means of lags and, thus, generate a unique time structure.<sup>23</sup> In various scenarios he reconsidered Wicksellian and Keynesian models of economic

<sup>21</sup> Again, there are discrepancies between the positions of Keynes (1936) and the Keynesian standard interpretation known as the Neoclassical Synthesis during the post-war period. As pointed out by Laidler (1999), during the inter-war period advocating expansive fiscal policy to combat depression and unemployment was not a unique selling point that singled out Keynes and his supporters.

<sup>22</sup> See, e.g., the classic survey by Haberler (1937: ch. 3) as well as Boianovsky and Trautwein (2006c) for a documentation of contemporary discussions of the accelerator principle.

<sup>23</sup> For example, the well-known *Lundberg lag* characterises the time required for production to adjust to changes of effective demand.



upswings that, due to accelerator effects or measures of interest rate policy, may be reverted into a downswing but under certain conditions may also result in a new equilibrium state. That way, Lundberg (1937) designed a self-contained synthesis of macroeconomic theories that, unlike the contemporary and now “classical” approaches by Haberler (1937) and Hicks (1937), was strictly based on dynamic modelling.

However, Lundberg’s modelling was so complex that it initially attracted little attention. Paul Samuelson (1939) employed its basic elements for a simpler and more general discussion about the dynamic stability of a multiplier-accelerator model of national income fluctuations. At the same time he followed Frisch’s approach, in which an impulse causes fluctuations of the system that peter out in the course of time (see section 2.4.2). Samuelson demonstrated that multiplier-accelerator models are dynamically stable under plausible conditions. Samuelson’s model became pathbreaking for the further advancement of business cycle theories.

However, Lundberg’s *Studies in the Theory of Economic Expansion* (1937) are interesting not only as a synthesis of theories of the business cycle but also as a point of origin for modern growth theories. Unlike Keynes (1936) and other contemporaries, Lundberg employed multiplier analysis not primarily for the investigation of contractive processes but was chiefly interested in expansion. In a simple model of the circular flow of income and expenditures, the investment multiplier in eq. (2.1) can also be defined as the ratio of investment to macroeconomic output in a goods-market equilibrium:

$$Y = (I/s) I, \quad (2.1a)$$

where  $Y$  denotes aggregate demand, which in equilibrium must equal aggregate supply – and, hence, under the usual simplifying assumptions, represents national income as well. Erik Lundberg (1937), and after him Roy Harrod (1939) and Evsey Domar (1946), established that, via multiplier processes, investment has an effect not only on income but also on production capacities. It increases potential output and, hereby, alters the equilibrium position in the goods market.

Following Cassel’s (1918) conception of the economy in a progressive state, Lundberg (1937: 183f. and 240f.) devised the conditions for a dynamic growth equilibrium (*steady state* growth equilibrium) that later became known as the Harrod-Domar model. The pivotal condition requires that aggregate demand grow at the same rate as productive capacity. This connection is illustrated by a few simple extensions of eq. (2.1a):

- The relationship between investment and national income,  $I/Y$ , can be expanded to  $(I/K)(K/Y)$ , where  $I/K$  denotes the capital stock ( $K$ ) increment with  $I = \Delta K$ . This rate is also the growth rate of potential output, in the literature mostly written as “ $g$ ”.  $K/Y$  or “ $v$ ”, respectively, denotes the capital coefficient, i.e. the amount of capital required for the production of a specific national income level. From this it follows:

$$I/Y = gv. \quad (2.2)$$

- The multiplier term in the goods market equilibrium condition (2.1a) can be rewritten as  $I/Y = s$ . If  $g$  is understood as the capacity growth rate that sets the pace for employment (and, thus, labour demand as derived from demand for goods), inserting  $s$  into (2.2) and solving the equation for  $g$  yields the condition for *steady state* growth going with full employment:

$$g = s/v. \quad (2.3)$$

$g$  here is the desired growth rate since at this rate the income effect of investments on the demand side exactly matches their capacity effect on the supply side.<sup>24</sup>

The important part of this reasoning is that the progression of potential output is not independent of current demand. Changes in the volume of investments affect aggregate demand as well as aggregate supply. Discrepancies between current potential output and current demand, via their feedback effects on investment activity, also affect future potential output.

Harrod (1939) and Domar (1946) regarded the savings rate and the capital coefficient as institutionally given constants. The latter assumption, in particular, led to a shift of the discussion about the capacity effects of investments towards a debate about “unacceptable” dynamic instabilities of the *steady state* equilibrium. For any deviation of the current growth rate  $g$  gives rise to self-reinforcing capacity excesses or shortages, and any discrepancy between  $g$  and the “natural growth rate” (population growth plus increase in productivity) brings about incessantly rising under- or overemployment. The treatment of economic growth as a *razor edge equilibrium*, that is achieved coincidentally at best and results in the system’s complete instability if the equilibrium conditions are not met, did not seem plausible (Solow, 1988). It prompted the design of models characterised by a stable *steady state*, brought about by endogenous changes of the capital coefficient.

Models of this type were developed by Robert Solow (1956) and Trevor Swan (1956) on the basis of a macroeconomic production function that exhibits positive but diminishing marginal returns at all points. Due to these and other features the Solow-Swan theory is labelled “Neoclassical Growth Theory” and is contrasted with the “post Keynesian growth theories” à la Harrod and Domar. Its vital attribute is the convergence of the equilibrium path of capital formation towards the long-term *steady state*, which is exogenously determined by the growth rates of population and productivity (as well as implicitly by consumer preferences and the state of technology). Since the Solow-Swan theory also presumes continuously cleared labour and capital markets, any discrepancy between current and potential

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<sup>24</sup> This is a slightly modified version of Harrod’s (1939) simple equation. Lundberg (1937: 185), by contrast, deduced the equilibrium growth equation by using a dynamic model and denoted the time path of income as:  $Y(t) = c e^{t(s/v)}$ . His advanced pioneer version was probably less noticed than Harrod’s because it was stashed in a footnote in the context of a complex analysis of growth sequences (another reason might be that it did not stem from Oxbridge).

output as well as between the current and the desired growth rate are ignored.<sup>25</sup> Any potential effects such differences may exert on the progression of potential output are naturally disregarded as well. Potential output is determined solely by effective factor supply, adjusted for the effects of technical progress.

Nevertheless, the development of Neoclassical growth theory significantly influenced the development of methods for estimating potential output. Based on a Cobb-Douglas production function, Solow (1956) decomposed empirically observed growth rates into the contributions of labour, capital and technical progress (total factor productivity) by means of *growth accounting*. This procedure forms the basis of most “economic” estimations of potential output that are presently employed in political advisory (see section 2.6.2).

Even though in *mainstream* economics Neoclassical growth theory quickly prevailed over post-Keynesian theory, with Okun’s law a reminiscence of the latter emerged. Okun (1962) demonstrated that the current growth rate of national income needs to equal or exceed the natural growth rate (the growth rate of population and productivity) in order to prevent an increase in unemployment. From an empirical point of view this only happens by way of an exception; the time series show a frequent occurrence of employment gaps that in the course of the business cycle are not automatically dismantled.

#### 2.4.7 Inflationary Gaps and Output Gaps

Okun (1962) defined potential output as the macroeconomic output level associated with neither inflationary pressure nor unemployment (see section 2.2). Thus, it suggests itself to treat deviations of current demand from potential output directly as gaps: If demand exceeds potential output, in the very short run a (positive) *output gap* emerges. However, the overutilisation of productive capacities is accompanied by supply shortfalls and sooner or later gives rise to price pressures and an inflationary gap. Conversely, if demand falls short of potential output, a (negative) *output gap* arises. Since Wicksell (1898), the interest rate gap concept had served as an explanation for inflation, and since the early 1930s it had also been employed for explaining underutilisation and unemployment. The first formalised concepts of inflationary gaps and output gaps, however, emerged only after Keynes’ *General Theory* (1936) had been published and were only indirectly related to it. Nevertheless, John Maynard Keynes and Erik Lindahl were key figures in the development of gap concepts that paved the way for Okun (1962).

The development of the inflationary gap concept is commonly accredited to Keynes (1940). In his collection of essays *How to Pay for the War* Keynes discussed the drastic increase in living costs that began to show in Great Britain at

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<sup>25</sup> In the Solow-Swan model, the dynamic stability of the *steady state* is ensured only with respect to the coincidence of the desired with the natural growth rate, not with respect to the relationship between the current and the desired growth rate; see Hahn (1960). The problems associated with the use of a macroeconomic production function in Neoclassical growth theory are addressed in section 3.2.

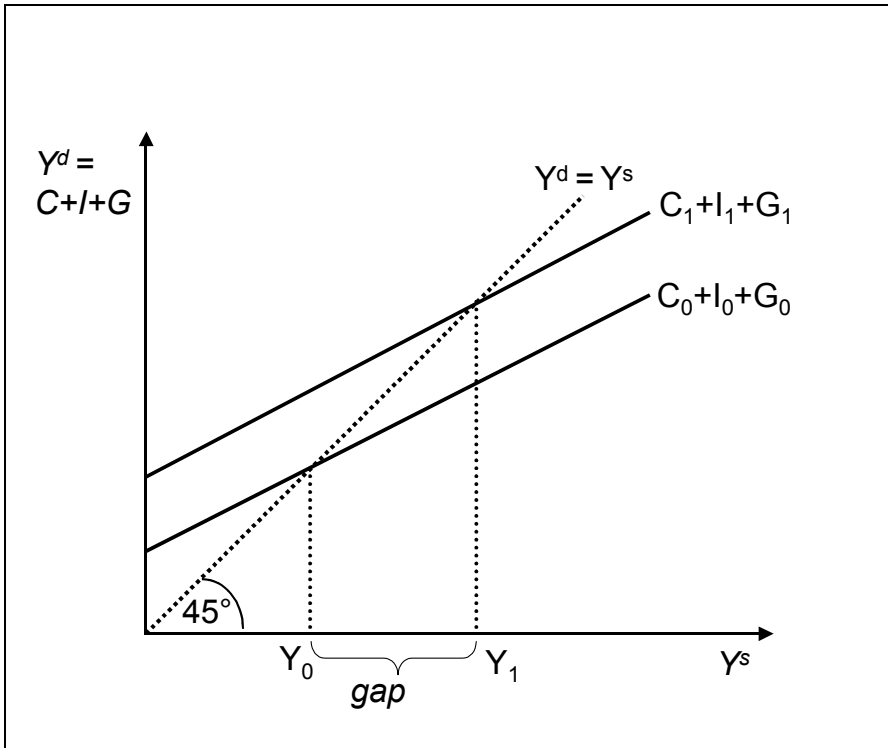
the beginning of World War II. As Keynes (1940: 4 and 17) emphasised, this development constituted a reversal of the pre-war situation when the level of production constantly fell short of its potential capacity. In wartimes, capacities available for private consumption are drastically reduced and the nominal excess demand for obtainable consumption goods is bound to cause inflation (which could be subdued by means of price controls but not fully averted). Keynes proposed to prevent inflation by introducing a system of forced savings that accredits claims for higher income in the post-war period for the general public. Noteworthy is his attempt to determine potential output and the demand gap propelling inflation on the basis of data on productive capacity, national income and demand components (Keynes 1940: ch. III, IX and App. I). Bringing Keynes' (1936 and 1940) lines of reasoning together, the systematic relationships of potential and gaps can be represented by the "Keynesian cross", which is well-known from introductory macro-economic textbooks (see Figure 1).<sup>26</sup>

The case of the output gap (or deflationary gap) is the typical case described by the simple investment multiplier according to Keynes (1936). In this model, aggregate demand ( $Y^d$ ) and aggregate supply ( $Y^s$ ) are presented as real quantities, and  $Y_l$  is the aggregate supply in full-employment equilibrium, thus, equalling potential output. In the typical case the impulse for the emergence of an output gap is an autonomous decrease of investment ( $I_0 < I_l$ ). This, via its impact on employment, income and consumption, leads to a fall of aggregate demand until underemployment equilibrium is achieved at the income level  $Y_0$  ( $Y^d = Y^s$  is below the level required for full employment). In the Keynesian model, quantities react prior to prices, and in the course of the multiplier process effective supply adjusts to aggregate demand after a time lag. Thus, there are no discrepancies between nominal and real variables, i.e. the inflation rate is zero. Effective supply decreases from  $Y_l$  to  $Y_0$ . But given unchanged prices, the capital stock and labour supply in the short run have not been reduced, and potential output remains at the level  $Y_l$ . Therefore, the output gap can be written as the difference  $Y_0 - Y_l$  and, provided data for the marginal rate of consumption and relevant aggregates are available, can also be quantified.

In the case of an inflationary gap,  $Y_0$  forms the starting point of the consideration;  $Y^d$  and  $Y^s$  are nominal variables. The economy is in a state of full-employment equilibrium where current output matches potential output. If effective demand now rises – for instance, due to an increase in public spending ( $G_l > G_0$ ), as observed by Keynes (1940) on account of the war – aggregate supply cannot adjust in the short run due to shortages. A rise in prices sets in, which gradually increases nominal national income to the level  $Y_l$  while its real (inflation-adjusted) value remains at  $Y_0$ . The difference  $Y_l - Y_0$  represents the inflationary gap.

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<sup>26</sup> The Keynesian Cross has shaped didactics concerning circuit- and multiplier analysis since the first edition of Paul Samuelson's classic textbook (Samuelson, 1948).

**Fig. 1.** The Keynesian Cross

This simple representation of possible deviations from potential output is based on comparative-static equilibrium theory. In the 1940s and 1950s it was widely used in political advisory as well, especially in the U.S. and Great Britain. However, it did also meet criticism (e.g., by Friedman, 1942). Lundberg (1937: 196f.) in his dynamic periodic analysis investigated a sequence featuring inelastic factor supply and flexible prices, and using a numerical example he calculated the magnitude of an inflationary gap – even before Keynes made a similar attempt in 1940. Under the direction of Lundberg, the Swedish National Institute of Economic Research regularly calculated inflationary gaps from 1943 onward (Ohlsson, 1987; Berg, 1987). It was an attempt to determine both the actual inflation and the inflation suppressed by means of price control, which was caused by deviations of demand from potential output.

However, Lundberg and his colleagues were not quite convinced by their own endeavours. Apart from shortcomings in the data basis, the more fundamental problem of static analysis that potential output is an unobservable variable, which results from plans of both suppliers and buyers in goods and factor markets, forced them to make oversimplifying assumptions. Even if planned quantities and prices could be assessed by means of surveys, the effective potential output may deviate from the aggregate planned variables since plans need not necessarily be compati-

ble. Adjustment processes of planned (*ex ante*) variables towards observed (*ex post*) results of the market process have to be explicitly modelled in order to distinguish price and quantity effects and to determine inflationary pressure.

In the tradition of the Stockholm School (see section 2.4.2), Turvey (1949), Hansen (1951), and Lundberg (1953) emphasised the importance of disequilibria between savings and investments but also between labour demand and supply. They demonstrated that consumption and investment functions are by no means as unalterable during the course of inflation as presumed in simple Keynesian approaches. Same as in the analyses by Lindahl and Myrdal, the formation of expectations concerning the progression of inflation played a vital part for Hansen and Lundberg. Expectations determine the answer to the questions whether inflationary pressure generates market forces that lead to a new equilibrium state with consistent plans and whether the new equilibrium state is different from the initial state in real terms. Moreover, similarly to Lindahl (1930) they discuss various cases where deviations of *ex post* from *ex ante* variables give rise to changes in budget constraints and revisions of plans in future periods. That way, adjustment processes in disequilibrium generate changes of the system's real equilibrium positions including potential output.<sup>27</sup>

#### 2.4.8 Interim Conclusion

It is safe to say that for a complete *tour d'horizon* of the historical background of potential output analysis a number of other approaches could have been included in the story. However, the gap-theoretical approaches and their Wicksell and Keynes connections presented in this section contain the essential foundations of potential output analysis that were developed prior to Okun (1962). The arguments and characteristics can be summarized as follows:

- In a modern monetary economy, market rates of interest tend to deviate continuously from the level associated with zero inflation, full employment and full utilisation of productive capacities. The interest rate gaps give rise to divergences of aggregate demand and aggregate supply, which cause inflation and output gaps.
- Expectations on future monetary policy, inflation and real returns on investment play a pivotal part in the formation of both cumulative inflationary and deflationary processes (in Wicksellian approaches) and underemployment equilibria (in Keynesian approaches). The significance of the interaction between expectation formation and monetary policy is expressed, amongst other things, in the term structure of interest rates and has led, in the early 1930s, to propos-

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<sup>27</sup> This primarily concerned the discussion of negative output gaps (or “deflationary gaps”). However, the existence of positive output gaps due to overutilisation of productive capacities and overemployment was not ignored. It was treated either as a concomitant of “suppressed inflation” (because of price regulations and the like), causing premature wearout of productive resources and bottlenecks, or as a short-lived pre-stage of inflation.

als of a rule-bound monetary policy aiming at the closure of the interest rate gaps.

- Investment is a key variable that affects both aggregate demand and aggregate supply. A joint characteristic of Wicksellian and Keynesian theory, which clearly distinguishes them from most Classical and Neoclassical approaches, is the treatment of the progression of potential output as **not** being independent of current demand.<sup>28</sup> Via their feedback effects on revenue expectations and investment, gaps between potential and currently demanded production affect future potential output as well.
- Potential output is not independent of monetary policy. Even though it is (explicitly or implicitly) used as a benchmark for current monetary policy, it is affected by the monetary policy of the past. Current monetary policy, thus, influences future potential output. This is also expressed in the term structure of interest rates.
- One major difference between Wicksellian and Keynesian theories concerns their methodological perspective: The former put emphasis on a dynamic analysis of disequilibria with a discrepancy of initial and final equilibrium states. The latter initially focussed on a comparative-static analysis of full-employment and underemployment equilibria and later on the analysis of growth equilibria.
- Even though literature at the time of the Great Depression and especially Keynes (1936) gave priority to the phenomenon of mass unemployment, macroeconomics in the first part of the 20<sup>th</sup> century primarily focussed on the analysis of interactions between goods markets and capital markets.

When Okun's conception entered stability and growth politics in the 1960s, the terms of debate about inflationary and output gaps had changed. The gaps became pitfalls in controversies about the existence of a stable long-term Phillips curve and the notion of a "natural rate of unemployment".

## 2.5 Phillips Curve Debates

### 2.5.1 Full Employment and Monetary Stability – A Trade-off?

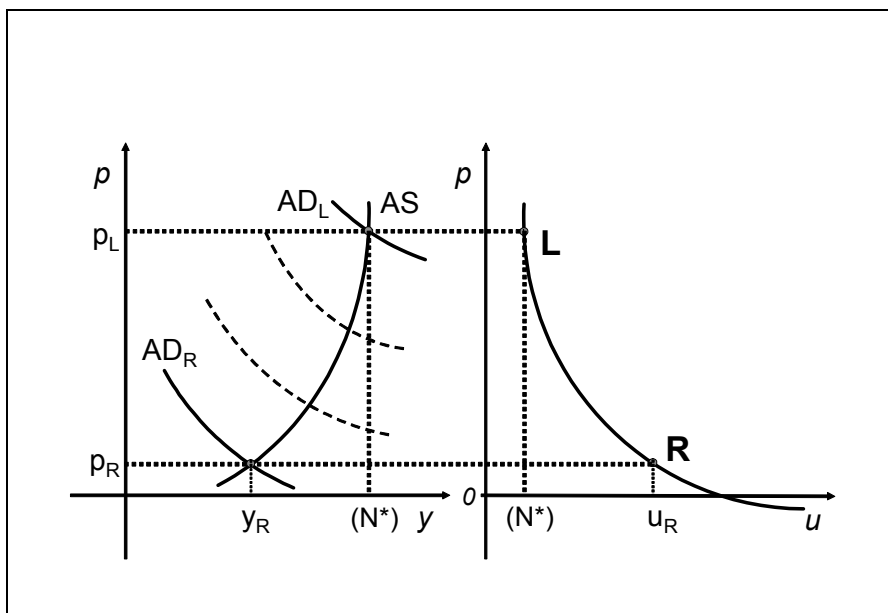
Given the discussions about the danger of inflation in a state of full employment that seemed to be imminent in Europe as a result of the Korea boom and the reconstruction after the war, in the 1950s the counter question, how much unemployment is compatible with price-level stability, was already familiar.<sup>29</sup> But the notion of the non-inflationary unemployment rate, which today is known as the

<sup>28</sup> Wicksell (1898) himself, however, disregarded this aspect and focussed solely on the explanation of "secular inflation."

<sup>29</sup> See, e.g., Turvey (1952), Hague (1958, 1962), and Boianovsky and Trautwein (2006b).

NAIRU and seen in close connection with the concept of potential output, became the pivotal concept for defining potential output only when Friedman (1968) equated it with the “natural rate of unemployment” in the course of debates that centred on the Phillips curve. Consequently, in the following we outline those aspects of the Phillips curve controversies that are particularly important for the discussion of concepts of potential output.<sup>30</sup>

**Fig. 2.** Phillips curve and AD/AS model



In 1958, a study by Alban W. Phillips was published that substantiated a negative relationship between the unemployment rate and the rate of change in nominal wage rates in Great Britain, which seemed to be stable in the long run. Using a curvilinear arrangement of regression lines, Phillips demonstrated that wages regularly decreased when unemployment was high and sharply increased in a state of full employment. This result in itself is not surprising. It matches common market logic that the price of labour rises when labour is in short supply and falls when there is an excess supply of labour. Two years later, however, the essay obtained brisance for economic policy debates, as Paul Samuelson and Robert Solow substituted the change rate of nominal wages by the rate of inflation based on some assumptions on the increase in productivity and profit mark-ups.

Samuelson and Solow (1960) proceeded on the assumption that a stable trade-off between inflation and unemployment prevails ( $p$  and  $u$ , respectively, in the right-hand side quadrant in Figure 2). Consequently, a goal conflict between monetary stability and full employment exists that obliges decision makers in eco-

<sup>30</sup> For an overview, see Santomero and Seater (1978) and the contributions in Cross (1995).



nomic policy to choose between two “menus”: either low inflation coupled with high unemployment or full employment coupled with high inflation. A government of the “left”, which primarily represents the concerns of workers, chooses the latter combination (point  $L$  in Figure 2); a government of the “right”, mainly representing the concerns of holders of financial wealth, chooses the former (point  $R$  in Figure 2). The trade-off illustrated by the Phillips curve gained plausibility because it was possible to deduce it from the AD/AS extension of the IS/LM model with the aid of Okun’s law (section 2.2).<sup>31</sup> The usage of Okun’s law as a link is intuitive because high economic growth as a rule implies full employment. In a state of low economic growth the number of unemployed rises. Also, in a state of strong economic growth, due to full utilisation of capacities, a tendency towards increasing prices exists. In general, boosts of growth are caused by increases in private investment activity and/or public spending that trigger multiplier processes. Consequently, they are treated as an outward shift of the AD curve. Proceeding on the plausible assumption that *nominal* wages are not entirely flexible, a relationship between the Phillips curve and the AD/AS model of the (traditional) Neoclassical Synthesis can be established.<sup>32</sup>

### 2.5.2 Inefficiency of Expansive Stabilisation Policy

The proposition that full employment can only be possible at the cost of inflation did not go unobjected for long. Edmund Phelps (1967) and Milton Friedman (1968) considered the concept of a Phillips curve that is stable in the long run as incompatible with rational economic behaviour. What matters for employees is what their money wages can buy, i.e. the *real* wage. Thus, an unambiguous relationship between unemployment and inflation does not exist. The level of employment in a state of labour-market equilibrium is compatible with any rate of inflation as long as nominal wages change in step. Following Wicksell’s “natural rate of interest”, Friedman coined the term “natural rate of unemployment” for the

<sup>31</sup> The AS/AD extension is a combination of the IS/LM analysis of product and financial markets and a Neoclassical labour market diagram. The linkage is established by means of a macroeconomic production function representing aggregate supply (AS) in the case of sticky real wages and/or of full employment. The aggregate demand curve (AD) represents the sequence of IS/LM equilibria given different price levels.

<sup>32</sup> Figure 2 illustrates this relationship in a simplified form that replaces the level of national income ( $Y$ ) and the price level ( $P$ ) by their rates of change, i.e. the economic growth rate ( $\dot{y}$ ) and the rate of inflation ( $\dot{p}$ ):  $AD_R$  corresponds to a restrictive monetary and fiscal policy; if monetary and fiscal policy is expansive, the AD curve shifts upwards ( $AD_L$ ). The intersection points of AD and AS (which is upward sloped and not vertical due to wage rigidities) represent macroeconomic equilibria. Higher growth and inflation rates are associated with higher employment as the real wages fall when nominal wages are sticky. Labour demand increases and labour supply declines until the theoretical full-employment point ( $N^*$ ) is reached. More employment means less unemployment and, thus, the Phillips curve mirrors the under- and full-employment equilibria in an economy with sticky wages.

level of unemployment that corresponds to theoretical full employment.<sup>33</sup> He defined the natural rate of unemployment as the result of rational choice acts determined by real economic factors (especially the fundamental data of technology and tastes, i.e. consumer preferences) but not by monetary policy.

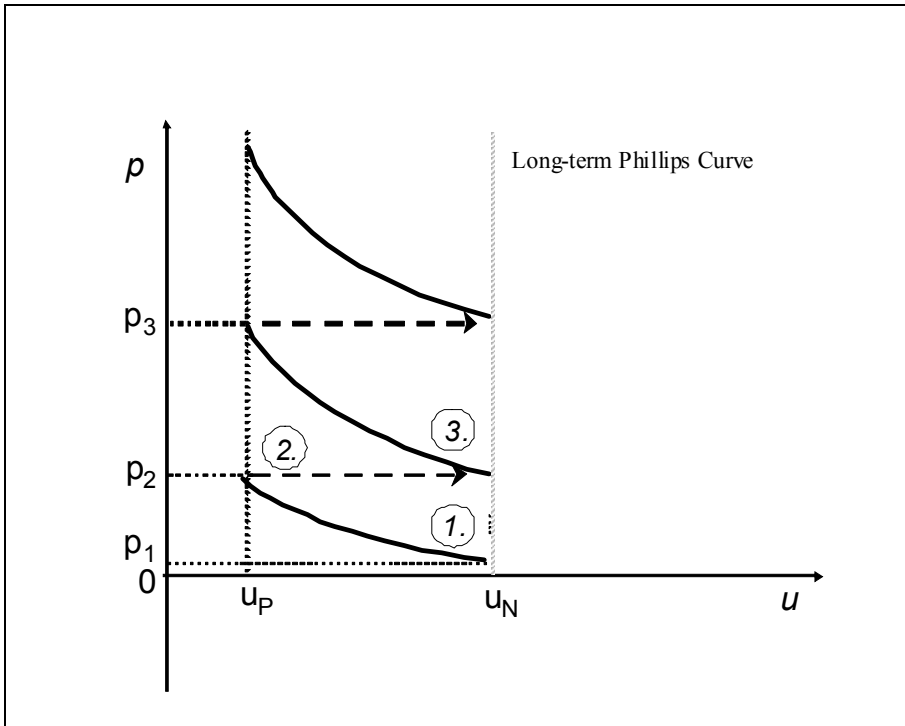
Nevertheless, Friedman (1968) conceded that boosts of inflation might lower statistical unemployment in the short run. This can happen if employers have information about the progression of prices in advance of their employees. Such information asymmetries can prevail if workers and their representatives confound nominal wage increases in phases of expansion with corresponding increases in purchasing power and accordingly raise labour supply (step 1 in Figure 3). Due to this “money illusion”, expansionary stabilisation policy can generate inflation that is underestimated. Sooner or later, however, workers will learn from their mistakes and correct their expectations on future inflation according to the observed rise of inflation. Friedman used the hypothesis of adaptive expectations – i.e. past expectational errors are taken into account in the formation of expectations concerning future time periods. In Friedman’s view, deviations of unemployment from the “natural rate” are short-dated because of adaptive expectations. If workers succeed to negotiate wage increases that compensate their (earlier and) expected losses from inflation (when compared to expected real wage increases), labour demand falls since full employment is not profitable; if, however, these wage increases fail to occur, labour supply is reduced (step 2 in Figure 3).

Thus, according to Friedman (1968) and Phelps (1967), an inverse relationship between inflation and unemployment can only prevail in the short run. If, after the return to the natural rate of unemployment, expansionary monetary and fiscal policy tries to reduce unemployment anew (for example to the level  $u_p$ ), the adaptation of expectations will push the next Phillips curve to a higher inflation rate and that Phillips curve will have a steeper slope (step 3 in Figure 3). This way, a host of short-term Phillips curves can be designed that, with increasing acceleration of inflation and inefficiency of expansionary policy, converges onto a vertical line.

The long-term Phillips curve is independent of inflation and will have an intersection at the point of observed unemployment and stability of the price level, i.e. at unemployment rate  $u_n$  (see Figure 3).

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<sup>33</sup> The theoretical definition of full employment deviates from the statistical one as the latter also includes those who are registered as unemployed but who are not prepared to work at the equilibrium wage rate. However, Friedman (1968: 8) in his definition of full employment as “natural rate of unemployment” also included “frictional unemployment”, which emerges due to structural imperfections in the labour market, for example, lacking information about job opportunities, mobility costs and stochastic changes of supply and demand.

**Fig. 3.** Accelerating Inflation

This implies that, with respect to real economic variables, monetary policy is neutral in the long run. Based on the long term Phillips curve, most mainstream economists directly equate the natural rate of unemployment with non-inflationary unemployment or the NAIRU.

Following from Friedman's (1968) concept of the natural rate of unemployment, the concept of potential output is implicitly defined as the level of national income compatible with the natural rate of unemployment. This leads to the conclusion that any stabilisation policy that aims at displacing the unemployment rate from its natural location causes only inflation gaps in the long run and not an increase in employment. It is, thus, inefficient as inflation causes adjustment costs and absorbs economic resources. Friedman and other Monetarists accordingly advocated a rule-bound monetary policy that prevents the emergence of money illusion and inflationary expectations by obliging the central bank to target a growth rate of the money supply that stabilises the value of money in terms of the (inverse of the) price level.

Criticism at the hypothesis of a stable Phillips curve trade-off was radicalised by Lucas (1972) and Sargent (1973). They considered the Monetarist hypothesis of adaptive expectations as irreconcilable with the basic principles of rational economic behaviour. Since it merely considers information related to the past, and, thus, constantly underestimates unidirectional changes in the rate of inflation, it al-

lows for systematic errors in expectations and associated losses of real income. Lucas and Sargent replaced adaptive expectations with (Muth-)rational expectations. This hypothesis eliminates systematic expectation errors in all market activities; consequently the plans of the agents in the system are compatible.<sup>34</sup> Basically, expectations would be self-fulfilling in the absence of shocks – i.e. unpredictable events leading to deviations of reality from expectations.<sup>35</sup> Furthermore, Lucas and Sargent assumed completely flexible prices and continuous clearing of markets. Consequently, they concluded that measures of monetary and fiscal policy cannot shift the level of output and employment from their “natural” positions even in the short run. This could only be achieved by means of erratic, unpredictable economic policy, which cannot be any government’s serious and lasting intention.

As demonstrated by Barro (1974), the Ricardian theorem of equivalence holds under the above-mentioned assumptions: Concepts of demand management by means of *deficit spending* are bound to fail as the private sector rationally expects present public spending to be funded by tax increases in the future. Since savings increase accordingly, the investment multiplier cannot take effect, and aggregate demand cannot affect potential output. The same assumptions were invoked by Sargent und Wallace (1975) in order to demonstrate that not only Keynesian measures of macroeconomic demand management but also Wicksellian prevention of inflation by means of interest rate management are bound to be ineffective because neither real aggregate demand nor the price level can be controlled by economic policy.

### 2.5.3 Time Inconsistency of Stabilisation Policy

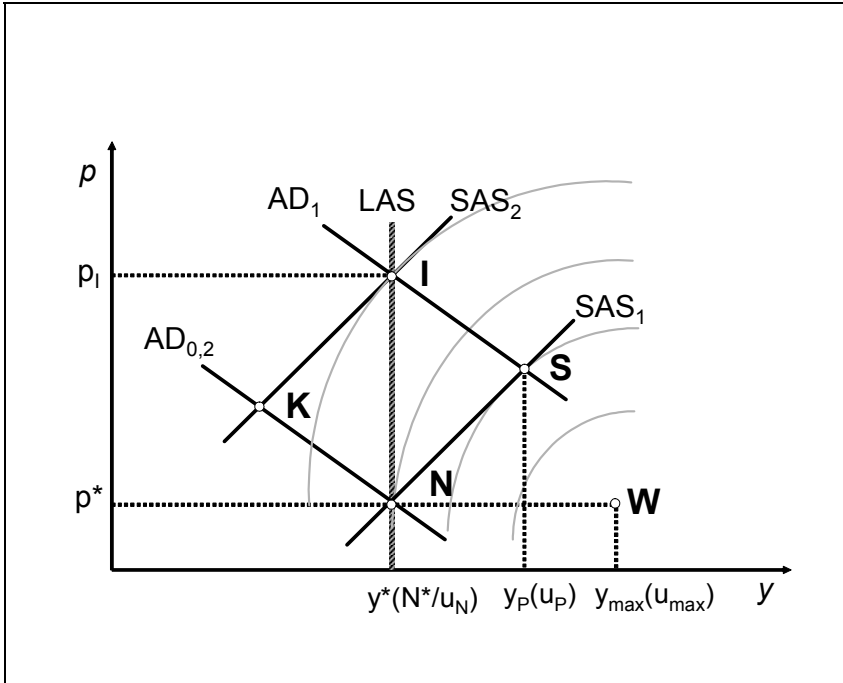
The combined assumptions of rational expectations, flexible prices and continuous market clearing signified a “New Classical” revolution of macroeconomic thought in mainstream economics. From then on, any modelling of output fluctuations, unemployment and other macroeconomic phenomena were put under the categorical imperative of micro-theoretical foundations. This, in turn, was equated with the development of stochastic-dynamic versions of Walrasian general equilibrium theory. Until then, as outlined in section 2.4 with respect to gap theories, cyclical output fluctuations had generally been treated as deviations from the equilibrium potential output and growth trend; they were considered as disequilibria of aggregate demand and aggregate supply. Within the analytical framework of New Clas-

<sup>34</sup> Since models following the tradition of Lucas und Sargent are mostly confined to discussing the optimisation problem of a single “representative agent”, compatibility of plans in the private sector is assumed rather than established; see, for example, Hoover (1988: ch. 9). Concerning the problems of learning behaviour and the convergence towards rational expectations, an extensive literature has developed, with Howitt (1992) and Evans and Honkapohja (2001) as outstanding contributions.

<sup>35</sup> Formally, shocks are stochastic events with an objective expected value of zero, i.e. “white noise”. The hypothesis of rational expectations as used in mainstream theory dates back to Muth (1961).

sical economics, short-term output fluctuations had to be representable as continuous equilibria. Deviations of current GDP growth rates and unemployment rates from their “natural” levels were explicable as the result of inefficient economic policy at best. Both lines of argument (policy errors and equilibrium business cycles) were further advanced by Edward Prescott and Finn Kydland.

**Fig. 4.** Time Inconsistency of Monetary Policy



The first advancement of New Classical economics with respect to potential output concerned the demonstration that rule-bound stabilisation policy is economically optimal. As argued by Kydland and Prescott (1977) as well as Barro and Gordon (1983), discretionary policy would not be credible, even if it were explicitly aiming at monetary stability.<sup>36</sup> If this goal ( $N$  at the inflation rate  $p^*$  in Figure 4) were actually achieved, it would offer an incentive for the government to promote growth and employment by means of low interest rates and a high level of public spending ( $AD_0 \rightarrow AD_1$ ). This way, tax revenues and the chances of a re-

<sup>36</sup> The term “discretionary” describes a policy that determines the optimal reaction as necessity arises. The favoured price level in Figure 4, defined as a low inflation rate ( $p^*$ ) rather than zero inflation, is in accordance with the standard target definitions concerning inflation, which take account of measurement errors and similar problems.

election could be increased.<sup>37</sup> The resulting inflationary push is the prerequisite for the intended positive output gap to emerge ( $y^*-y_p$ ) at the equilibrium point  $S$ . The private sector would have to underestimate inflation to the extent that the long-term, “natural” supply position ( $LAS$ ) is displaced by a higher growth equilibrium ( $SAS_1$ ) in the short run. Since the agents in the market realise the incentives for this kind of “surprise inflation” ( $S$ ) once it has happened, the expansionary effects of such measures quickly vanish. With rational expectations, the private sector will accommodate its plans such that higher inflation rates result but no gain in real growth ( $SAS_1 \rightarrow SAS_2$ ). The economy will settle in the inflation-bias equilibrium  $I$ .

Announcing a policy of inflation prevention is understood as a game between the government and the private sector in which the government’s position is dynamically inconsistent and, thus, not credible. Even if the government does not have “surprise inflation” in mind, an inflation bias arises from time inconsistency. This constantly causes adjustment costs and runs counter to both the government’s intentions and the private sector’s interests.<sup>38</sup> If political decision makers try to break inflationary expectations by means of high interest rates ( $AD_1 \rightarrow AD_2$ ), a negative output gap emerges and – according to Okun’s law – a substantial increase in unemployment results.<sup>39</sup> Literature initiated by Kydland and Prescott (1977) and Barro and Gordon (1983) concluded that credibility could only be achieved by a stabilisation policy that restricts itself to clear rules with respect to combating inflation. Strict adherence to a rule of monetary policy that retains the system at the equilibrium point  $N$  prevents the emergence of positive and negative output gaps from the outset and ensures that current GNP and potential output coincide.

In the 1980s and 1990s, the relationship between time inconsistency and binding rules in monetary and fiscal policy gained much attention and promoted a vast amount of literature. This can be explained in part by the incipient popularity of game-theoretical models that were readily applied in this field, in part by preliminary considerations concerning the design of the European Monetary Union. In textbook literature and political discussion, time inconsistency is still invoked to advocate rule binding of monetary and fiscal policy. However, in the light of

<sup>37</sup> Policy calculus can be represented by means of a social welfare function or utility maximisation on the part of political decision makers (following the theory of political business cycles by Nordhaus, 1975). The point  $W$  in Figure 4 thus represents either maximum social welfare or maximum votes. The concentric indifference curves describe, in the manner of topographic lines, declining levels of welfare or utility towards the upper left side.

<sup>38</sup> While in cases of discretionary policy  $N$  and  $S$  denote unstable equilibria,  $I$  represents a stable inflation equilibrium associated with a lower welfare level (or politician utility level) than in the original equilibrium state  $N$ .

<sup>39</sup> The equilibrium  $AD_2/SAS_2$  in Figure 4 corresponds to the constellation  $AD_R/AS$  in Figure 2. However, as opposed to the Phillips curve in the Samuelson/Solow version, this situation is unstable as it is based on a disinflationary shock and erroneous expectations of product suppliers.

common evidence concerning measures of monetary and fiscal policy and their well-known lagged effects, the idea of a surprise inflation and inflation propensity is hardly plausible, especially if rational expectations are assumed.<sup>40</sup>

### 2.5.4 Equilibrium Business Cycles

Real business cycle theory (RBC) constitutes the second advancement of New Classical economics with respect to potential output. Prior to New Classical economics, business cycles were commonly considered as disequilibria of aggregate demand and aggregate supply. Following Lucas (1972), the first wave of New Classical economics explained business cycle fluctuations as phenomena of equilibria under incomplete information concerning monetary policy, i.e. as unexpected shifts of aggregate demand that trigger responses from aggregate supply. Kydland's and Prescott's (1982) approach went even further: It attempted at explaining stylised facts of business cycle theory<sup>41</sup> entirely as optimal responses to real shocks that solely emerge on the supply side.

RBC theory is radical in its negation of the business cycle as an independent phenomenon discernable from growth. Any fluctuations of macroeconomic activity are treated as consequences of changes in the reference data of general equilibrium theory. Monetary impulses and other factors that, according to prior theories, affect the business cycle are disregarded in order to exhaust the explanatory potential of general equilibrium theory. The RBC approach consists in constructing "stylised" dynamical models of stochastic growth processes in an Arrow-Debreu framework. In general, these models are limited to the decision problem of a representative household (or social planner) that over an infinite time horizon optimises consumption and leisure time, and they exclude any problems caused by heterogeneity, incomplete information and other frictions.<sup>42</sup>

According to Frisch's impulse propagation scheme (see section 2.4.2), technological shocks are the most important exogenous impulses that, by being processed within the intertemporal optimisation system of consumption and leisure time, are transmitted to investment, employment and output. Assuming that households aspire to smooth their consumption over their life cycle, it is demon-

<sup>40</sup> See Spahn (2006: 230f.) and the critique in Section 2.5.5 of the present report.

<sup>41</sup> According to a long tradition following Mitchell (1913), Haberler (1937), and Lucas (1977), stylised facts confirmed by a multitude of empirical studies and explicable by any business-cycle theory are said to be:

- cyclical variability of the main macroeconomic aggregates;
- positive correlation (pro-cyclical progression) of fluctuations of GDP, productivity, prices, profits, investment and consumption;
- the accelerator principle (investment fluctuates more forcefully than consumption).

<sup>42</sup> As stated by Lucke (2002: 3), under these drastically simplifying assumptions there remains an economy reduced to its bare essentials – a caricature of an economy. RBC theory maintains that this caricature exhibits the true nature of mid-term fluctuations more clearly than the multitude of existing portraits.

strated that positive technological shocks bring about increasing systems activity and, thus, resemble a boom in the business cycle: If, due to product and process innovations, productivity rises, current attainable real income increases. This causes a substitution of present leisure and consumption for future leisure and consumption as well as an increase in current employment, production and investment. The latter gives rise to a corresponding change of the capital stock, thereby making the productivity shocks' effect persistent.<sup>43</sup> By the same logic, negative productivity shocks diminish real activities manifesting as recessions.<sup>44</sup>

In RBC theory, the trend around which the observed variables of real activities fluctuate corresponds to equilibrium positions of the system in the absence of shocks. However, these shocks are considered as random, and their effects are not readily reconcilable with the stylised fact of cyclical variability of macroeconomic aggregates. Cyclical variability implies certain regularities and a systematic relationship of positive and negative deviations from the trend. In RBC theory, endogenous regular fluctuations are excluded, but internal feedbacks as a temporary phenomenon (decreasing fluctuations) can be generated by choosing appropriate types of equations (e.g., second order difference equations). Conformance of RBC models with stylised facts is normally achieved by calibrating model parameters, conducting model simulations on this basis and comparing the simulation results with statistical time series. Due to various restrictions, RBC models are not suitable for forecasting business cycles but – again based on their restrictions – are employed for identifying macroeconomic shocks in structural vector autoregressive (SVAR) models.<sup>45</sup>

Within the framework of RBC theory, the ideas of a “growth trend” and “current output” have nothing to do with the distinction between potential output and output gaps. As any fluctuations of macroeconomic output are treated as optimal responses to shocks, current output is considered to be pareto-efficient and equivalent to potential output. Thus, there is no need for political action with respect to stabilising output to match the growth trend – on the contrary: Such kinds of interventions would cause welfare losses because of their implicit tax burdens. Accordingly, in RBC theory, output gaps are representable as a result of government failure at best. In this respect, RBC theory is related to the Monetarist and monetary New Classical criticism of the idea of a stable long-term Phillips curve (sections 2.5.2 and 2.5.3).<sup>46</sup>

RBC theory is a research programme rather than a specific theory of the business cycle, and nowadays the choice of shocks causing fluctuations is made in a less dogmatic manner. The original modelling strategy showed fundamental weaknesses, especially with respect to the explanation of fluctuations of consump-

<sup>43</sup> In some RBC models this persistence co-determines the growth trend, but in general the trend is treated as independent.

<sup>44</sup> Negative productivity shocks include all events that increase unit costs of production – for example, massive increases in energy prices, costly charges or climatic and political catastrophes (like droughts, storms and war).

<sup>45</sup> See Lucke (2002). Some of these restrictions are discussed in sections 2.6.2 and 3.3.

<sup>46</sup> A similar argument is put forward by Lucas (1995 and 2003).



tion and employment.<sup>47</sup> Thus, outside the “strictly New Classical core”, experiments with different types of real as well as monetary shocks are conducted, and the mechanisms of transmission are modified by integrating “frictions”. The approach is now more aptly labelled as DSGE approach (*Dynamic Stochastic General Equilibrium*). The New Neoclassical Synthesis outlined in section 2.3 is based on the DSGE approach enhanced to encompass inertia and inflexibility of prices and other nominal variables. In the framework of the new synthesis, the original RBC theory is but an indirect reference core for determining output gaps. Each RBC equilibrium represents the purely hypothetical potential output in an environment of perfect competition; it is the reference equilibrium for the “actual” potential output under monopolistic competition *and* price flexibility (see, e.g., Woodford 2003: ch. 3-4). As such, it provides the basis for determining welfare losses caused by monopolistic pricing power (*deadweight losses*). These welfare losses need to be distinguished from welfare losses due to price inflexibilities (*output gaps*), which are caused by a deviation of current production from potential output under monopolistic competition.

### 2.5.5 Persistent Unemployment

While New Classical thoughts became established in academic macroeconomics during the 1980s, Monetarist and Keynesian ideas remained dominant in the realms of stabilisation policy and the media. The concept of a non-inflationary unemployment rate (NAIRU) gained more and more importance as a reference variable for stabilisation policy. If the NAIRU is considered as the natural rate of unemployment encompassing only “structural” unemployment, which is not susceptible to influences by monetary policy and with respect to labour input conforms to potential output, it provides a simple rule for action for monetary policy, similar to Wicksell’s rule of interest (section 2.4.1):

- If current unemployment is lower than the NAIRU, interest rates must be raised in order to reduce inflationary pressure.
- If current unemployment is higher than the NAIRU, interest rates must be cut in order to close the output gap.

As the combined time path of inflation and unemployment between the early 1970s and the early 1990s in the U.S. was consistent with the idea of a vertical Phillips curve and a NAIRU of about 6%, the interest rate policy of the Federal Reserve System seemed to be fairly predictable by the above-mentioned procedure.

In Europe, however, and especially in the core countries of the European Monetary Union, the NAIRU left, from the 1980s onwards, the impression of a highly unsteady variable showing substantial increases from one period of high in-

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<sup>47</sup> A well-known weak point is the explanation of mass unemployment during the Great Depression. As no evidence for sufficiently negative productivity shocks could be found, the less than plausible hypothesis of a sudden outbreak of contagious sloth (increased preferences for leisure) was all that remained.

terest rates to the next. Consequently, the convention of equating the NAIRU with “natural unemployment”, which is independent of monetary policy and basically of voluntary character, was called into question. Attempts were made to systematically analyse the structural causes of persistent mass unemployment within the framework of both a micro- and macroeconomically founded theory of the labour market. These efforts are particularly relevant for forecasting the growth of potential output as estimations of the NAIRU are frequently employed in structural and semi-structural methods of forecasting. The literature dealing with the identification of the NAIRU and persistent unemployment is diverse and extensive. For an overview, see Bean (1994) and Wyplosz (1994). With respect to potential output, two concepts are particularly important: the quasi-equilibrium rate of unemployment (QUERU) and hysteresis.

Unlike (Neo-)Classical analysis, modern labour market theories do not proceed on the assumption of perfect competition.<sup>48</sup> With reference to real world behaviour, the presumption is that, due to market power and negotiation authority, wages and prices are ordinarily set by suppliers or buyers. Individual labour supply of employees ( $N^s$  in Figure 5) is not disregarded. However, it solely provides a point of reference that is represented as the usual intertemporal substitution calculus concerning consumption and leisure ( $w/P$  denoting the real wage). Based on empirical studies, a low elasticity of wages and a lower bound at the level of the reservation wage ( $w_R/P$ ) are assumed.<sup>49</sup> Presuming a Neoclassical labour demand curve ( $N^d$ ) with marginal costs of labour corresponding to (decreasing) marginal productivity, the Neoclassical labour-market equilibrium with purely voluntary unemployment is reached at  $N^*_{hyp}$ . Thus, the difference between the maximum potential labour supply  $L$  and labour supply at the market wage in  $N^*_{hyp}$  represents “natural unemployment” ( $u_N$ ).

However, market-clearing equilibrium is purely hypothetical if wages in the labour market do not result from individual labour supply but from wage setting behaviour on the part of unions and employers ( $WS$  curve in Figure 5). Recent labour market theories explain this kind of wage setting behaviour for the most part by means of the *insider-outsider* approach<sup>50</sup> or efficiency wage theory.<sup>51</sup> Both ap-

<sup>48</sup> The development of modern labour-market economics is, for example, surveyed by Layard, Nickell, and Jackman (1991), Franz (1996), and Carlin and Soskice (2006: ch. 4 and 18).

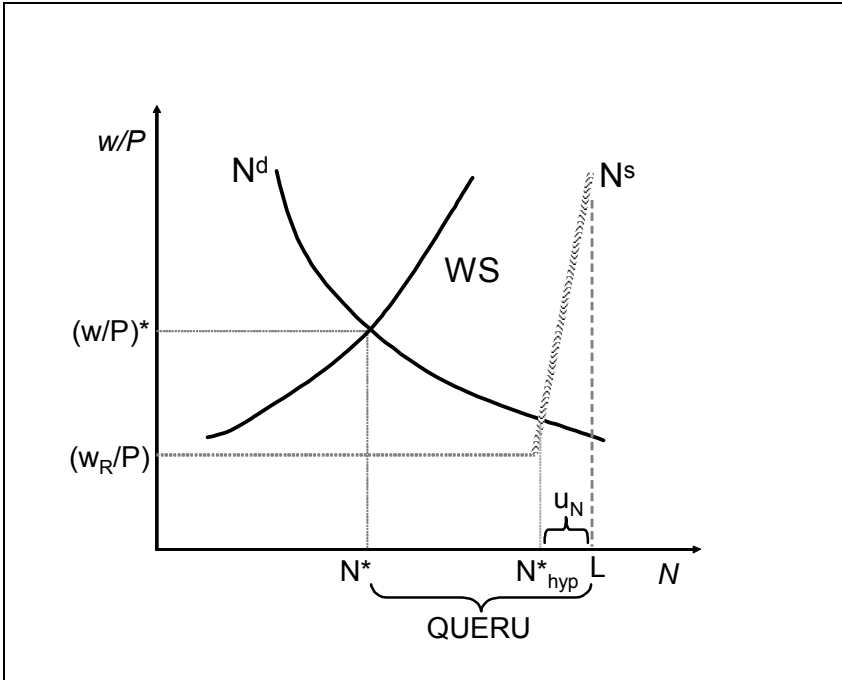
<sup>49</sup> The reservation wage corresponds to the opportunity costs of taking up work, for example, the magnitude of social transfers received in the case of unemployment.

<sup>50</sup> The insider-outsider approach rests on the assumption that in wage bargaining trade unions, which mainly represent employees (*insiders*), make use of the cost disadvantages that employers face if they hire competing unemployed (*outsiders*) due to the required transfer of knowledge specific to the enterprise, prevention of conflicts etc. This generates a real wage level that renders the recruitment of *outsiders* unprofitable.

<sup>51</sup> According to efficiency wage theory, the wage rate is not an absolute cost factor to be minimised (as on the  $N^d$  curve in Figure 5) but is also invoked as a performance incentive in the presence of asymmetrical information about work performance. The higher the state of employment, the more enterprises make use of fringe benefits in order to ensure the commitment of well-skilled employees. When optimising their price and wage

proaches may also be combined. Due to wage setting on the  $WS$  curve, labour-market equilibrium is attained at a market wage higher than in  $N^*_{hyp}$ . At this real wage ( $w/P^*$ ), effective labour demand matches the labour supply that is effective for employees because of cost concerns. The effective labour-market equilibrium  $N^*$  is not a market-clearing but a rationing equilibrium.

**Fig. 5.** Quasi-Equilibrium Unemployment



It includes elements of involuntary unemployment, as *outsiders* cannot find work, even if they undercut the current market wage. One way or another, their placement would cause unit costs to increase. The difference between hypothetical full employment at  $N^*_{hyp}$  and effective employment at  $N^*$  is called quasi-equilibrium unemployment or QUERU<sup>52</sup>. If the QUERU is treated as the result of a contest between unions, who are only in a position to negotiate nominal wages, and price-setting employers, wage-price spirals may emerge (*battles over mark-ups*). This amounts to an upward movement along the long-term vertical Phillips curve, provided that the relationship between nominal wages and prices remains stable with differing rates of inflation. If, however, the rates of increase of inflation and wages can be driven down to approach zero, the QUERU matches the

settings (the  $N^d$  curve being interpreted as price setting curve including a profit mark-up), enterprises set the real wage (at  $N^*$ ) above the market-clearing level (at  $N^*_{hyp}$ ).

<sup>52</sup> QUERU stands for “quasi-equilibrium rate of unemployment”.

NAIRU. It exceeds, nevertheless, the “natural rate of unemployment” in the sense of a market-clearing equilibrium (by the difference of  $QUERU - u_N$  in Figure 5).

In the formation phase of a  $QUERU$ , its difference to the natural rate of unemployment could be considered as a negative output gap as in this situation potential output exceeds current output. However, the separation of *insiders* and *outsiders* may consolidate quite rapidly after the increase of unemployment. Along with their job, displaced workers lose part of their qualification whilst others are not in a position to acquire the specific human capital of *insiders* in the first place. Thus, a lasting rise of the  $QUERU$  connotes a decline of potential output as *outsiders* are no longer considered as efficient labour suppliers by potential employers. Temporary increases in real wages can therefore give rise to persistent unemployment since the displaced workers, owing to the cost increase, after a short time no longer match up to the job requirements. Underemployment does not even vanish if subsequently real wages fall to their original level (e.g., due to increases in consumer prices or longer labour time without compensatory wage increases). In economic literature this continuance of effects after their causes have vanished is commonly termed “hysteresis” or (in the case of gradual abatement) “persistence”.<sup>53</sup>

Recent labour market theories can, thus, explain the existence of persistent involuntary underemployment and corresponding decreases in potential output by invoking assumptions about imperfect competition, asymmetrical information and other types of “frictions”. In the simplest case of *insider-outsider* theory, both the triggering shocks (excessive wage claims) and the propagation mechanisms (downward rigid wages, costs of conflicts, devaluation of human capital etc.) are described as malpractices on the part of wage-setting institutions on the labour supply side (unions, minimum wages regulations, dismissal protection etc.). However, unemployment through hysteresis may also be caused by efficiency wages set by employers and, in this sense, is a labour demand problem. In many industries or countries, labour markets are characterised by wage setting that results from combinations of collective bargaining and efficiency wage considerations. From an empirical point of view, a clear separation of unemployment caused by demand side factors versus supply side factors is hardly possible.

In the cases considered up to this point, involuntary unemployment and curtailment of potential output is solely caused by the process of wage setting in the labour market – as opposed to Keynesian models that explain involuntary unemployment as the result of pessimistic revenue expectations in the goods market and asset holders’ liquidity preference (see section 2.4.4). Combinations of both lines

<sup>53</sup> See, e.g., Franz (1987) and Cross (1995). While under the keyword *hysteresis* unemployment is examined as a time sequence, the same phenomenon represents a mismatch when considered as a cross-section at a point in time: The qualifications that firms require are not matched by those offered by workers. Thus, if unemployment is explained as a phenomenon of hysteresis and mismatch, the investigation of the macroeconomic labour market is no longer confined to the dimensions of price (real wage) and quantity (employment). The quality of labour (differences in qualification and other performance criteria) is taken into account as well.

of argument are discernable in the extensive literature that explains the instability of the NAIRU in European countries since the mid 1970s by central bank rallies of disinflation following the oil price shocks OPEC I and II as well as German reunification (see, e.g., Bean, 1989; Gärtner, 1997; Ball, 1999; Spahn, 2006: ch. 4.4). In this framework, the real economic losses resulting from combating inflation by means of rising nominal interest rates are quantified as sacrifice ratios in terms of negative output gaps or cumulative changes of the unemployment rate in relation to disinflation (the decline of the inflation rate). The general explanation of the magnitudes of the sacrifice ratios invokes several transmission channels of monetary policy:

- In the labour market, the decline of inflation causes real wages to rise if nominal wages are not reduced to the same extent immediately. As individually rational contract obligations, relative wage settings and other forms of wage rigidities exist, such reductions can be expected in exceptional cases at best. Consequently, as outlined, QUERU or hysteresis unemployment may emerge.
- Unexpected or unexpectedly strong declines of inflation can cause substantial declines of aggregate demand as entrepreneurial revenue expectations are disappointed. A small open economy might be able to increase its exports due to a cost-cutting edge of disinflation; however, considering the international interest-rate nexus, generating this kind of advantage will be difficult.
- The decrease of inflation caused by the rise of nominal interest rates amounts to a substantial increase in real interest rates. This not only dampens entrepreneurial investment activity but may also bring about a devaluation of real capital by increasing real indebtedness. Thus, the decline of investment and capital devaluation diminish the capital stock and persistently reduce potential output – analogously to the losses of qualification in the labour market, which may be further aggravated by company closures and rationalisation measures due to capital shortages.
- Comparing sacrifice ratios, there is no clear evidence that central banks, which adhere to clear rules and enjoy higher credibility for combating inflation have been more successful in cutting the costs of disinflation compared to central banks in “soft currency countries”, which ran discretionary policies during the period in question. In some studies, the central banks of “hard currency countries” performed even worse (see, e.g., Gärtner, 1997; Spahn, 2006: 60). It is possible that the “expectation channel” of monetary policy does not quite work as suggested by models of time inconsistency in the manner of Barro and Gordon (1983) (see section 2.5.3).
- Explanations for the unexpected effects in the expectation channel range from rational price inflexibility to individually rational but macroeconomically excessive price flexibility. In the first case it is assumed that in countries with comparably low inflation rates, contract obligations featuring fixed prices are beneficial, and adaptive expectations suffice. Consequently, a comparatively moderate increase of interest rates has more substantial effects on quantities than in other countries. The second case primarily refers to the comparatively high interest elasticity of asset prices (and derivative contracts) in financial and real estate markets. It is also widely acknowledged by now that in the case of

negative supply shocks (such as OPEC I and II), restrictive demand management can cause persistent negative output gaps.

### 2.5.6 Interim Conclusion

Overall, the progression and present status of the Phillips curve debates can be preliminarily summed up as follows:

- By now, economists are largely in agreement that when moving upward along the Phillips curve, an *inflation-unemployment trade-off* does not exist: High employment and full utilisation of potential output cannot, in the long run, be bought with an increase in inflation.
- Also, a great majority of economists advocates rule-bound policies of inflation prevention on the part of an independent central bank.
- Primarily for reasons of research strategy, New Classical approaches still proceed on the assumption that rationally anticipated inflation (or disinflation) cannot affect potential output.
- By contrast, labour market theories and empirical studies conclude that, when moving downward along the Phillips curve, the inflation-unemployment trade-off in the process of disinflation may exist even if the central bank is credible in fighting inflation: The interplay between demand losses and various mechanisms that devalue human and real capital on the supply side initially gives rise to a negative output gap that (in the absence of positive “counter-shocks”) vanishes only because potential output correspondingly adjusts to the lower level of demand. Strictly speaking, the NAIRU, and along with it the hypothetically vertical long-term Phillips curve, is shifted within short time towards an equilibrium with higher unemployment and a diminished potential output.
- New Neoclassical Synthesis attempts to demonstrate that inefficient monetary policy may cause persistent output gaps even if the equilibrium-theoretical imperative of New Classical economics holds. Investment-theoretical extensions of the synthesis (e.g., Woodford, 2003: ch. 5) include output gaps that cause feedback effects on the progression of potential output.

## 2.6 Empirics and Politics

### 2.6.1 The Progression of National Accounting

For estimating potential output and output gaps, aggregate data on production, investments, employment and other macroeconomic variables are required. However, when gap theories had their heyday in the 1930s, no national accounting existed and labour market statistics were inconsistent and fragmentary. To wit, in response to the waves of inflation and deflation following World War I, encom-

passing systems of price indices had been developed, mostly at Irving Fisher's suggestion. Also, in many countries instruments for monitoring the business cycle existed, frequently designed in the style of the famous Harvard barometer, which included various indicators for the situation in the money markets, asset markets and goods markets. However, macroeconomic data giving information about potential output were scarce. In view of the reparation obligations specified in the Versailles treaty, Germany in particular, had an enormous interest in assessing productive capacities. Still, the German Statistical Office conducted only sporadic calculations but no systematic surveys.<sup>54</sup>

The Great Depression and especially World War II initiated extensive national and international activities aiming at a systematic collection of macroeconomic data. Aided by the Rockefeller Foundation, the League of Nations under Bertil Ohlin (1931/32), Gottfried Haberler (1934-36), and Jan Tinbergen (1936-38) commissioned comprehensive investigations of the Great Depression, the synthesis potential of business cycle theories and their empirical assessment.<sup>55</sup> Even so, it was not until the post-war period that a UN commission under the leadership of Richard Stone published standards for a systematic national accounting (United Nations 1947) and the large-scale, continual collection of macroeconomic data set in. In 1952, Stone's guidelines were expanded to form the first standardised *System of National Accounts* (SNA) by the United Nations and the OEEC (the predecessor organisation of the OECD), a system that was reformed in 1968 and 1993 and until today builds the international foundation of national accounting.<sup>56</sup>

In retrospect, the inter-war period was characterised by an interesting multitude of attempts to develop national accounting on the basis of macroeconomic theory. According to textbook folklore, chapter 6 of Keynes (1936) and its defining  $Y = C + I$ ,  $S = Y - C$ , *ergo*  $I = S$  is considered the decisive impetus for the progression of modern national accounting. But history is more complex and commenced prior to that. Some of the Wicksellian approaches outlined in section 2.3 as well as other initiatives played a significant part. To mention only a few examples:

- In the UK, the first estimations of national income were presented by Colin Clark in 1932, followed by Simon Kuznets (1934) in the United States. Both studies already featured the basic traits of output, income and final expenditure compilation, and especially Clark's estimations had an influence on Keynes (Patinkin, 1976).

<sup>54</sup> For example, according to Krengel (1986: 20) for the first and only time in the weekly report of the German Institute for Economic Research (DIW-Wochenbericht) No. 38/40, December 23, 1929.

<sup>55</sup> The best-known result of these activities is Haberler's classic on "Prosperity and Depression" (1937); see also Boianovsky and Trautwein (2006c).

<sup>56</sup> An extensive overview of the history of national accounting is presented by Vanoli (2005). In what follows, we merely address the evolution of national accounting. The development of labour market statistics used for estimating the NAIRU cannot be covered here.

- Since the early 1930s, Jan Tinbergen in the Netherlands and Ragnar Frisch in Norway developed econometric models of the economic cycle, which in both countries were employed as a basis for calculating national product.
- Erik Lindahl combined his cooperation in the major study on Swedish national income from 1861 to 1930 (Lindahl, Dahlgren, & Kock, 1937) with the conception of theoretical foundations for defining, in the style of Irving Fisher, national income as a flow of yields on capital, and systematically coupling stock and flow calculations (Lindahl, 1933 and 1939: Part I).
- At Harvard in 1932, Wassily Leontief developed input-output analysis based on suggestions he had gained in the course of his work at the Kiel Institute for the World Economy (1927 to 1930). By means of matrix systems that record the economy's inter-industry relations and the contributions of the individual sectors to national product, Leontief investigated the inter-industry flows necessary to achieve macroeconomic equilibrium, given the level of final demand and coefficients of technology. With this he built the foundation for structural investigations of potential output.

The emphasis put on macroeconomic aggregates in Keynes' *General Theory of Employment, Interest and Money* (1936) was doubtlessly important for the concept formation in national accounting. Keynes' definition of savings as a variable adjusting *ex post* to investment via the income mechanism (multiplier) cut the Gordian knot of prior debates about the empirical representation of the process of capital formation.

But it was not until Keynes, on account of the war, in his collection of essays [How to Pay for the War] (1940) used Clark's concepts and data to introduce the calculation of inflationary gaps that systematic efforts of establishing a system of national accounting were started. The trailblazers of this endeavour were James Meade and Richard Stone, who pointed out a theoretically consistent three-tier system for calculating national income via income, production and expenditure (Meade & Stone, 1941). This approach became decisive for the development of output, income and final expenditure compilation at the various stages of the SNA. In the beginning, however, this concept was controversial. The Meade-Stone system concentrated on national income at factor costs using simple accounting entries of monetary transaction values and entrepreneurial information on depreciation as well as nominal interest rates to capture the factor costs of real capital. By contrast, the Scandinavians around Frisch and Lundberg had developed systems that followed the principle of double-entry accounting, determined a range of national product aggregates, kept real and financial transactions apart, calculated the "real" reinvestment requirements by including repair and maintenance expenditure and tried to distinguish between market rates of interest and "real" costs of capital.<sup>57</sup>

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<sup>57</sup> See Ohlsson (1987). The respective debates took place in the late 1940s and, thus, even before Tobin's  $q$  was developed. A concept corresponding to Tobin's  $q$  had already been developed by Myrdal (1931, 1933) according to whom real net investment rises until the present value of the net investment goods equals their reproduction costs. Tobin's  $q$  is likewise based on the relationship between the present value of an investment good and



The heydays of the Keynesian concepts of aggregate demand management were all at once the heydays of national accounting and related data systems. From the 1950s to the 1970s, survey methods and databases were forcefully expanded, mostly according to SNA standards but with numerous national peculiarities (Vanoli, 2005: Part II). The increasing impact of public sector actions on the economy's growth and stability required plentiful information that was gathered by national accounting, input-output analysis, labour market statistics and other instruments. The integration of economic theory and statistics were further advanced by the development of extensive macroeconomic models. A leading part was played by the Cowles Commission (later Cowles Foundation) in the U.S., the statistical-econometric institute INSEE in France and the Centraal Planbureau in the Netherlands. International organisations, especially the OEEC (later: OECD) and the International Monetary Fund, increasingly used national accounting for short- and medium-term forecasting. Since these institutions by their nature had (and still have) to work out international comparisons, they became driving forces in the definition of standards for macroeconomic data.

However, since the 1980s a schism has emerged in the coupling of macroeconomic empirics, theory and politics. On the one hand, the predominance of Monetarist and especially New Classical ideas in mainstream macroeconomics has substantially reduced the academic prestige of econometric and statistical research on national accounting and other macroeconomic data. Monetarist and New Classical models are by their nature kept rather "small". Their empirical versions frequently make very selective and pragmatic use of available macro data (e.g., for calibration); they are also often mixed with data and estimates from microeconomic studies. On the other hand, macroeconomic statistics have been used to an even greater extent than before in political advisory and on the basis of quite refined statistical and econometric methods (filter techniques, VAR models, cointegration and error correction models, amongst others). This expansion has been fostered by technical progress in data processing. But for the most part it is explicable by the massive need for advice in the course of macroeconomic transformations, such as the European integration and the transformation of Eastern Europe and Asian economies.

### 2.6.2 Potential Output in Political Advisory

Estimates of potential output, potential growth and output gaps are invoked in many realms of political advisory. They are used to determine the non-inflationary provision of liquidity by monetary policy, to ascertain structural budget positions in medium-term fiscal planning and to assess other needs for action by economic policy by distinguishing business cycle fluctuations from growth dynamics. This

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its replacement costs; if  $q \geq 1$ , the investment pays off. Tobin's  $q$  can also be expressed as the relationship between the (expected) return on investment and the risk-equivalent market rate of interest and, thus, corresponds to Wicksell's idea of comparing the interest rate in the capital market and the money rate; see Tobin (1969).

section does not present a comparative survey of methods of estimating potential output,<sup>58</sup> but outlines the connections between the theories presented up to now and standard methods of estimation.

At first glance, the intersection of the multitude of standard estimation methods and the theories considered in this chapter may seem disappointingly small. A large share of the estimations are not based on economic theory, but rest solely on statistical filter methods that decompose time series of output in a trend component (potential) and a cycle component (gap). Apart from these univariate techniques, multivariate, “semi-structural” methods exist that model the relationship between output gaps and changes of the inflation rate with the aid of Phillips curve equations and Okun’s law (see, e.g., Apel & Jansson, 1999; Gerlach & Smets, 1999). Most techniques based on economic theories, however, draw on macroeconomic production functions in the manner of Solow’s growth theory. Predominantly, Cobb-Douglas functions (and occasionally CES functions) are utilised, and the contributions of the production factors and technological progress are mostly determined by means of growth accounting. When estimating the potential increment of labour input, capital stock and “total factor productivity” (Solow residual), often purely statistical methods are employed. Ordinarily, estimations of the labour input are based on data on labour force potential, participation rate and average working time as well as estimations of the NAIRU.

The Cobb-Douglas approach is employed since the 1960s by the Council of Economic Advisers (CEA) and the Congressional Budget Office (CBO) in the U.S., since 1973 by the German Central Bank and more recently also by the International Monetary Fund, the OECD, the EU commission (DG ECFIN) and the European Central Bank. The German Council of Economic Experts (Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, SVR) does not share the common practise. Since 1968 (with the exception of 1999 to 2002 for reasons of data availability), the SVR has estimated potential output using a limitational production function that describes potential output as solely depending on the progression of estimated capital productivity. The Council explains that this approach proceeds on the assumption that cyclical fluctuations of capacity utilisation are primarily caused in the entrepreneurial domain (SVR 2003: No. 746).

The relationship between the Cobb-Douglas approach for estimating potential output and Solow’s growth theory seems close and natural. Following to the common dichotomy that treats the short run and the business cycle as determined by aggregate demand and the long run and growth as solely determined by aggregate supply, estimated factor contributions are usually equated with factor supplies. Moreover, many models (e.g., those of the OECD, the IMF, and the CBO) proceed on the assumption of demand adjusting to supply and output gaps being

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<sup>58</sup> With respect to the analysis and critique of common estimation methods, see chapter 5 in this study as well as Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2003: No. 734-64) and Cotis, Elmeskov, and Mourougane (2004). For an international survey of institutions and methods of mid-term forecasts encompassing estimates of potential output, see ZEW (2005).

closed by the end of the forecasting horizon (ZEW 2005: 28, 36, 40). But it is not imperative to interpret trends that result from purely statistical extrapolation as completely determined by supply data. Likewise, the possibility that underlying NAIRU estimates contain hysteresis components that reflect cyclical impacts of the past cannot *a priori* be excluded.

In macroeconomic studies, structural vector autoregressive (SVAR) models have become increasingly popular, and they also seem to gain influence in the business of estimating potential output (e.g., Gerlach & Smets, 1999). In vector autoregressions with no restrictions all variables are equally endogenous, i.e. determined interdependently via time lags. In SVAR models theoretical restrictions are imposed in order to permit the unambiguous identification of impulses and propagation mechanisms (according to the classification by Frisch, see section 2.4.2). These kinds of restrictions may consist in ordering variables according to degrees of exogeneity or classifying shocks according to the persistence of their effects. Conforming to the well-known classification by Blanchard and Quah (1989), shocks effective in the long run are treated as supply shocks, and transitory shocks are treated as demand shocks. However, this is merely conventional and would not have been accepted in many of the older theories outlined in this chapter since it disregards the difficulty of separating demand and supply effects of investments along the time axis.

### 2.6.3 Conclusion: The Evolution of Theories and Growth Regimes

In concluding this chapter, the connections between historical macroeconomic theories and the economic situation at their time of origin are examined. Since the 1920s, in both Europe and the U.S. the pendulum of macroeconomic thought has swung at least as forcefully as the rates of inflation, real interest and GDP growth.<sup>59</sup> This section presents an experiment that relates to those interest rate gap theories presented in this chapter that have contributed to the development of the concepts of “potential output” and “output gaps” since the 1920s. History is, after all, the biggest (and often only) laboratory available for macroeconomists.

The experiment reads:

1. Identify different growth regimes by comparing time series of real GDP growth rates and real capital market interest rates in the time period 1925-2004.
2. Examine to what extent the theories outlined in this chapter contribute to the explanation of growth regimes at their time of origin.

In this study, the experiment cannot be conducted by every trick in the book. In its simple shape it is not intended to provide “hard” empirical evidence for the conformity of theory and reality or for divergence of both. Rather it serves to give an impression of how the progression of macroeconomic theories is related to changes of variables that are closely connected with the progression of potential output in reality. In order to identify different growth regimes, a well-known tech-

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<sup>59</sup> For three different interpretations of the evolution of macroeconomics in the 20<sup>th</sup> century, see, for example, Woodford (1999), Blanchard (2000), and Leijonhufvud (2004).

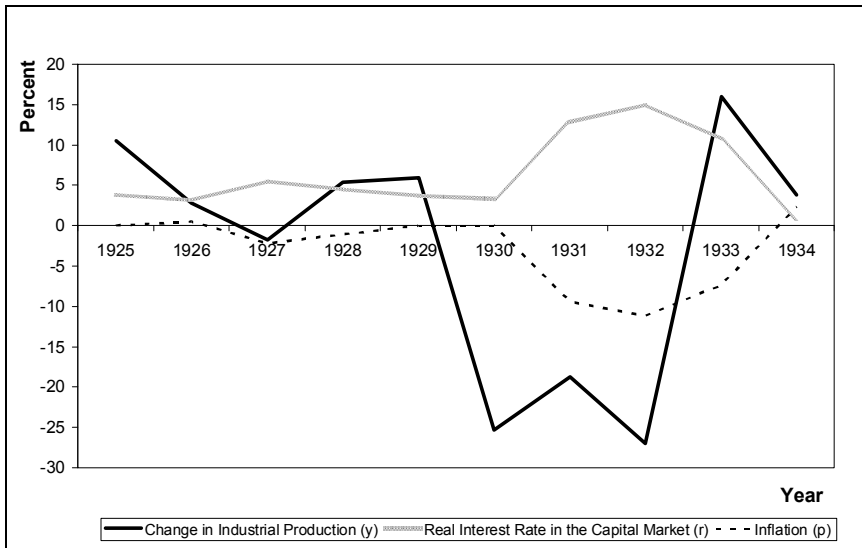
nique for empirical testing the “golden rule of capital accumulation”<sup>60</sup> is employed. However, it starts out from a different line of argument, which stems from the short-term to medium-term interest rate gap theories outlined in this chapter. It should be widely acceptable to macroeconomists as it is supported by a large number of theoretical approaches. It introduces the notion of growth regimes, in which a growth regime is denoted as *expansionary* if growth rates of real GDP are higher than real interest rates in the capital market. If, conversely, interest rates are higher than growth rates, a *stagnative* regime prevails. Expansionary growth regimes are associated with higher increments of potential output than stagnative regimes.

This relationship between interest rates and growth can be substantiated as follows:

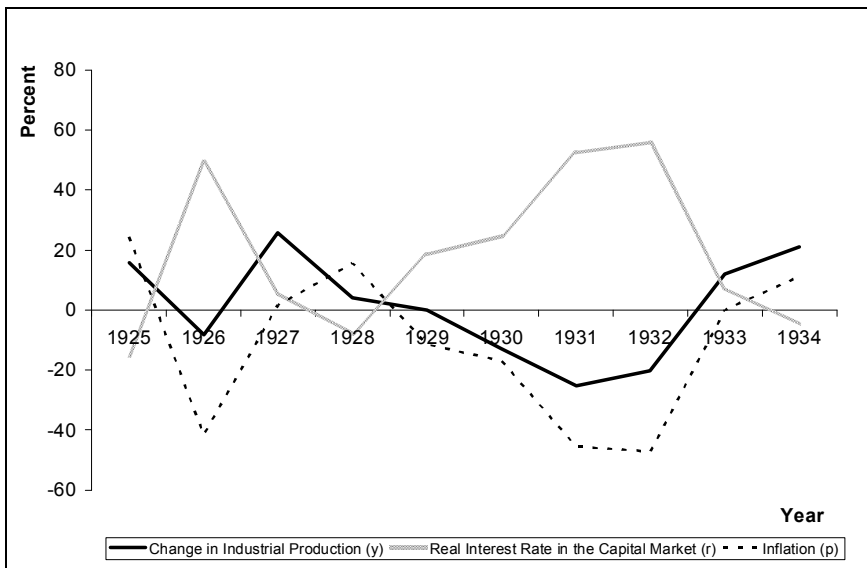
- Growth rates and interest rates in the capital market are pivotal determinants of investment activity, which in turn is a strategic variable for the progression of potential output. Economic growth affects investment positively due to the accelerator effect of revenue expectations; interest rates affect investment negatively due to the cost effect.
- Real interest rates in the capital market are not “natural rates of interest” in the sense of physical yields on capital or an equilibrium interest rate that reconciles planned savings with planned investments. They are inflation-adjusted money rates of interest to be compared with expected yields from investment in real capital – in modern versions of interest rate gap theories this is commonly done in terms of Tobin’s  $q$ . Concerning Tobin’s  $q$ , see footnote 63.
- While observed growth rates are also a determinant for investment activity (as already described), they are first and foremost dependent on investment. As a component of aggregate demand, investment has an immediate effect on the current growth rate; as a component of aggregate supply, it influences future growth rates through its capacity effect.
- Periods of deflation and disinflation are characterised by negative or small positive rates of inflation, frequently associated with an increase in nominal interest rates. The corresponding increase of real interest rates slows down investment activity and, thus, diminishes the growth of potential output. Consequently, persistently high real interest rates are associated with real economic stagnation or a slowdown of the growth trend.
- Low real interest rates can provide for sustainable real economic expansion if they are based upon comparatively low nominal interest and inflation rates. Higher rates of inflation may temporarily be associated with low or even negative real interest rates but ordinarily cause capital supply shortages or disinflation induced by monetary policy, thus, heralding the end of an expansionary growth regime.

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<sup>60</sup> According to the golden rule of capital accumulation deduced by Phelps (1961) from Solow’s growth model, an economy reaches its maximum consumption growth path if the growth rate of real output equals the real interest rate relevant for investment.

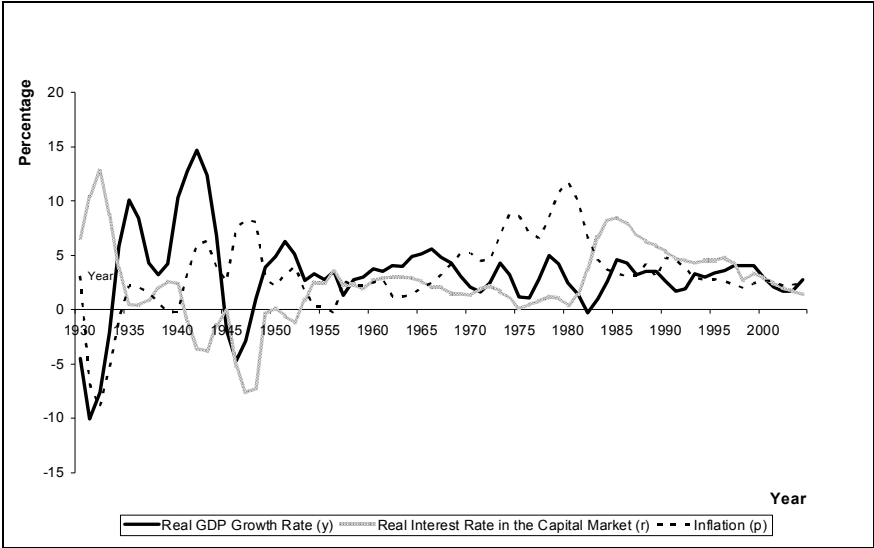
**Fig. 6.** Production and Interest Rates in the U.S., 1925-1934

Source: NBER Macrohistory Database, FRED (St. Louis Fed)

**Fig. 7.** Production and Interest Rates in Germany, 1925-1934

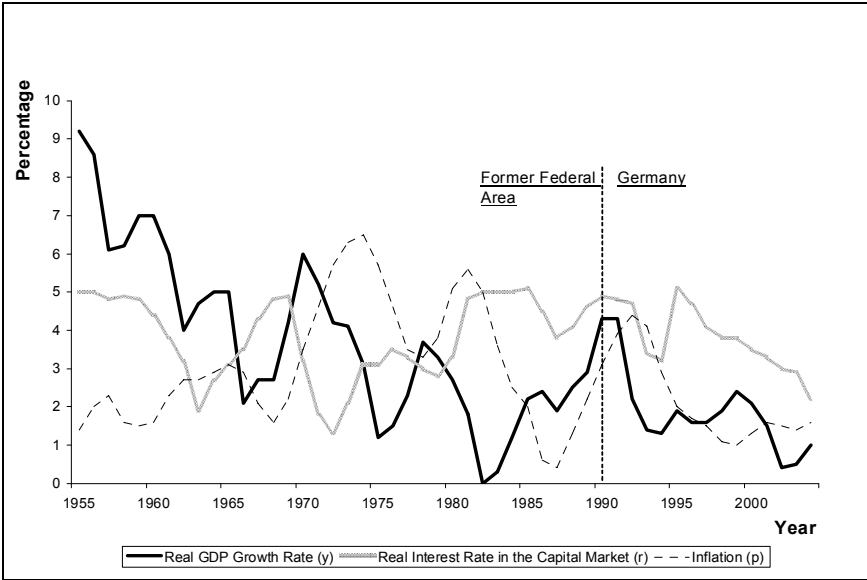
Source: NBER Macrohistory Database

**Fig. 8.** Growth and Interest Rates in the U.S., 1930-2004



Source: OECD, NBER; FRED (St. Louis Fed)

**Fig. 9.** Growth and Interest Rates in the U.S., 1955-2004



Source: German National Statistic Office, German Central Bank

This perception is supported by the data for the U.S. and Germany in the time period between 1925 and 2004 as presented in Figures 6-9. Choosing these two countries is motivated by pragmatic but also by theoretical reasons: The study commissioned is (at least implicitly) concerned with the economic progression in Germany. However, German economic history is also a particularly interesting case. Since the 1920s, it has frequently mirrored world economic progression in the extreme: In Germany, macroeconomic turbulences prior to and during the Great Depression were more pronounced than in most other countries. The ascent of the Western German economy to the most powerful economy in Europe up to 1974 is as striking as the slowdown of economic growth since then. The U.S. form a benchmark for the development in Germany in many respects. They play the leading part in the world economy since the 1920 and in economic research since the 1940s. In addition, the macroeconomic databases for these two countries are comparatively sound.

The examination starts in the mid-1920s. As there are no reliable data on GDP for the time prior to the Great Depression (see Section 2.5.1), consistent time series available for the progression of output, prices and interest rates for the period 1925-1934 were selected.<sup>61</sup>

The long-term time series on the progression of real GDP, inflation and real interest rates in the US capital market, 1930 to 2004 (Figure 8), bridge the pre- and post-war period and lead into the present. Due to the lack of data on comparable interest rates, for Germany (until 1990 only the old West German states) these variables are shown from 1955 onward (Figure 9).

In the following, *expansionary growth regimes* are defined as periods with GDP growth rates being positive and higher than real interest rates in the capital market ( $y > r$ ) over several years. *Stagnative growth regimes* are defined as converse constellations ( $y < r$ ). Applying this simple classification and adding some historical information yields the following rough picture.<sup>62</sup>

*Prior to 1929*      *No unambiguous assignment:* massive fluctuation of output, prices and interest rates in the aftermath of the reintroduction of the Gold Standard

*1929-1933*      *Stagnation:* severe recession during the Great Depression

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<sup>61</sup> The data used here are taken from the National Bureau of Economic Research's (NBER) Macrohistory Database and the Federal Reserve Bank of St. Louis' FRED database. For the U.S., the industry production index and the consumer price index were chosen, for Germany, the production index by the Berlin Institute for Economic Research (now: DIW) was employed; inflation is represented by the "Index of Sensitive Prices" from the same source. Interest rates in the capital market for both countries are reported using inflation-adjusted current yields of long-term government bonds.

<sup>62</sup> It should be considered that due to the asynchrony of business cycles in the U.S., Germany and other countries, the temporal assignment is only an approximation. In addition, from Figures 8 and 9 it appears that the usage of three-year averages (for better illustration of regime changes) may cause minor deviations.

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1934-1939	<i>Expansion: New Deal</i> policy in the U.S.; military build-up in Germany
1940-1949	<i>No unambiguous assignment:</i> expansion of output in the war-time economy, suppressed and open inflation, post-war recession, the early stage of the Bretton Woods system along with balance-of-payments crises and adjustments of exchange rates
1950-1970	<i>Expansion:</i> “Golden Age” of the Bretton Woods era with high GDP growth rates and comparatively minor inflation
1971-1980	<i>No unambiguous assignment:</i> collapse of the Bretton Woods system of fixed exchange rates, in the aftermath of the oil price shocks OPEC I (1973/1974) and OPEC II (1979/1980) boosts of inflation in fits and starts, massive volatility of inflation and GDP growth rates <sup>63</sup>
1981-1997	<i>Stagnation:</i> disinflation due to a policy of high interest rates in the aftermath of OPEC II and German reunification, period of intensive financial market globalisation, initiation of convergence processes in the run-up to the European Economic and Monetary Union
1998 to date	<i>No unambiguous assignment:</i> mild expansion with minor inflation and low real interest rates in the U.S. (accompanying both the “New Economy” and the burst of the <i>dot.com bubble</i> by means of an enormous increase of liquidity); in Germany stagnation with real interest rates higher than in the U.S. and some EU countries (after the German interest rate advantage was eliminated by the introduction of the European Monetary Union)

Examining the evolution of macroeconomic theories against this background, it turns out that it can only partly be explained as responses to real economic problems. It was to a greater extent driven by the inner logic of tackling the question how empirically observed fluctuations of real economic activity can be reconciled with a general theory of rational economic behaviour. The answer to this question had (and still has) fundamental implications for economic policy – not least for the question of how to define and utilise potential output best. The pendulum of economic doctrines has swung to and fro between the idea that deviations of current output from potential output are market failures and thus require public demand management and the idea that deviations from potential output stem from malpractices in economic policy which cause inflation and call for rigorous self-restrictions of economic policy. However, there are both older and more recent

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<sup>63</sup> This period is frequently characterised as “stagflation“, even though there were some years with high economic growth and the average growth rate in the U.S. only fell short by 0.2 percentage points compared to the following decade while in Germany it even was 1.1 percentage points higher. Thus, the choice of term has more likely resulted from retrospection to the 1950s and 1960s.



theories that combine both lines of argument and, thereby, arrive at more balanced conclusions. Moreover, from the two above-mentioned propositions, it cannot be inferred that macroeconomic mainstream theory has always taken the optimal route of scientific progress.

One by one: It is no historical coincidence that the interest rate gap theories in the tradition of Wicksell (1898), which form the basis of the concepts of potential output and output gaps, originated in the late 1920s and early 1930s (see sections 2.4.2-2.4.5). In those turbulent years, monetary policy required deep conceptional thinking, first about the reversion to the gold standard in the mid-1920s, then about (ultimately) abandoning the gold convertibility of currencies in the early 1930s. In particular, the question came up which kinds of cumulative processes of prices and output adjustments may be caused by measures of interest rate policy (or by their omission in cases of technical progress and other innovations) and to what extent the system's real equilibrium position is changed by it. In the 1920s, economic mainstream took more and more the position that, when it comes to analysing the dynamics of disequilibrium processes, the core subject of monetary and business cycle theory, Walrasian general equilibrium theory is a static and purely hypothetical reference model at best. Monetary and business cycle theory are linked by the notion that, in coordinating savings and investments, the interest rate mechanism frequently fails, thus, triggering excess demand and supply in other markets which in turn create feedbacks due to their effects on income distribution and productivity. It has been debated whether adjustment processes of wages and prices suffice to restore a general equilibrium with full utilisation of potential output and zero inflation or whether the government needs to take suitable measures of interest rate and employment policy. Both anti-cyclical fiscal policy aiming at stabilising output and rule-bound monetary policy aiming at stabilising prices had been already advocated by the early 1930s – prior to Keynes (1936) and long before Friedman (1968).<sup>64</sup>

Nevertheless, the common perception changed when Keynes' *General Theory of Employment, Interest and Money* (1936) was published. By that time, the mass unemployment of the Great Depression had shattered the belief that free markets always tend to produce full-employment equilibrium. Keynes attempted to demonstrate why market systems may fall into depression without being able to automatically find their way out of it. He set his principle of effective demand against Say's law and implicitly also against Walras' law: Goods and financial markets may be in market-clearing equilibrium while unemployment persists in the labour market due to rationing of labour supply. The latter cannot be equated with effective demand for consumption goods, nor do savings necessarily translate into future effective demand for consumption goods (due to asset holders' liquidity preference, among other things). Keynes argued that the interest rate mechanism does not coordinate investment and savings at all, but that income adjustments are re-

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<sup>64</sup> Both strategies are proposed, e.g., in the translation (1939: Part II and Appendix) of Lindahl (1930) and Lindahl (1935). An international survey is given by Laidler (1999), who shows that the view that, prior to Keynes (1936) and during the Great Depression, most economists banked on the markets' self-regulating forces is largely a myth.

sponsible for reconciling savings with investment *ex post*. Rather than analysing the dynamics of cumulative price adjustments in disequilibrium, Keynes emphasised the comparative statics of underemployment equilibria (the rule) and full-employment equilibria (the ideal case exception), brought about solely through adjustments of quantities. Keynes' theory resulted in the notion that full utilisation of potential output requires continuous stabilisation of aggregate demand, largely by means of fiscal policy.

The achievements of the *New Deal* in the U.S. as well as the strong role of fiscal policy in overcoming the post-war recession seemed to confirm this belief. The lessons learnt from the planned organisation of war economies and the political competition with the Soviet Union and its sphere of influence contributed to the belief widely held after World War II that concepts of global demand management and indicative planning are the most efficient solutions for macroeconomic problems of resource allocation. Ensuring full utilisation and expansion of productive capacities by means of governmental guidelines and spending became the planning project of social engineers, who made use of recent "technical progress" in the realm of statistical data collection and econometric data processing. As recessions rarely occurred during the 1950s and 1960s and, when they occurred, were much milder than the cyclical fluctuations of the pre-war period, this was considered as a success of Keynesian stabilisation philosophy. Fostering economic growth became a major concern, and the concept of potential output began to play a key role in it.

Meanwhile, Keynes' theory was being integrated into the Neoclassical Synthesis in the form of IS/LM analysis and its AD/AS extension. In the process, the hitherto central issue of coordination failures of the interest rate mechanism causing inflationary and output gaps completely disappeared from the scene.<sup>65</sup> The explanation of underemployment equilibria by means of Keynes' liquidity preference theory seemed to reduce the whole story to the liquidity trap – an exceptional case, scarcely empirically observable and plausible only in the very short run if at all. Ultimately, the Neoclassical Synthesis reduced the explanation of underemployment and corresponding output gaps to the existence of wage and price rigidities. An expansionary mix of monetary and fiscal policy seemed to provide a remedy for underemployment albeit associated with inflation. That way, the Phillips curve became popular making post-war standard macroeconomic theory an easy prey for Monetarist and New Classical criticism.

Concerning Friedman's (1968) and Phelps' (1967) Phillips curve critique, it may seem as if reality for once followed theory, rather than the reverse. The rapid success of Monetarism in the 1970s was based, amongst other things, on the strong empirical confirmation that the great inflation of those years seemed to provide for Friedman's acceleration hypothesis (see section 2.5.2). It should be remembered, however, that even in the early 1930s as well as during the inflationary waves in the post-war period, attempts at fostering growth and employment by way of inflation had been widely criticised without resorting to the concept of a

<sup>65</sup> See Leijonhufvud (1981 and 2004). The development of Tobin's  $q$  and Tobin's emphasis of the importance of financing structures could be considered an exception.

“natural rate of unemployment” (sections 2.4.3 and 2.5.1). Furthermore, the oil price shocks in the 1970s can be interpreted as supply shocks (as is now customary in RBC theory) and, thus, as a shift of the long-term AS and Phillips curves to the left (Figures 3 and 4), rather than a host of short-term curves converging on a long-run vertical. Even if one follows the Monetarist and New Classical lines of argument, inflationary pushes and declines in economic growth during this period (Figures 8 and 9) can hardly be reduced to the idea that politicians have tried to displace markets from their (long-run) equilibrium position. Expansionary monetary and fiscal policy during those years was motivated by the attempt to stabilise unemployment rates considered as “natural” in the sense of an equilibrium in the labour market.

Nevertheless, in the 1970s and 1980s the pendulum of economic doctrines swung towards the notion of policy malpractices. Not only were the parallel increases of inflation and unemployment considered as signs of a complete failure of social engineering. They were considered to be the result of discretionary “stabilisation policy” that threatens to destabilise the system because it is both ineffective and inefficient: It is ineffective since the private sector anticipates the policy’s time inconsistency, and it is inefficient because anticipated inflation and unexpected disinflation entails welfare losses. Monetarist theory implies the correspondence of potential output with the natural rate of unemployment. Negative output gaps emerge only in rare cases of deflation and “incredible” disinflation; more generally, positive output gaps and especially inflationary gaps tend to develop in the short run. New Classical theory even goes the extra mile and reduces short-term effects to mere surprise responses towards shocks. Thus, deviations of current output from potential output can only occur stochastically and can be reduced by self-binding monetary and fiscal policy. By then, it had become imperative to explain fluctuations in real economic activity as equilibrium phenomena rigorously deducible from microeconomic rational behaviour to the greatest possible extent.

When, during the period of stagnation in the early 1980s, the relationship between growth rates and interest rates went into reverse (Figures 8 and 9), mainstream economic theory hardly reacted at all. High real interest rates in the short run were interpreted as an indispensable investment in acquiring reputation capital that independent and rule-bound central banks have to make for the sake of their credibility. Growth rates that persistently fall short of real interest rates are harder to explain without alleging a drastic increase in consumer time preferences. The methodological imperative ultimately established with RBC theory, commanding to model any macroeconomic fluctuations in terms of continuous intertemporal equilibrium, has rendered coordination failures that result from market processes (as opposed to political malpractices) basically “unthinkable”. In standard models of present macroeconomics, capital markets – in the non-trivial sense of price and other mechanisms that coordinate the supply and demand for loans – have largely vanished.<sup>66</sup>

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<sup>66</sup> However, during the 1980s and 1990s, on the sidelines of mainstream economics attempts were made at deducing financial constraints of real economic activities by em-

Nevertheless, since the 1980s, various attempts have been made at explaining why changes of GDP growth are empirically observed to run ahead of changes of inflation (Figures 8 and 9) as well as providing micro-founded explanations for the obvious persistence of the effects of monetary policy on output and employment. Corresponding NAIRU models are supported with a substructure based on the concept of quasi-equilibrium unemployment (QUERU) (Figure 4), a hybrid between market clearing and rationing equilibrium that allows for various interpretations with respect to potential output – depending on the extent to which rationed outsiders are still considered as effective labour supply. Within the framework of the New Neoclassical Synthesis, attempts are made to substantiate the existence of persistent output gaps in intertemporal equilibrium models (section 2.3). In these models, the RBC core of intertemporal optimisation is modified by integrating nominal rigidities that emerge on the supply side of product markets in an environment of monopolistic competition. To what extent this renaissance of interest rate and output gap theories based on New Classical methods will prove tenable for a consistent definition of potential output, remains to be seen.<sup>67</sup>

Up to now, the dominance of New Classical methods in academic mainstream economics has carried little weight in political advisory concerning questions related to potential output.<sup>68</sup> In many realms of political advisory, however, using a macroeconomic production function as in Solow's growth model has become a widely accepted practice. The aggregate production function is a purely supply-theoretical concept that excludes feedback effects of temporary interest rate and output gaps on potential output from the outset. The advantages and drawbacks of this type of exclusion with respect to calculating potential output will be discussed in the following chapter.

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ploying information asymmetries and financial accelerators. Two major advances were Stiglitz and Weiss' (1981) credit-rationing approach and the credit cost approach by Bernanke and Gertler (1989). However, both attempts employ rationing equilibria, which presently tend to be frowned upon in mainstream economics. For a survey of this *credit view* and a comparison with pre-war interest-rate gap theories, see Trautwein (2000).

<sup>67</sup> Various problems associated with determining potentials and gaps in the New Neoclassical Synthesis are addressed in chapter 3 of this book.

<sup>68</sup> By developing the “a-theoretical” Hodrick-Prescott filters, Edward Prescott has probably exerted a more lasting influence on methods for estimating potential output than by advancing RBC theory.

Projecting Potential Output

Methods and Problems

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