A SIMPLE FRAMEWORK FOR STABILIZATION POLICY

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Contents

I. Introduction

Successful stabilization policy not only needs effective instruments and reliable indicators but also a usable theoretical framework. Since the breakdown of the „consensus model vintage 1970" (Tobin 1980), among economists there was no agreement on such a framework. Reality was seen too complex to be scetched in a simple model.

One session of the 1997-meeting of the American Economic Association was labeled „Is There a Core of Usable Macroeconomics We Should All Believe In?" with Robert M. Solow, John B. Taylor, Martin Eichenbaum, Alan S. Blinder and Oliver Blanchard as contributers. In their answers some topics repeatedly were mentioned: The IS-LM model, the Phillips Curve and the NAIRU, Okun's Law, expectations, rules for monetary policy, and factor productivity as the driving force for growth of potential output.Obviously all answers are „opportunistically" in Solow's sense: it was chosen „whatever works" (p. 231). There was no attempt to integrate these topics into something really usable.

This paper departs with a different intention. It looks for an as-simlple-as-possible presentation that combines useful concepts for stabilization policy. Not surprisingly, our candidates are all among those of Solow & Co. But to fit them together we had to make some modifications. Especially Okun's Law (Okun 1970) had to be replaced by the x-u relation. The result is a graphical presentation, that covers important parts of the economy: demand and supply for goods, money and labour, the wage-price mechanism and monetary policy. In it's core it is a combination of four graphs: the IS-LM graph, the x-u relation, the Phillips Curve and a Monetary Policy Function. One question this paper adresses is wheather this heroic framework is usable to discuss stabilization policies at least in a comparative static manner.

In the short-run this framework describes stabilization policy in the traditional Keynesian way: Starting in a situation with underemployment, higher public spending or lower interest rates lead to an expansion in aggregate demand and may result in full employment. But if there is structural unemployment or economic agents do change their expectations on inflation (which result in shifts of the Phillips Curve) this short-run equlibrium causes or aggravates medium-term disequilibria. As all variables used on the axes are stationary, this presentation even covers growth.

This framework is too simple to describe the time-paths of changes; but it shows what has to change how and it gives the conditions of a „golden age" of short-run, medium-term and long-run equlibrium - the „never-never land". With this overall equilibrium as a reference, the state of the economy can be scetched graphically in a comparative static way. So the next question is, whether this representation gives useful informations for stabilization policy.

The paper is organized as follows: Chapter II presents the components of our framework and shows some basic applications. In chapter III some refinements take place, i.e. we open the economy and introduce growth. Having completed our instruments, we apply them to some historical situations (chapter IV). The usefulness of the instruments proved, we turn to contemporary problems and our final question: What is contemporary the „right" stabilization policy (chapter V)? Finally we give some concluding remarks on caveats and further research (chapter VI).

II. Components

In this chapter we describe the components of our presentation. The main ingredients are the IS-LM-curves, the x-u relation, the Phillips Curve and a function which describes the monetary policy of the central banks.

II.1 IS-LM

The first ingredient is a modified IS-LM presentation. As known from text-books, the IS-curve represents the geometrical locus of all combinations of the long-run real rate of interest (r) and real gross domestic product (Q) where investment equals saving. In the r-Q-space this curve is downward sloped and it gets steeper in relation to the Q-axis, when investment reacts lesser to changes in interest-rates, the multiplier is lower and the productivity of capital increases. Higher government expenditure, expected demand or real private wealth shifts the curve to the right.

The LM-curve represents the geometrical locus of all combinations of the real rate of interest and gross domestic product, where money-demand equals money-supply. This curve is upward sloped in

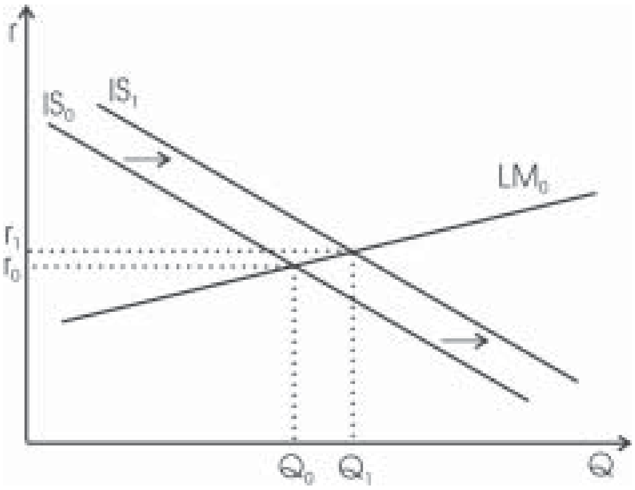

Fig. II.1 A Rise in Government Expanditure in the Standard IS-LM-Framework (without accomodation)

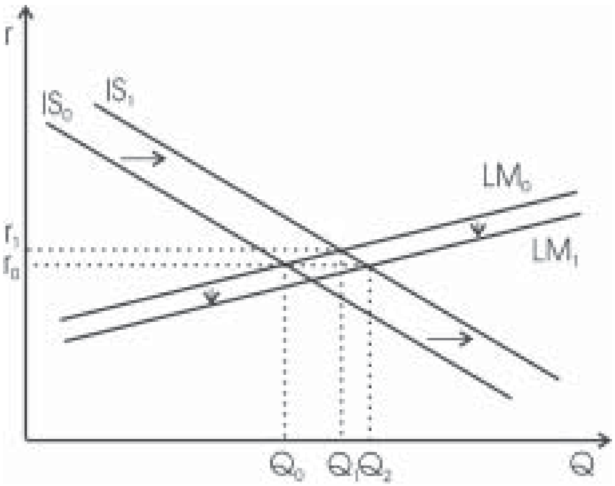

Fig. II.2 A Rise in Government Expanditure in the Standard IS-LM-Framework (with accomodation)

the r-Q space and it gets steeper in relation to the Q-axis the lower the interest-elasticity of money-demand and the stronger the reaction of the long-run interest rate is to changes in the short-run interest rate. Higher private wealth, price-level or expected inflation drifts the LM-curve up, an increase in money-supply down.

This all is nothing new but known from textbooks (e.g. Westphal 1988a, pp 380 - 385, less elaborated: Samuelson / Nordhaus 1987, pp. 567 - 575, Romer 1996, pp. 197 - 205 and Burda / Wyplosz 2003, pp. 271 - 278). Remember that this analysis is basicly short-run, i.e. prices are assumed not to change. This is motivated by the assumption that we start in a situation with unemployment and underutilized capital stock. In Fig. II.1 we plot the IS and LM curve before and after a permanent increase in government expenditure. This act of stabilization policy leads to higher aggregate demand, more production, employment and income and via the multiplier to a higher level of GDP. Higher income means more demand for transaction money, thus the interest rate goes up. We end in a new equlibrium with higher GDP and interest rate. This rise in the interest rate tends to reduce investment, but as long as the multiplier exceeds unity, GDP is higher than before. Graphically this is represented by a shift of the IS-curve to the right (from IS_0 to IS_1) with the new equlibrium values Q_1 and r_1.

In this argument the central bank was passiv, i.e. it accepted a higher rate of interest. If she does not want to see retarding influences on private fixed investment and consumption, she has to raise the money supply. As interest rates are not up, this accomodation by the central bank results in an even higher GDP. Graphically the increase in money supply means a downward shift of the LM-curve and we have a new equlibrium at the intersection of IS_1 and LM_1 with the equlibrium-values r_0 and Q_2 (see Fig. II.2).

In the real world central banks try to steer the money supply by setting conditions for private banks to get high powered money, i.e. take influence on the nominal short-term interest rates. The private sectors adjust their portfolio-choice and investment decision according to changes in the real rate of interest. Assuming constant prices (short run analysis), nominal and real interest rates move pari passu.

A cut in short-term nominal interest rates results in a lower real rate of interest. Costs for credits for investment and consumption are reduced, demand rises and the result is a higher output. Graphically the LM-curve shifts downward and we end in the point (r_1,Q_2) where the LM_1-curve intersects the IS_0-curve (see the second step in Fig. II.2).

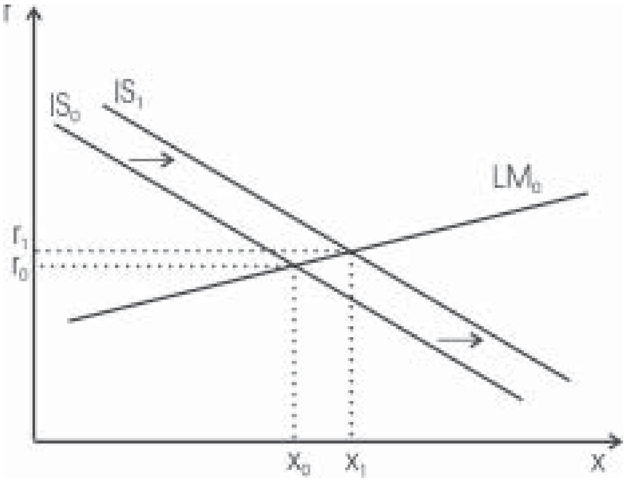

Fig. II.3 A Rise in Government Expanditure in the Modified IS-LM-Framework (without accomodation)

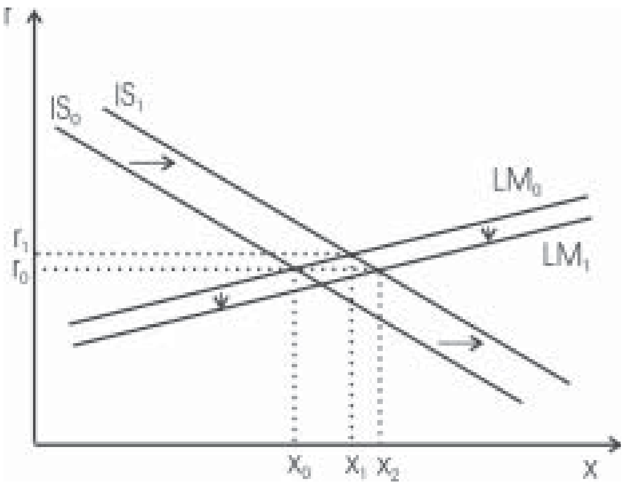

Fig. II.4 A Rise in Government Expanditure in the Modified IS-LM-Framework (with accomodation)

Befor taking the next step we make a little transformation. Dividing output by potential output gives the rate of utilization (x) of potential output. In the short run, the capital stock and thus potential output does not change. So it makes no difference whether we take output (Q) or the utilization rate (x) (Fig, II.3 and II.4).

II.2 The x-u Relation

The second component of our framework is the relation between the utilization rate of potential output and the unemployment rate (which is an utilization rate of the labour force). But what is potential output? Is it the technically maximum output that can be produced according to the factors of production (i.e. capital and labour)? Or is it the output that can be produced using the factors of production on normal levels? We follow the concept of normal use, motivated by a look at the labour market. The volume of labour can be defined as the number of persons times the hours they work. If we take standard hours as they are fixed in collective contracts or labor-laws, we have the standard (or normal) volume of labour.

With these two factors of production we have two potential outputs: the amount of goods and services that can be produced utilizing the existing stock of capital at its normal rate (assuming that sufficient labour is available) or the amount of goods and services that can be produced utilizing the existing labour force at standard hours (assuming that sufficient capital stock is available). In models with perfectly flexible prices and wages both will be equal. But we live in a world with sticky prices and wages. Thus the factor which is scarcer restricts possible output and gives potential output. Which of the both is scarcer may (and will) change over time (Vogt 1964).

Taking L^F for labour force (i.e. the number of people who are willing to work at given labour-market standards if there is no shortage of capital or demand), L for the number of people employed and U for the number of people unemployed gives the following definition:

$$U = L^F - L \qquad (1).$$

Let H^S be the standard hours and Q the output L workers produce during standard hours. This gives us the definition of normal labour productivity:

$$\mu = Q \,/(H^S * L) \qquad (2)$$

Dividing (1) by L^F, solving (2) for L and inserting gives the following expression for the rate of unemployment (u):

$$u = 1 - Q/(\mu * H^S * L^F) \qquad (3).$$

The term $(\mu * H^S * L^F)$ is the output that can be produced employing all the labour-force at standard-hours, i.e. under nomal conditions. In other words: it is the potential output if potential output were restricted by labour:

$$QP^L = \mu * H^S * L^F \qquad (4).$$

Potential output can as well be restricted by capital. With K the capital stock an ν the normal capital productivity we have:

$$QP^C = \nu * K \qquad (5).$$

Expanding equation (3) with potential output restricted by capital (QP^C) we get:

$$u = 1 - 1/\mu * (Q/(H^S * L^F)) * (QP^C/QP^C).$$

Rearranging gives:

$$u = 1 - (Q/QP^C) * (QP^C/QP^L),$$

where Q/QP^C is the rate of capital-utilization x. We define $QP^C/QP^L = f$ and finally have:

$$u = 1 - x * f \qquad (6).$$

We plot this relation in the x-u space (Fig. II.5). The intersections with the axes are 1 $(x = 0)$ and $1/f$ $(u = 0)$.

The slope of this curve depends on the relation of the two potential outputs (f). If both are equal, the slope is -1. When output is restricted by capital, i.e $(f < 1)$ a one unit increase of the utilization rate reduces the unemployment rate by less than one unit: the slope is flatter, in the opposite case steeper.

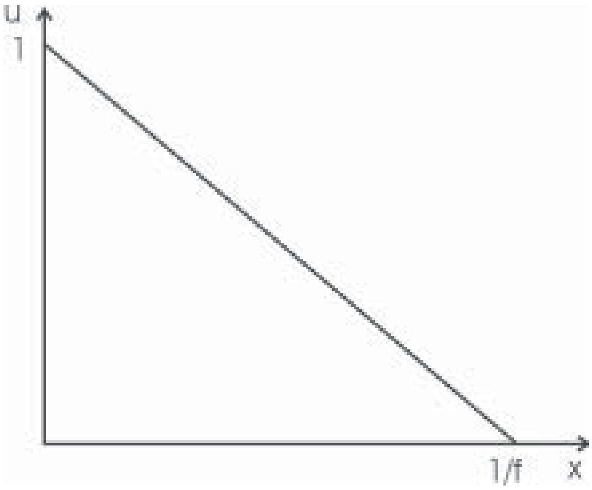

Fig. II.5 The x-u Relation

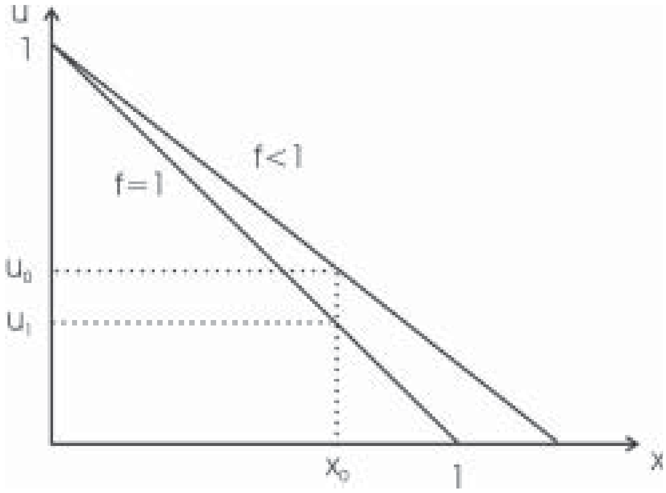

Fig. II.6 Different Kinds of Unemployment in the x-u Relation

Thus f is a measure for what I earlier called the „substitution requirement“ (Stark-Veltel 1987, p. 7): It shows how much factor-substitution c.p. is needed to have both potential outputs equal.

Let’s assume the case that potential output is restricted by capital ($f < 1$). At a certain utilization rate (x_0) we have the unemployment rate u_0 (see Fig. II.6). We now add the x-u relation for the case that the both potential outputs are equal ($f = 1$) which gives us the unemployment rate $u_1 < u_0$. The interpretation is: The difference u_0 - u_1 is unemployment due to lack of capital. And the rest?

The x-u relation for ($f = 1$) intersects the x-axis in unity, i.e. full capital utilization. There is no unemployment due to lack in demand, and no unemployment due to lack in capital stock. In fact, for $f = 1$ and $x = 1$ the graph shows no unemployment at all. This contradicts our experience: there always is a certain amount of unemployed persons due to frictions in the labour market. Their relation to the labour-force usually is called the frictional rate of unemployment.

This frictional rate of unemployment satisfies Friedman’s definition (Friedman 1968) of the „natural rate of unemployment“. To incorporate this, we split total unemployment into three components: unemployment due to shortage in capital stock (structural unemloyment U^c), due to lack in demand

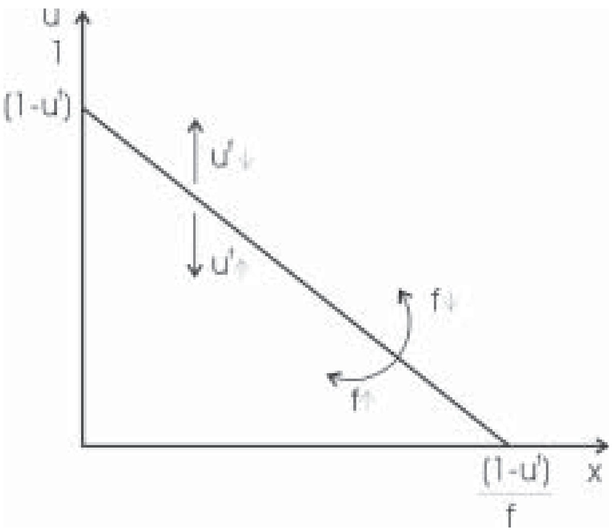

Fig. II.7 The Modified x-u Relation

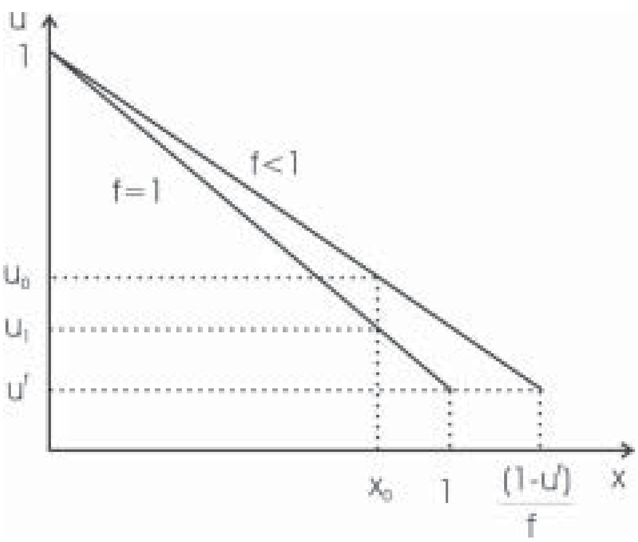

Fig. II.8 Decomposition of Unemployment in the Modified x-u Relation (cyclical unemployment U^d) and due to frictions (frictional unemployment U^f). Let according to our definition of the labor force (L^f) unemployment (U) be the sum of U^c and U^d, then total unemployment U^t is $U+U^f$ or in rates: $u^t = u + u^f$. Modifiing equation (1) gives:

$$U^t = L^F - L \tag{1 a}$$

and

$$u = 1 - x * f - u^f \tag{6 a}$$

The intersections of the x-u relation with the x-axis are $((1-u^f)/f)$ (for $u = 0$) and with the u-axis are $(1-u^f)$ (for $x = 0$). The slope of the x-u relation is -f. When frictional unemployment increases (decreases), the x-u relation shifts down (up) (see Fig. II.7).

For a clearer graphical representation we shift the curve by u^f (see Fig. II.8). Now u_0 is the unemployment rate, u_0-u_1 is structural unemployment and $u_1 - u^f$ is cyclical unemployment. If there were no frictional unemployment ($u^f = 0$), figures II.6 and II.8 were identical.

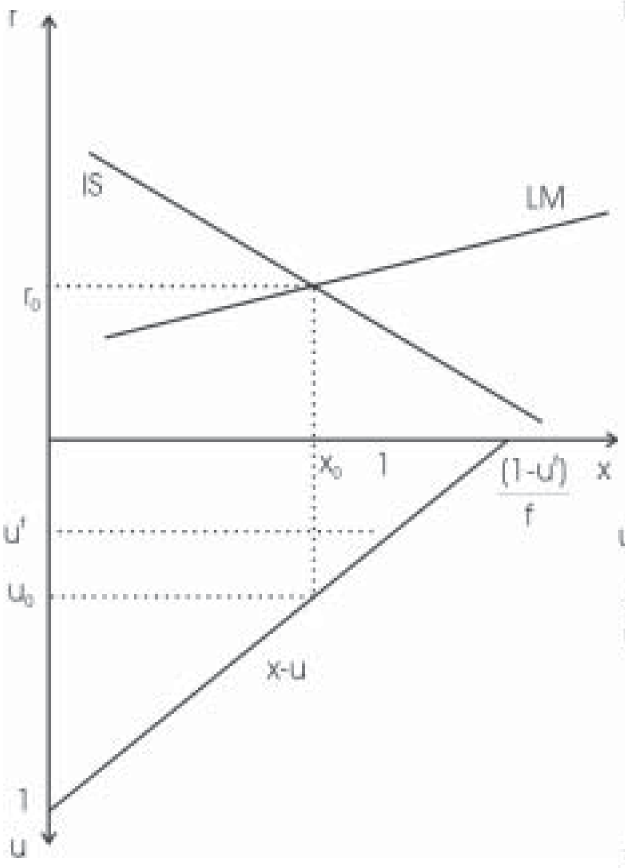

Fig. II.9 The Combined IS-LM and x-u Model

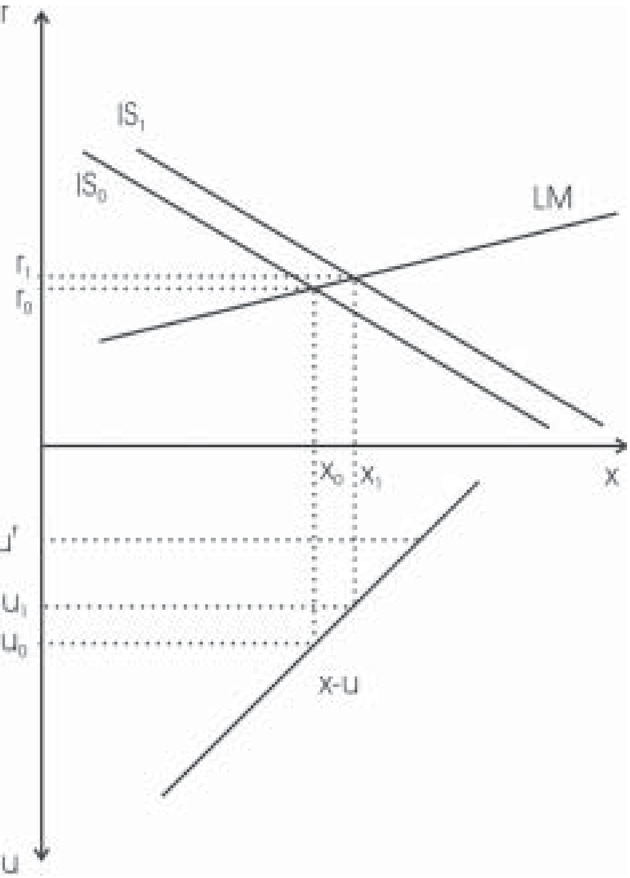

Fig. I.10 An Increase in Govermeant Expenditure in the Combined IS-LM and x-u Model

After this modification we can combine the IS-LM curves with the x-u Relation. To do this we mirror the x-u Relation at the x-axis. To concentrate on relevant items, we focus our graphics to the area arround full capacity utilization ($x = 1$) (see Fig. II.9 and II.10).

The effects of a permanent increase in government expenditure are plotted in Fig. II.10. The standard argument is that we start in a situation with unemployment and underutilized capital stock. So expanding output and thus employment poses no pressure on prices and wages. A permanent increase of government spending rises output and as long as fixed investment does not change potential output, the rate of capital utilization is higher than before. Graphically we see this as a shift of the

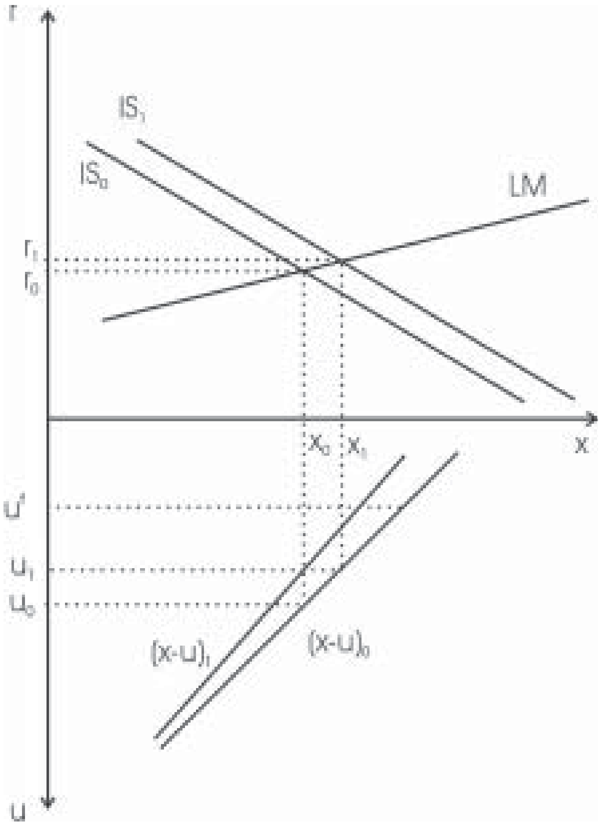

Fig. II.11 Change in the Capital Stock After a Permanant Rise in Government Expenditure

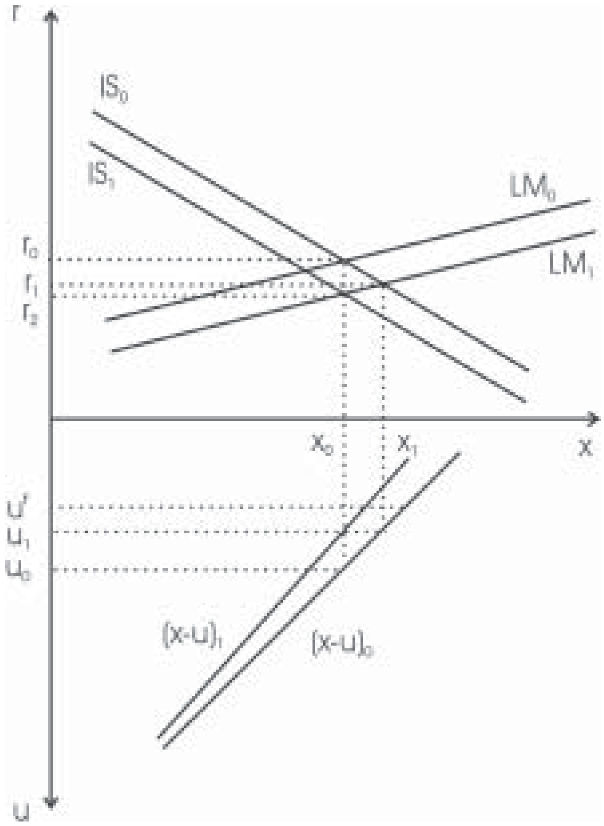

Fig. II.12 Change in the Capital Stock After a Reduction of the Real Rate of Interest

IS-curve to the right. Higher capital utilization means higher demand for labour and less unemployment. We end up with $x_1 > x_0$ and $u_1 < u_0$.

When firms detect an increase in demand they first try to meet it with overtime-work. Only if the change is seen as persistent, overtime-work is reduced as additional workers are hired. Depending on production techniques and labour-laws (how costly is hiring and firing), it may take quite a while before the switch from overtime-work to hiring is done: In a world of ex-ante and ex-post substitutability („putty-putty" technology) a larger labour-force can be combined with an unchanged capital stock. But in a world of ex-post limited production technology („putty-clay") first additional capital stock, i.e. private fixed investment, is needed before additional workers can be hired (Stark-Veltel and Westphal 1985, p. 277). In true life we face both types of technology present at the same time (e.g. „putty-clay" in industry and „putty-putty" in services). In an economy with rigid labour-laws or -jurisdiction, i.e. where firing is very costly, adjustment to changes in demand are more likely done via variing the hours and productivity (investing into more capital-intensive technology) of those in work and not via hiring and firing. Note that neither production technology nor labour-laws or -jurisdiction affect the slope of the x-u relation. What they affect is the time-profile of changes in employment.

This analysis is made under the assumption that we have underemployed resources, i.e. an utilization rate below unity. But if the permanent increase in government expenditure rises the utilization rate above unity, i.e. all capital stock is employed, there is pressure for investment in additional machines.

As soon as the capital stock is changed, the IS curve and the x-u relation start to move. The IS-curve shifts to the left (we have the same output with a lower rate of capital utilization) and the x-u relation turns right (in the original graph as QP^L remains unchanged as QP^C rises, i.e. in the mirrored relation it turns left). This rise in the capital stock increases the number of working-places and - as long as demand and the rate of capital utilization is not reduced for other reasons - reduces unemployment. In Fig. II.11 we assumed that investment creates as many working-places as needed to keep unemployment constant at the reduced rate (u_1). In our graph this happens to be combined with the original IS-curve, i.e. the original real rate of interest (r_0) and the original rate of capital utilization (x_0). But this is only to reduce complexity of the graph. We might have drawn new lines as well.

An act of monetary policy, e.g. a reduction of the real rate of interest from r_0 to r_1 (graphically a downward-shift of the LM-curve; see Fig. II.12) expands private consumption and investment by reducing credit costs. The rate of capital utilization rises (from x_0 to x_1) and unemployment is reduced (from u_0 to u_1). Again the x-u relation is affected as soon as additional capital stock enters the production process. In terms of our graph: The IS-curve shifts to the left (the same output is produced with a higher capital stock) and the x-u relation turns left. Due to the reduction in the rate of capital utilization we end up with a further reduced real rate of interest (r_2). Again we assumed that we end with the unchanged unemployment rate u_1 just to reduce complexity of the graph.

II.3 Phillips Curve

Our next component is the Phillips Curve (PC), a relation between the rate of unemployment and the rate of inflation, which Alban Phillips described in his seminal 1958 paper. During the 1960s this relation was assumed to be stable. In effect it was seen as a menu-card for stabilization policy: choose the combination of inflation and unemployment you want and adjust monetary and fiscal policy accordingly (Fig. II.13).

But the Phillips Curve proved not to be stable. Starting with zero inflation and an unemployment rate of u_0, an increase in government expenditure rises the demand for labour. Employers offer higher

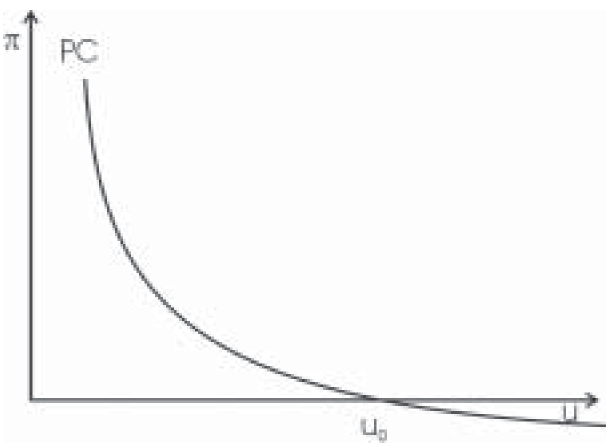

Fig. II.13 The Phillips Curve

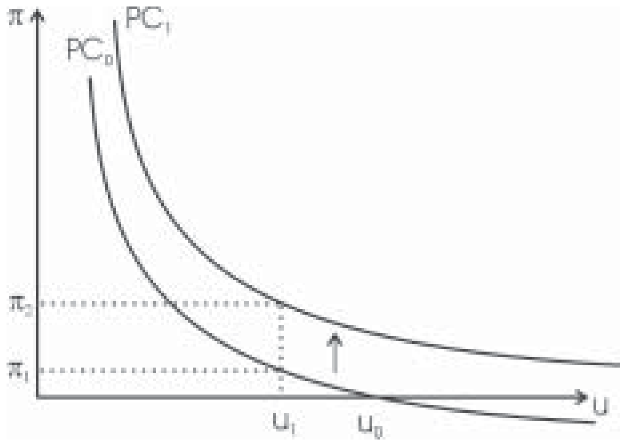

Fig. II.14 Expectations Shifting the Phillips Curve

wages and give employees new employment opportunities. This reduces unemployment to u_1. At the same time higher wage costs are transformed into higher prices and the inflation rate rises to π_1, the real wage and thus labour costs go down and more labour is hired. After some time workers recognize that their nominal wages-increase was no permanent increase in real wages. They adjust their inflation-expectations to the new rate of inflation and demand for further increases in their wages. Thus the new level of unemployment (u_1) can only be sustained with a higher inflation rate (π_2): the Phillips Curve has moved (Fig. II.14).

To reduce inflation, a contraction is needed with rising unemployment. Constant prices can be reached only at the unemployment rate u_0. To reduce inflation, unemployment has to rise above this rate (u_0) until expected inflation is back to nil. Graphically this means that the Phillips Curve has moved back to its original place. To sum up: In the short-run the Phillips Curve offers a trade-off between inflation and unemployment, but in the long-run an unemployment rate below u_0 cannot be sustained. And: only when unemployment equals u_0 the expected rate of inflation equals the actual rate and expectations need not be changed. This means that the long-run Phillips Curve is vertical and this unemployment rate has the property of not changing the inflation expectation and thus not shifting the short-run Phillips Curve. This unemployment rate u_0 is also called the „Non-Accelerating-Inflation Rate of Unemployment“ (NAIRU).

Our next step is to integrate the Phillips Curve into our graph with the IS-LM-curve and x-u relation. PC-curve and x-u relation have in common the u-axis. So we put the PC-curve it into the south-west quadrant of our graph (Fig. II.15). This figure shows a situation of overall equlibrium (the long-run equilibirium values of the variables and the long-run equilibirium positons of the curves are marked

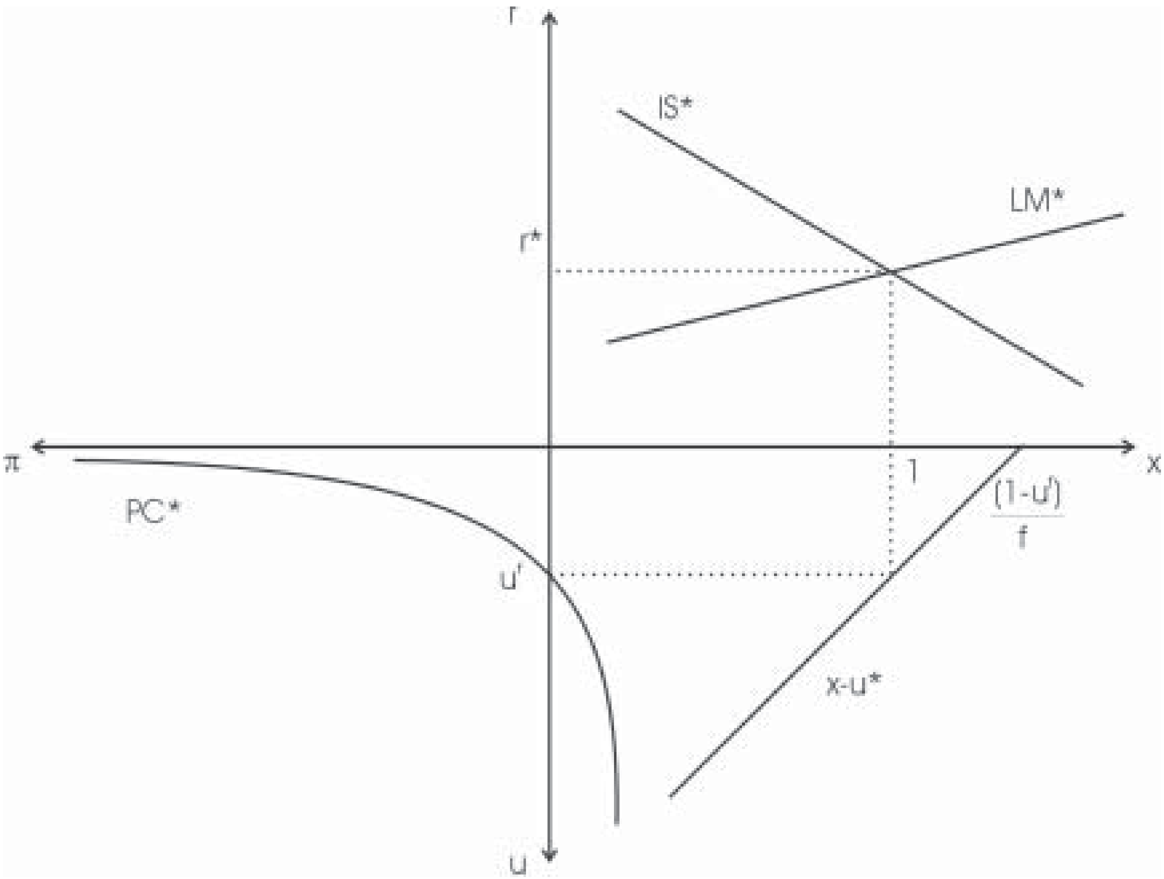

Fig. II.15: The Combined IS-LM, x-u and PC System in Equilibrium

with an *): in the goods- and money-market, in the labour-market (the NAIRU equals the frictional rate) and it shows absence of inflation: the never-never land.

Fig. II.16 shows a situation out of equilibrium, as it was typical for short-run Keynesian analysis: The economy is in an underemployment-equilibrium with stable prices (curves IS_0 and LM_0). Both factors, capital an labour, are underemployed (x_0 and u_0 respectively).

Consider now a permanent increase in government expenditure. We have more demand, more production, a higher rate of capital utilization and more employment. This is shown by a shift of the IS-curve to the right (IS_1). The new (higher) utilization rate is x_1 and the new (lower) unemployment rate is u_1, the new real rate of interest is r_1 (higher).

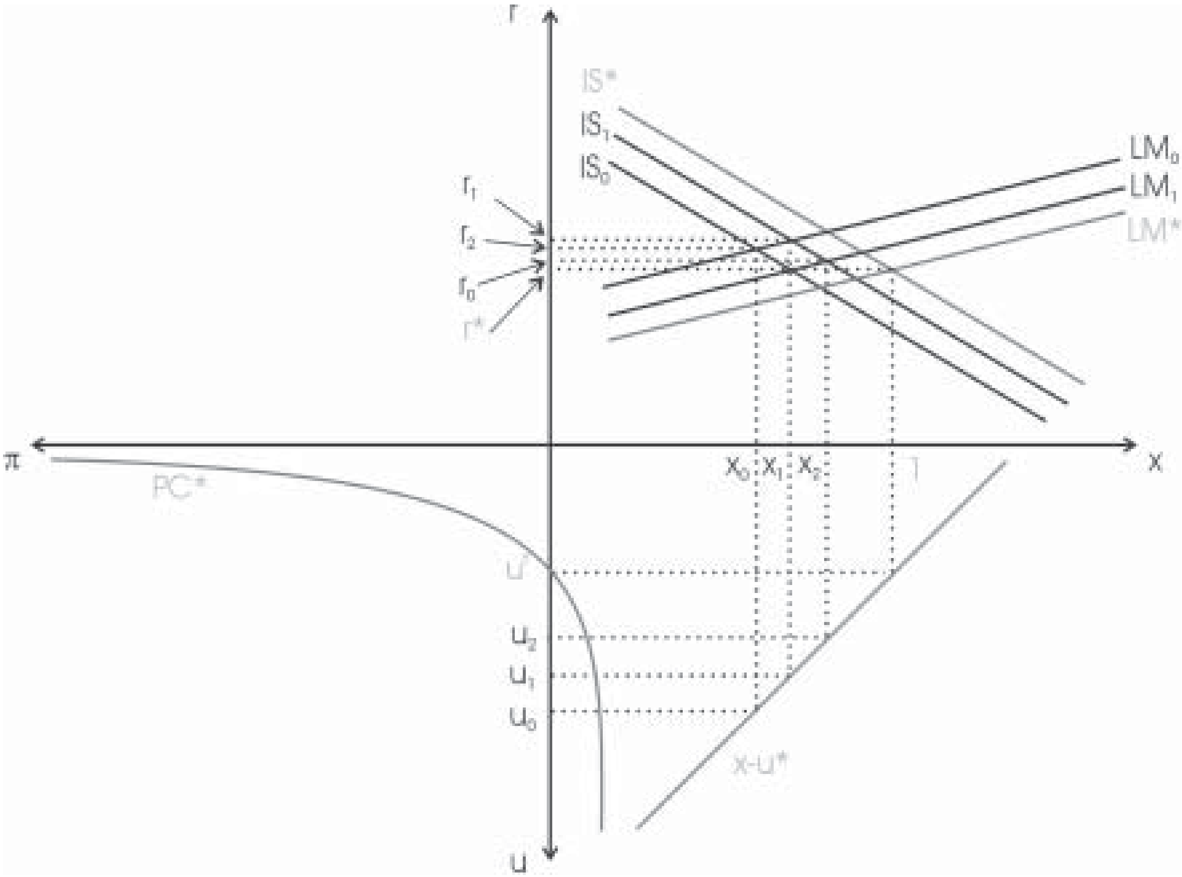

Fig. II.16: Expansionary Fiscal and Monetary Policy in the IS-LM - x-u - PC System:
The Keynesian Case

Suppose now, the central bank expands money supply and thus the LM curve shifts down (LM_1). The real rate of interest is reduced (r_2), demand, production and employment are even more up. The new situation is described by a higher rate of capital utilization (x_2) and a lower rate of unemployment (u_2), both closer to their equilibrium values as is the new real rate of interest (r_2). Now we are very close to the dreams of stabilization-policy makers of the 1960s: Just tune fiscal and monetary policy fine and you can reach the overall equlibrium.

There is no over-utilization and no rising tensions in the goods- and labour-market that could drive wages and prices up. The Phillips Curve is in its equilibrium position and the inflation rate is not really affected by these policies. Indeed, our story sounds like a fairy-tale.

But what makes the difference between our fairy-tale and the real world? First, there is a row of factors that can be neglected in a model but not in reality: uncertainty, lags, political issues. Uncertainty means that we do never know, what the actual situation of the economy is. To raise statistical data takes time and the data have lots of mistakes. Annother branch of uncertainty is that we do not know whether our model is qualitatively correct and even if it is, whether it will be quantitatively. Lags describe that it takes time to make decisions and to implement stabilizing measures. The economic situation might turn during these processes. On top of this political considerations may lead to a timing of stabilization policy consistent with electoral cycles and not with the bussiness cycle.

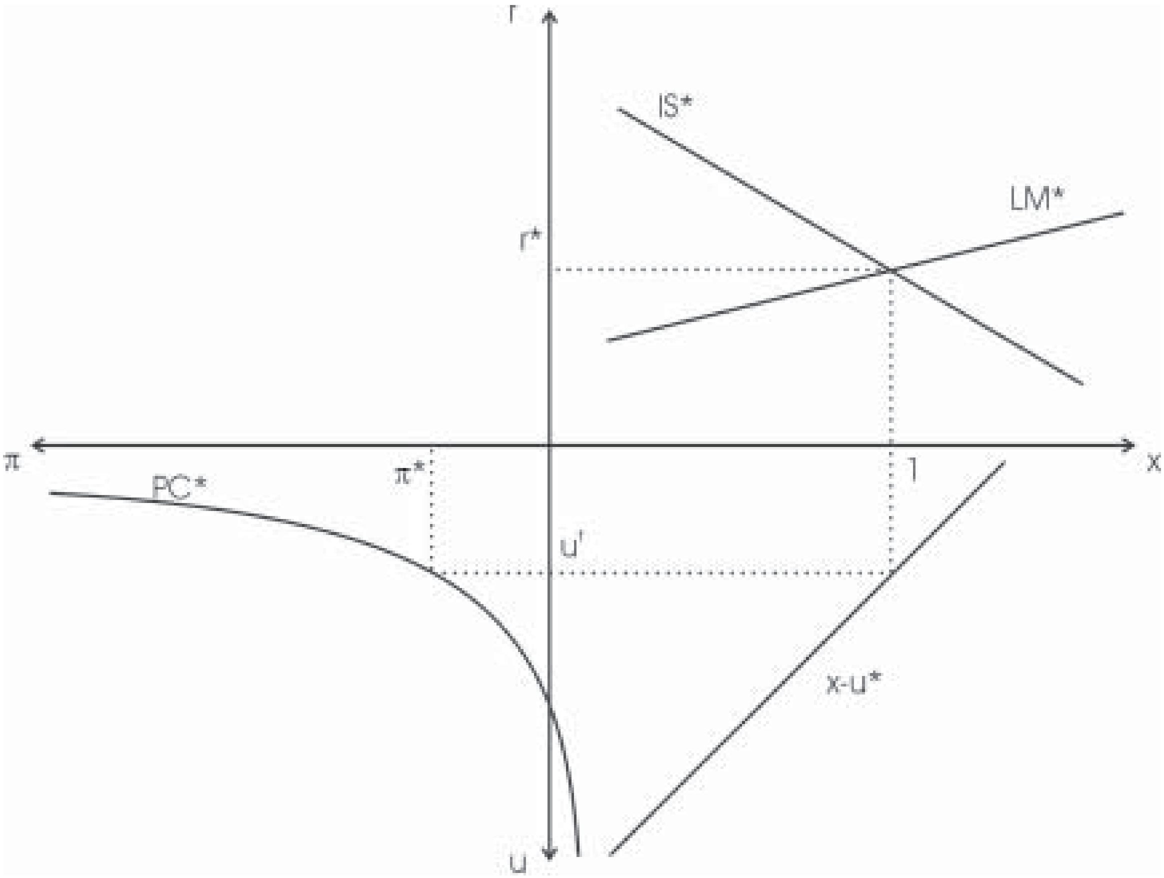

Fig. II.17: The System with Inflationary Bias

Second, we have to qualify our placing of the Phillips Curve. In the real world there is no unique labour-market but but there are different segements according to profession, educational level etc. In each of these labour-market segments the reaction to changes in the relation of demand and supply is asymmetrical: when labour-demand exceeds supply (nominal) wages go up, in the opposite case nominal wages usually do not go down. Even in a recession some segments of the labour market will have excess demand so that wages do go up there while in the bulk of the segments wages do not go down. Assuming target-return-pricing, prices will follow wages on the aggregate level. This „inflationary bias“ leads to rising prices even when on the makro-level the labour market is ballanced, i.e. the rate of unemployment equals the frictional rate ($u = u^f$). Although we do not have stable prices but an inflation rate π^* people do not adjust their inflation-expectations because they recognize diffuse signals: some prices go up, some down, new products have better quality and cost more than those they replace (Fig. II.17). As long as expectations need not be corrected the Phillips Curve will not move.

Now let us look at the ideal situation for Keynesian-style demand management. Fig. II.18 shows us a situation with an underemployment-equilibrium in the goods-market (IS_0). The rate of capital utilization is below unity and the unemployment rate is above the frictional rate. Potential output restricted by capital equals that restricted by labour ($QP^C = QP^L$, i.e. f = 1). The rate of inflation is lower than it's equlibrium value. To restore equilibrium an expansionary fiscal policy is needed, i.e. graphically a policy to shift the IS-curve to it's overall equilibrium position. The rate of capital utilization is lifted to unity, unemployment reduced to it's frictional level and inflation goes up to it's equlibrium value. This is the textbook-case for fiscal policy. In this argument the influence of changing prices on real wealth, the IS- and LM-curve are neglected.

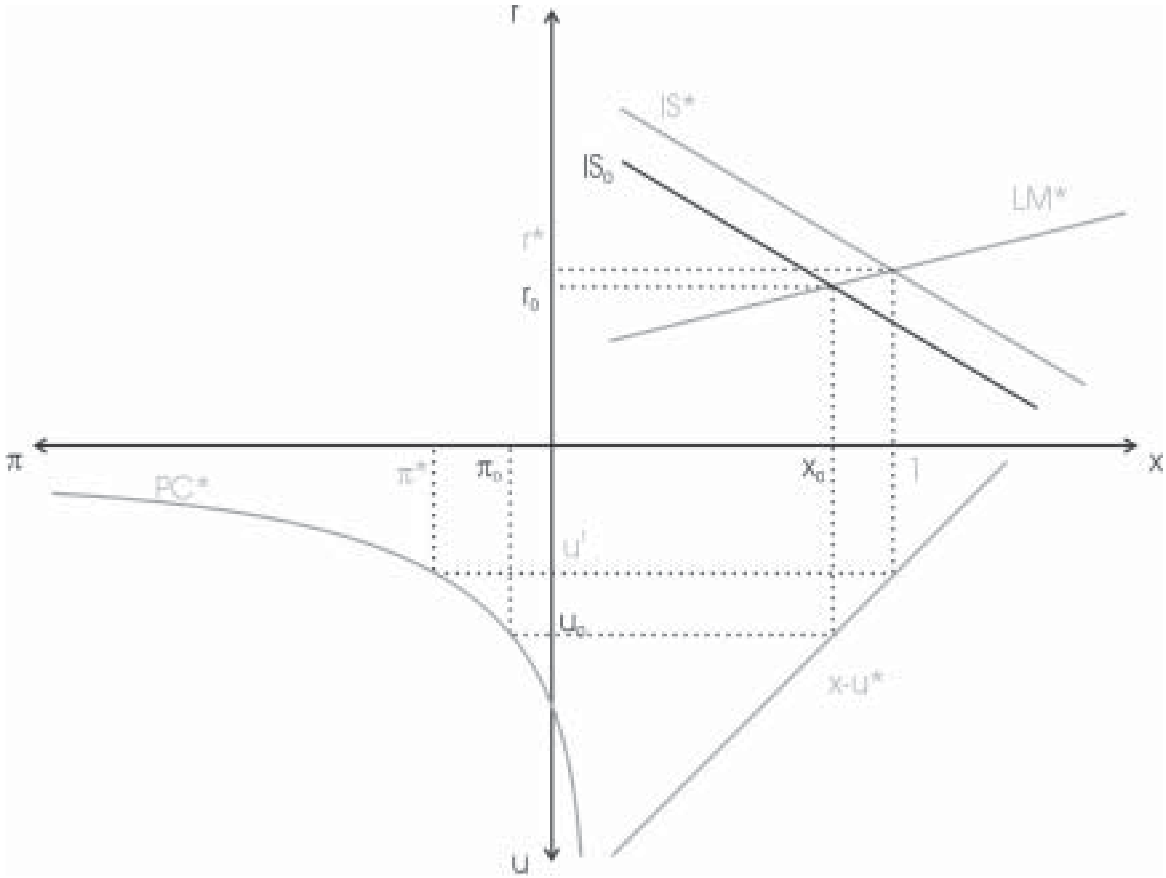

Fig. II.18: Expansionary Fiscal Policy in the IS-LM - x-u - PC System:
The Keynesian Case with Inflationary Bias

Now suppose, we start in a situation with a Phillips Curve out of its equilibrium position (e.g. due to past inflation experience). Actual unemployment is $u_0 > u^f$, the utilization-rate is $x_0 < 1$ and the inflation-rate is $\pi_0 > \pi^*$ (see Fig. II. 19). A permanent increase in government expenditure (graphically a shift of the IS-Curve from IS_0 to IS_1) rises the rate of capital utilization (x_1) and lowers unemployment (u_1). As the Phillips Curve PC_0 is valid, workers adjust their inflation-expectations and demand for higher wages which are transmitted to higher inflation (π_1), i.e. the Phillips Curve shifts to PC_1. Unemployment is back to u_0 and capacity utilization to x_0. As a result fiscal policy has not reduced unemployment but raised inflation.

The adjustment of expectations takes time. But as long as capacities are underemployed there is no reason for net investment and thus a rise in the capital stock that rises potential output and creates new employment. All in all this is a crude description of what happened during the 1970s and discredited Keynesian policy.

But the Phillips Curve not only moves horizontal. We also observe vertical movements, i.e. movements in the NAIRU. Gordon's (1997, p. 14) triangle model of inflation incorporates supply side effects. In his empirical work on the „Time Varying NAIRU" he offers labour militancy and union's strengh as reasons for movements of the NAIRU (Gordon 1997, p. 30). As trade-unions care for those who have a job („insiders") and not for those who do not („outsiders"), they are not willing to accept lower wages for their membership („hysteresis", e.g. Franz/Gordon 1993, pp. 720f, Stiglitz 1997, p. 8). In their 1997 paper Phelps and Zoega (p. 288) found some empirical evidence that changes in the labour force have influence on what they call the natural rate (u^n) which is our NAIRU. In Germany the inflation rate shows a stable relationship to capacitiy utilization and wages, but no feedback from unemployment on wages (Franz/Gordon 1997, p.751). This means that all non-cyclical unemployment

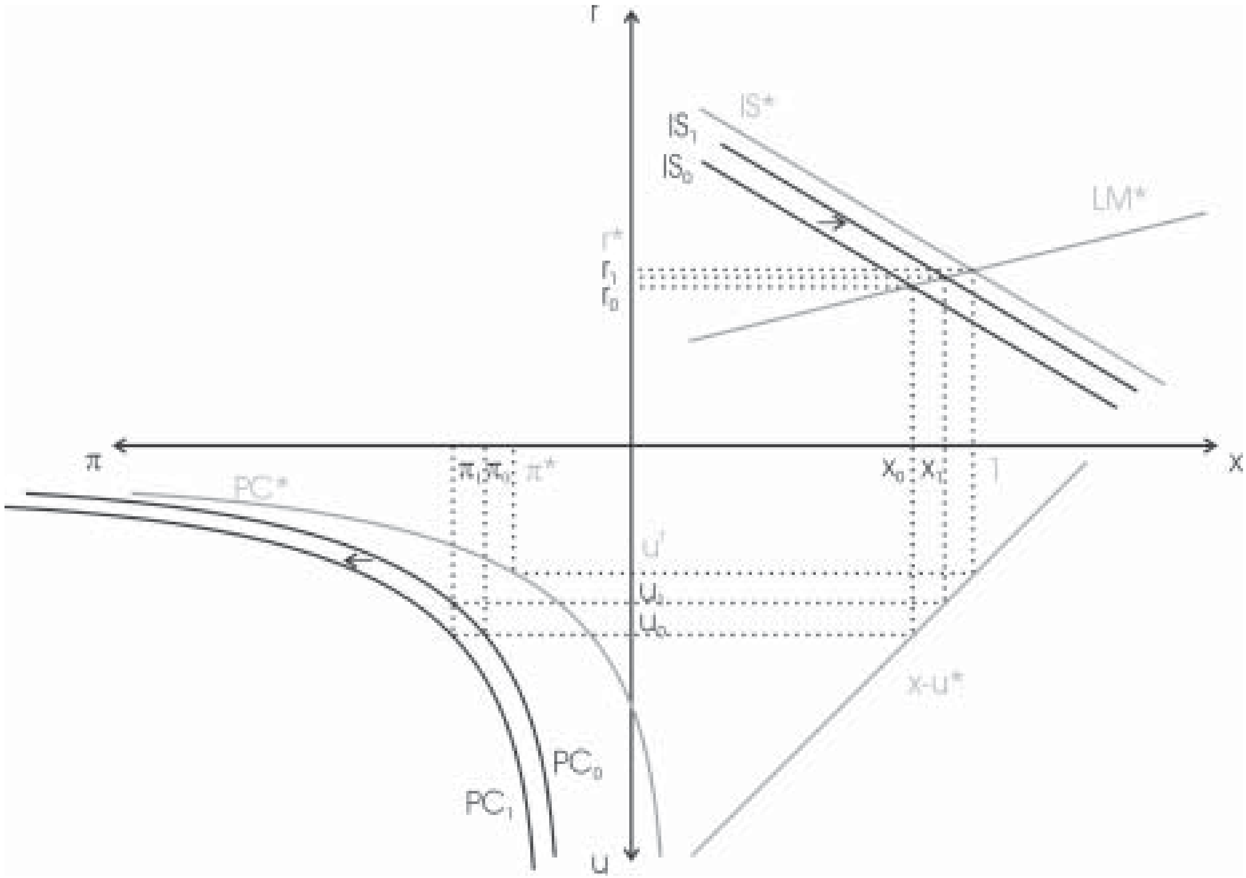

Fig. II.19: Expansionary Fiscal Policy in the IS-LM - x-u - PC System:
When the Phillips Curve Has Moved

moves the (German) Phillips Curve: the NAIRU (or u^n) is the sum of frictional (u^f) and structural (u^c) unemployment ($u^n = u^f + u^c$).

What moves the NAIRU respectively the natural rate? Clearly it is f, the ratio of potential output restricted by capital (QP^C) and potential output restricted by labour (QP^L). The larger the difference between the potential outputs ($QP^C < QP^L$), i.e. the lower f, the higher is the NAIRU. If both potential outputs coincede (f = 1) the NAIRU is the rate of frictional unemployment (u^f). With the NAIRU the Phillips Curve moves up and down the u-axis. As we already have seen, changes in inflation-expectations shift the Phillips Curve vertical to the u-axis.

II.4 Monetary Policy Function

Our system is closed by a monetary policy function which describes the behavior of the central bank. When inflation goes up, the central bank rises her interest rates. How tough she reacts is described by the slope of the MP- curve: the steeper the curve, the tougher her reaction. If she reacts 1 : 1, i.e. rises nominal interest rates by 1 percentage point when the inflation-rate increases 1 percentage point, the real rate of interest is unchanged. Indeed, the European Central Bank watches the short-term real rate as an indicator for the monetary policy stance (ECB 2004, p. 57). In Fig. II.20 we plot the MP-curve in a space with the inflation rate (π) on the horizontal axis and the nominal (R) and real (r) rate of interest on the vertical axis.

In reality central banks set refinancing conditions for private banks and thus short-term nominal interest rates. To close our system we need the long-term real rate that is on the axis of the IS- and LM-curves. Thus what we plot is the long-term nominal rate as it is the result of central bank policy and the transformation of the short-term rate through the banking system into a long-term rate. The

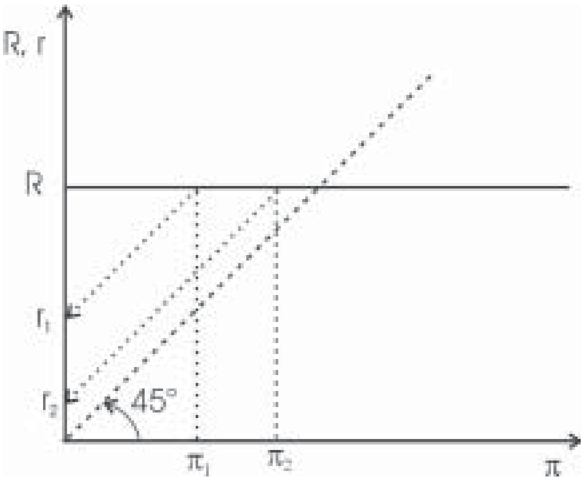

Fig. II.20: The Transformation of Nominal Rates to Real Rates

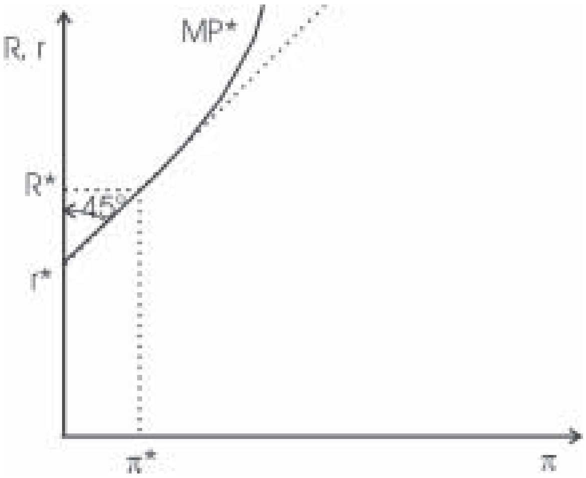

Fig. II.21: The Monetary Policy Function

slope of the MP-curve is the result of both: the setting of short-term nominal interest rates by the central bank and the transmission of these short-term nominal interest rates to nominal long-term interest rates by the banking system. The transformation of the nominal long-term rate to the real long-term rate is easily done in our graphic: A 45°- line transforms nominal rates into the real rates.

In our graphics as a standard we assume the following policy of the central bank: As long as the inflation rate is not substantially higher than the target rate of inflation π^*, which is that rate of inflation people observe as normal and does not give impulse to expect higher inflation (i.e. a higher rate of price changes), the central bank tries to keep real rates constant. Above that she sees dangers

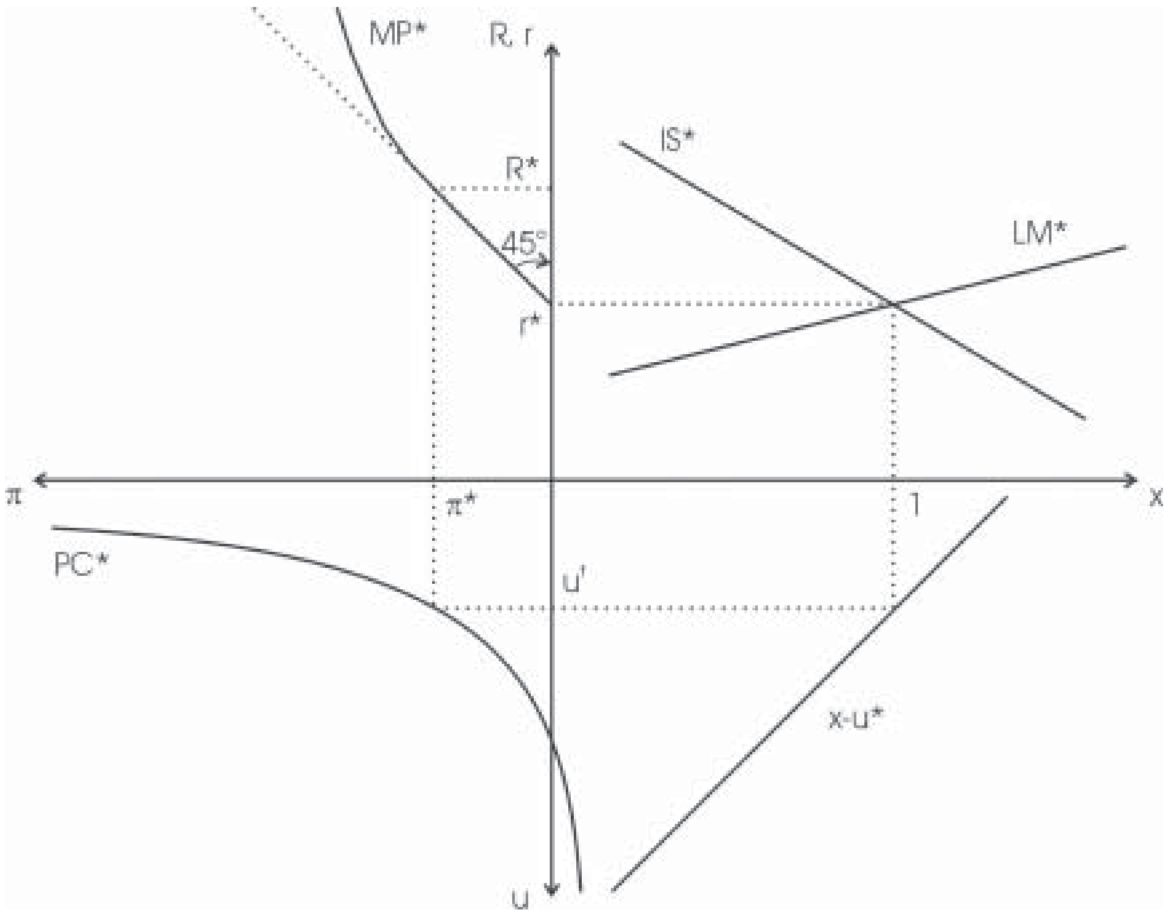

Fig. II.22: The Full System

from inflation and reacts with increasing elasticity: the policy function gets steeper and steeper (Fig. II.21). Where is the point of change from inflation elasticity of interest rates of one to higher? This certainly depends on historical factors: the independence of the central bank, the credibility of the central bank, the latest history of inflation, and the state of the economy.

Applying our framework, here is the largest room for intuition of the user.

Our last step to complete our graphic representation is to mirror the MP-graph at the r/R-axis and fit it into our system (Fig. II.22). Now we have all four quadrants filled and can start our analysis in a closed system.

Again we assume a situation of under-utilization of potential output (the utilization rate x is below unitiy), both potential outputs beeing equal (i.e. $QP^L = QP^C$, or f =1, i.e. the NAIRU equals the frictional rate u^f), and the IS-curve and the LM-curve in a short-run equilibrium position (see IS_0 and

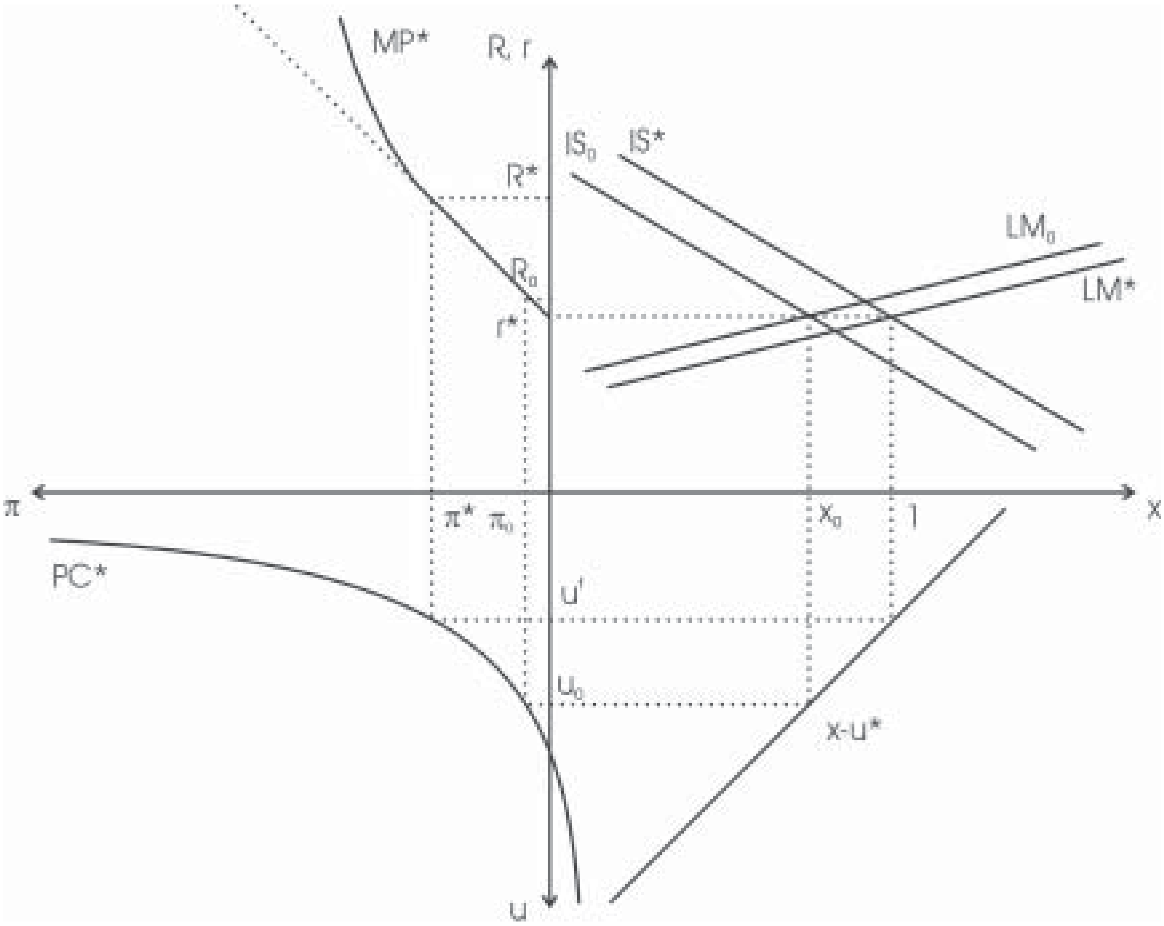

Fig. I.23: Fiscal Policy in the Full System

LM_0 in Fig. II.23). To reduce unemployment the fiscal authorities rise government spending. As well-known the utilization rate rises (the IS-curve is shifted to the right), more labour is needed, thus unemployment goes down. As unemployment is above the NAIRU, there is no pressure on prices and wages and no inflation-expectations arise. Nominal interes rates are adjusted to keep real rates constant (graphically: the LM-curve shifts down). As a result the overall equilibirium is reached. This is the text-book case for Keynesian demand management and our completed presentation of the fairy-tale we mentioned above.

III. Some Comments on Open Economy and Growth

So far we have presented our framework for a closed, not growing economy. In the real world economies are open, i.e. there are trade and capital flows between them and they are growing - most the time. In this chapter we discuss how international interactions and growth have influence on our framework and the results of our analysis.

III.1 Open Economy

Open economy variables such as exchange rates, international capital flows, foreign interest rates or world trade do not enter our model directly. But they may have an influence if the slopes or positions of our curves are affected by them.

At the beginning we have to define the crucial condition: The exchange rate regime and the size of the (domestic) economy. Assuming fixed exchange rates and a small economy (i.e. an economy that does not dominate the international capital market) means that the central bank cannot control the supply of money. To defend the exchange rate, it has to adjust the money supply accordingly. The domestic interest rate is the world interest rate plus the expected inflation-rate (interest parity). For the major economies this is not a realistic setting. The major currencies float against each other and no economy dominates world capital markets. Thus we shall assume flexible interest rates and a (fairly) small economy.

With flexible exchange rates the central bank has control over the domestic money supply. But this means that there is a new channel of transmission: the exchange rate. We have to analyse, what this means for the use of our instruments of stabilization policy.

The IS-curve represents the geometrical locus of all combinations of the long-run real interest rate and the utilization rate of capital where supply of goods equals demand. Both are affected in an open economy: Foreign demand, i.e. exports, and foreign supply, i.e. imports, are part of domestic GDP. An expansion abroad rises exports and thus shifts the IS-curve to the right as does an increase in government expenditure.

Imports usually depend on domestic demand. A rise in demand e.g. as an effect of expansionary fiscal policy, rises domestic production and imports. Thus the effect of that policy on domestic output and the rate of capacity utilization is lower than in a closed economy. Graphically this means that given the same impetus from fiscal policy, the IS-curve in an open economy shifts less than in a closed economy. It is well kown from textbooks that due to leakages in the form of imports the multiplier in an open economy is lower.

What about monetary policy? If the central bank reduces interest rates, we have the well-known effects on private consumption and investment: consumer credits get cheeper and more investment-projects pass the rentability-test. In an open economy we have an additional effect: with flexible exchange rates (as we know, with fixed exchange rates there is no autonomous interest policy of the central-bank) lower domestic interest rates make domestic financial assets less attractive and capital flows out. The demand for domestic currency is reduced, the exchange rate depreciates and thus raises net exports. This is a third channel with an expansionary effect on domestic GDP. The same reduction of the interest rates in an open economy has a larger effect on capacity utilization than in a closed economy. Graphically this means that the IS-curve is flatter.

This is the well-known Mundell (1961, 1963)-Flemming (1962) result: Under flexible exchange rates fiscal policy is less and monetary policy is more powerful in an open than in a closed economy.

What happens to our LM-curve? Changes in the exchange rate have influence on the price level: A depreciation of the home currency rises import-prices of both: final goods and intermediate goods or raw materials for production. The first directly enter the price index for investment and consumer goods, the latter may result in higher costs of production and thus producer prices and enters final prices indirectly. A higher price level means a reduction in the real supply of money and thus an upward shift of the LM-curve.

The x-u relation is affected as soon as the exchange rate changes prices for goods (intermediate or raw materials) that are used in the production process. With rising prices for imported production-factors, either substitution has to take place or, if the processes are putty-clay, parts of the capital stock may become unprofitable to be employed and will leave the production process after some time. This means a reduction of capital-restricted potential output and a widening (or closing) of the gap between the two potentials. As we know this changes the slope of the x-u relation.

The Phillips Curve moves with changes in expectations and the NAIRU. Informed agents know that a depreciation results in rising import prices and more export demand. The first gives reason to expect rising prices and the latter to expect rising tensions on the goods-market (unless capacity utilization is well below unity). Qualitatively this is true. How large the effects will be quantitatively and how much the curve will move is a matter of the specific situation.

The position and slope of the MP curve is the result of the interpretation of the central bank policy. Open economy considerations are to enter that process of interpretation. Thus changes of the exchange rate have no direct impact on the position and slope of the MP curve.

All these considerations and others that might be made as well show that in an open economy there are additional transmission channels and the positions and slopes of some curves are different compared to a closed economy. But none of the curves is altered in a way to make our framework obsolete. To plot the curves is a matter of the specific situation, i.e. the economy and the point of time.

III.2 Growth

What about growth? Suppose our economy was on the steady-state growth path. What would change in our framework? Nothing. All our variables are stationary. Interest rates, capacity utilization, unemployment rate and inflation rate: none of these variables changes on the steady state growth path.

What happens if the economy is not on the steady-state path - as in the real world it is usually? The IS and LM curves represent short-run equilibria and are not affected by long-run disequilibria. The x-u relation is affected as soon as the two potentials differ, so long-run disequilibria are catched in the slope of the x-u relation.The Philips Curve moves as soon as the inflation rate is long enough out of its steady-state value to change expectations or the NAIRU changes due to differences in the potential outputs.

All this can be taken into account in our framework. As simple as the graphics look, to handle it deserves a lot of experience and intuition. It is not for quantitative analysis but just for qualitative analysis. It compares different states of the economy, but shows no time paths. It is an instrument of analysis and needs for stabilization policy. It can tell us what has to be done, but not how much, when and for how long.

IV. Historical Applications

In answering to our first question, we have seen that our framework is usable to describe stabilization policy in a comparativ static manner. To test the usefullness of our framework to give informations for stabilization policy, we apply it to historical situations. We choose three interresting points in German economic history: The years 1975 (after the first oil-price crisis), 1980 (after the second oil-price crisis) and 1989 (the last year before unification). Surely the theoretical knowledge especially in 1975 was different from today's. Nevertheless this exercise may give us some insight in the usefullness of the framework. The data we use are taken from the Sachverständigenrat (2004), the SYSIFO-database (Westphal 1988b), and supplemented with own calculations.

The plots in this chapter are not the result of empirical studies. The equilibrium situation we plot is pure fantasy. The slopes of the curves and the equilibirum-values (as far as they are not derived from theory) are not empirically tested. These equilibirium curves and values serve as reference for the curves we plot for specific years. With other words: We do not know the Phillips Curve (or the other curves) of year Y, but we have arguments where it's position was in relation to the equilibrium Phillips Curve (or the other equilibrium curves). Describing these disequilibria and analysing the reasons for it, is the starting point for recommendations how to come closer to equilibrium.

IV.1. 1975

In 1975 the German economy was on a cyclical downswing. Because of rising inflation and inflation-expectations fiscal and monetary policy turned restrictive in 1973. After two years of deficit the federal budget was in surplus in 1973 and the Bundesbank raised the money market rate from 4.3 % in 1972 to 10.2 % in 1973. These contractive actions were amplyfied by the income transfer to the OPEC because of rising prices for crude oil.

We sketch the beginning-of-1975-situation in Fig. IV.1. As reference we plot the equilibrium-case as known from Fig. II.22. As a result of the contractive monetary and fiscal policy the LM-curve had shifted upwards and the IS-curve to the left. Due to rising expected inflation in the years before 1975 the Phillips curve had moved to the left. We draw the MP-curve flatter than the equilibrium curve, because in that time the Bundesbank was not that tough on inflation as later. As most production technique is putty-clay the rise in energy-prices made some part of the capital stock unprofitable and potential output restricted by capital was reduced (at least it's growth-rate). Workers lost their jobs and structural unemployment (u_c) rose. Graphically this means that the x-u relation turned a little right and the Phillips Curve shifted downwards due to a rise in the NAIRU.

Stabilization policy reacted and turned expansive: The budget-deficit climbed to unprecedented hights and the money market rate went down to 4.4 % during 1975. This was demand management in the Keynesian way: Raise demand by government expenditure (up 14.6 % in 1975) and lower interest rates. In terms of our graph: shift the IS-curve to the right and the LM-curve down. This is what the north-east quadrant of our graph suggests.

And the result? From theory we know today: In the short run higher employment and more inflation and in the long run higher expected inflation (the Phillips Curve shifts farther out to the left) and more unemployment as real wages do not sink (enough). Indeed, due to inflation-expectations the difference between short-term and long-term interest rates increased by some 4 percentage points and narrowed only slowly during the following years. During the second half of the 1970s the Bundesbank was able to keep short-term interest rates low only because the DM enjoyed a substantial appreciation due to the weakness of the US-$. Otherwise a reduction in inflation-expectations could not have been reached without higher interest rates.

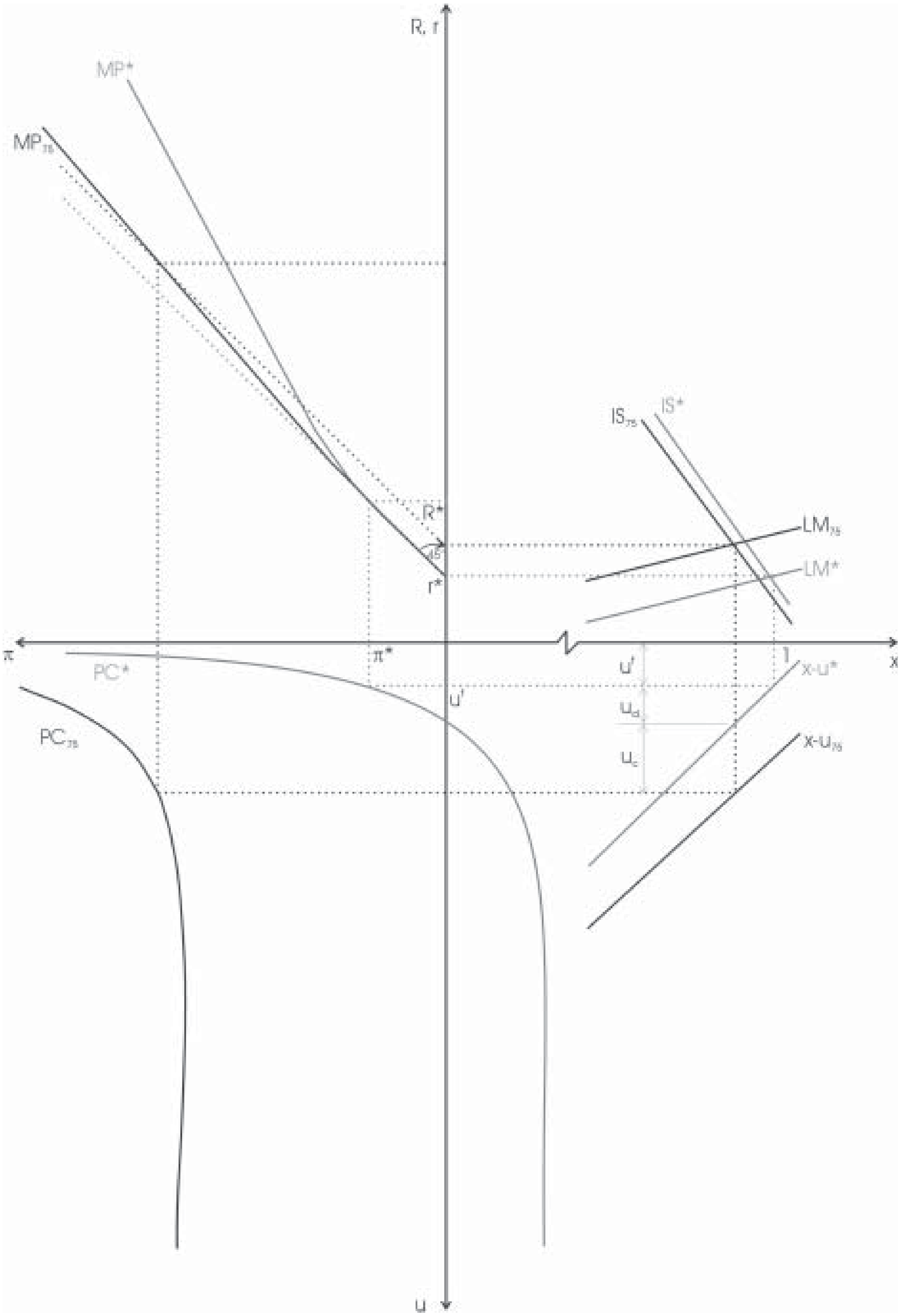

Fig. IV.1: The German Economy in 1975

But what stabilization policy to recommend, if the whole framework is considered? Compared to equilibrium the Phillips Curve is too far out left and the x-u relation had turned right. This means that inflation expectations are too high and there is need to reduce the user costs of labour in relation to the user costs of capital, i.e. reduce real wages not only temporarily but lastingly. So monetary policy has to turn tough (or at the beginning of 1975: stay tough) to reduce inflation and inflation-expectations. As far as unemployment stems from lack in demand, fiscal policy could raise demand to reduce this partition of total unemployment. At least it should act as an automatic stabilizer, i.e. accept the deficits arising from unemployment and not to raise unemployment contributions and thus put additional costs on the factor labour. To reduce the structural partition of unemployment relative labour, costs have to be reduced. As wage policy is not conducted by the government nor by the central bank, both have to convince those responsible for wage policy (i.e. trade unions and employers) that they also have a responsibility for employment.

IV.2. 1980

When the second oil-price crisis (1979/1980) hit the German economy, it was in an upswing. The statistics show a still high inflation (5.4 %), low unemployment (1.7 % of total labour force), a rate of capacity utilization above the normal and high long-run interest rates (8.6 %). A high premium on long-term assets indicates persistend inflation-expectations.

To prevent inflation after the second oil-price shock the Bundesbank raised interest rates during 1979 (the money-market rate rose from 3.1 % at the end of 1978 to over 9 % in mid-1980). Although the labour force was growing, high investment in capital goods during the second half of the 1970s created enough jobs to keep unemployment in a reasonable range. Nevertheless potential output restricted by capital grew slowlier than potential output restricted by labour. As real labour costs were still rising, factor substitution kept to run into the wrong direction. Rising energy-costs as a result of the explosion of crude-oil prices surely had an influence on the capital stock. Again, as in 1974/75, some machinery was no longer profitable and left the production process. Thus capital restricted potential output was c.p. reduced while labour restricted potential output was not.

In terms of our framework this means that at the beginning of 1980 the IS-curve lay to the right of its equilibrium position ($x > 1$) as real GDP was above potential GDP. The long-run real rate of interest was some .5 percentage-points higher than 1975 indicating a further upward-shift of the LM-curve. This shows a policy-mix of expansive fiscal and very restrictive monetary policy. Consequently we draw the MP-curve steeper. As monetary policy tried to reduce inflation-expectations fiscal policy tried to keep unemployment on reasonable levels. The costs of this policy-mix were high fiscal deficits which were aggraviated by high interest payments of the government.

The Phillips Curve still was left of its equlibrium position, the x-u relation had turned right from its equilibrium position indicating structural unemployment. Thus, overall unemployment was less than the sum of frictional and structural unemployment because of high demand. In other words: the cyclical partition of unemployment was negativ (see Fig. IV.2).

How did stabilization policy react in this situation? The Bundesbank kept interest rates high to reduce inflation and inflation-expectations. Fiscal policy faced enormous fiscal deficits and had learned from the 1970s that activist fiscal policy produced high inflation and high budget deficits without reducing unemployment lastingly. Thus in a situation with comparably low unemployment the growth of government spending was reduced (from 8 % in 1980 to 2.5 % in 1983) and the budget deficit trimmed. Fiscal policy turned restrictive as was monetary policy.

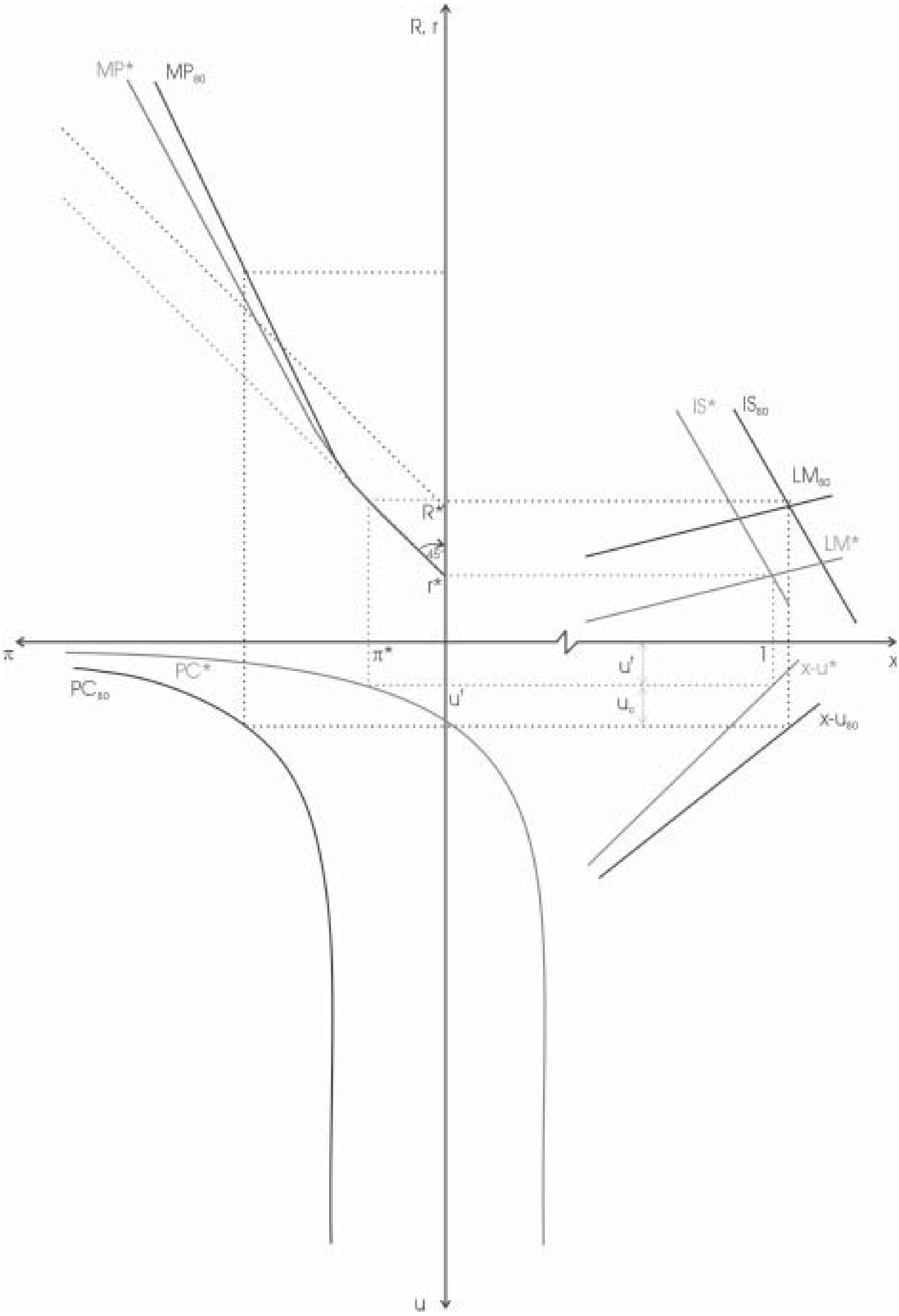

Fig. IV.2: The German Economy in 1980

All in all this stabilization policy was in terms with the recommendations our framework suggests. Even real wages sank in 1982/83 but that was not enough to turn the process of factor substitution arround. Unemployment grew to up to then unknown hights due to two reasons: The first is contractive stabilization policy by the Bundesbank and by the fiscal authorities, the second is a rising potential labour force for demographic reasons. With rising unemployment especially because of the demographic shift the substitution requirement grew further, i.e. the x-u relation kept turning right.

IV.3. 1989

1989 was the last year before unification. Stabilization policy during the 1980s was successfull insofar as inflation and inflation-expectations were reduced (inflation was 2.8 % in 1989 and the premium for long-term assets was some half percentage point). Capital utilization was normal and even the government budget was in ballance (with a slight surplus in 1989). Unemployment was sinking, but still on a high level. Monetary policy still was restrictive (money-market rate 6.6 %) and the real long-term interest rate (4.3 %) was high on historical standards.

Due to a growing labour-force the gap between capital restricted and labour restricted potential had widened further. Additional, factor substitution still ran into the wrong direction. The problem of too high real wages was amplyfied by a rising wedge between labour costs and employee's take home due to rising fees for social security. With the gap between the two potentials the NAIRU had risen.

In terms of our framework: Because of the willingness to reduce inflation and inflation-expectations the Bundesbank kept real interest rates above the natural level (ECB 2004, p. 63) so we draw the MP-curve steeper than in equilibrium. Consequently the LM-curve had moved up and normal capacity utilization could only materialized because the IS-curve had shifted to the right. This shift to the right was not the result of deficit spending (the government budget was slightly in surplus) but of high foreign demand. The current account reached a historical high (4.8 % of GDP). The rising gap between the two potentials (i.e. the rising NAIRU) is represented by a right-turn of the x-u relation. With lowering inflation and inflation-expectations the Phillips Curve shifted closer to its equilibrium position but because of the rising NAIRU it also shifted downwards (Fig. IV.3).

And the poliy recommandations? The main problem still was the gap between the two potentials. In other words: there still was a high substitution requirement. Monetary policy does not have the instruments to force factor substitution into the right direction. What fiscal policy could do - at least in times of budget surplusses - is to reduce the wedge by lowering social security contributions. But the work also has to be done by those responsible for working condition: employers and employees (i.e. the trade unions).

The target of reducing inflation and inflation-expectations was nearly reached, so the Bundesbank could have reduced it's interest rates and thus shifted the LM-curve closer to the equilibrium position. Fiscal policy suffers most from international integration: with a rising marginal propensity to import the multiplier is reduced. A proper reaction is to co-ordinate stabilization policy internationally with some possible gains in effectiveness (Stark-Veltel 1984, pp. 209 - 231). Indeed the Maastricht-treaty and European integration followed this path.

These three examples for historical situations show that our framework can be used to describe them in a compact manner. The graphical presentation makes obvious where the problems lie and the knowlegde of what moves which curve how is the basis for policy recommendations. As a framework that incorporats the IS-/LM-curve, the Phillips Curve, the x-u relation and a montary policy curve it covers not only monetary and fiscal policy but also wage policy which is the third, but not least important branch of stabilization policy. Thus it is a useful instrument to describe situations and

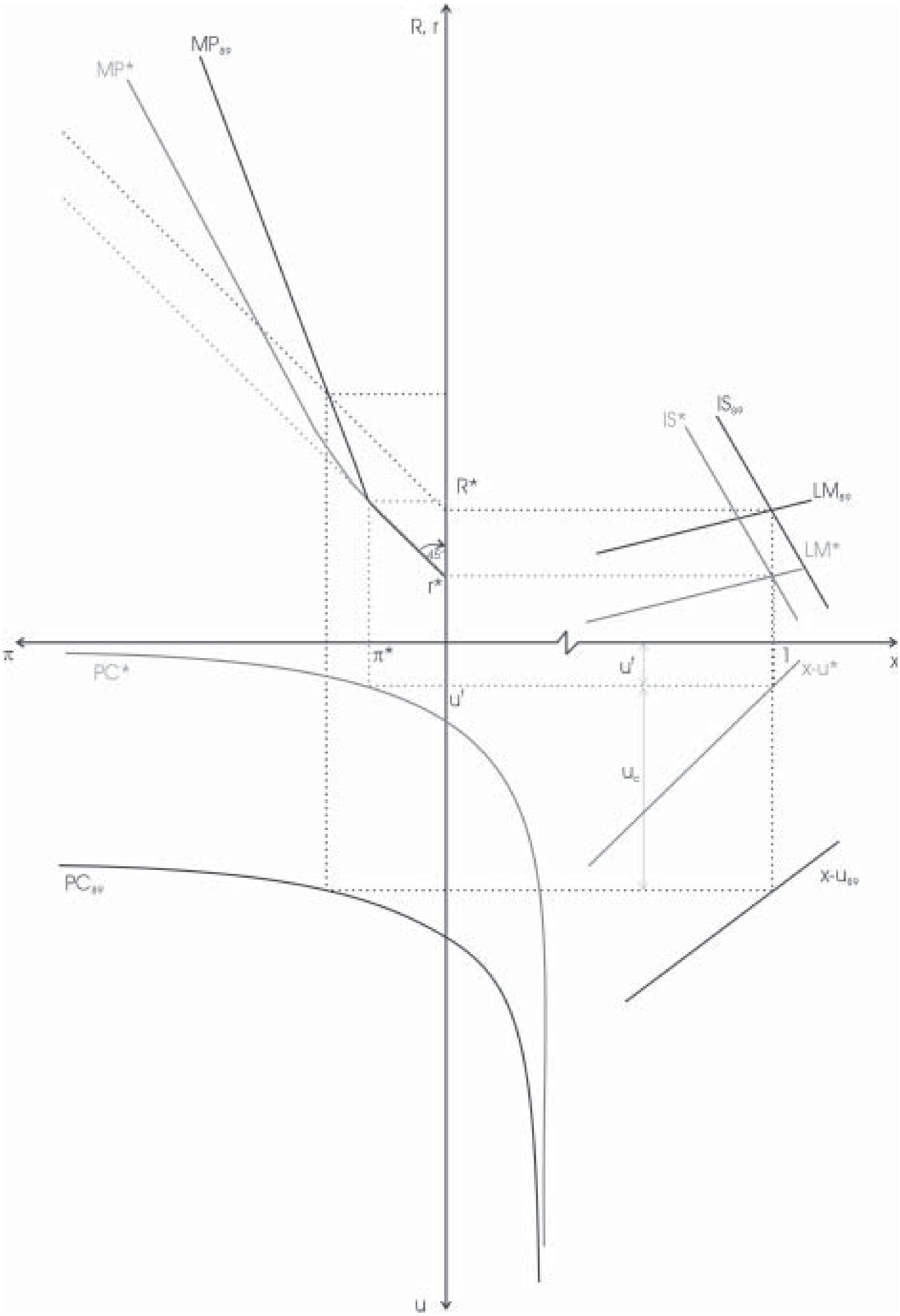

Fig. IV.3: The German Economy in 1989

makes clear which problems' sollutions are most urgend. It gives necessary and useful informations to those who are responsible for stabilization policy - what answers our second question. But it does not show how (i.e. with which intensity) to use which instrument to solve the problems.

V. Contemporary Analysis

Since 1990 two major shocks hit the German economy: Unification with the German Democratic Republic (GDR) and it's socialist economy and the introduction of the Euro which shifted responsibility for monetary policy from the Bundesbank to the ECB. In fact unification means that the old Federal Republic's market economy of some 60 million people has to integrate a centrally planned economy of some 17 million people. Infrastructure, production technique and productivity in the east could not reach western standards by far.

In order to help the eastern part to catch up with the western part several programs were installed. Enormous sums are poured into the east. Alone intergovernmental transfers sum up to some 7 % of GDP each year since unification. As a consequence German debt increased from 900 billion DM (460 billion Euro) to 2300 billion DM (1176 billion Euro) within a decade (Sinn 2000, pp 23 - 24). In spite of this strain, the gap in productivity could not be closed although wages have caught up more. The capital stock in the eastern part has been modernized substantially but there are by far not enough working-places. So the unemployment-rate in the eastern part is nearly double the western parts'.

In preparation for the Euro European governments introduced the so called Maastricht criteria for public debt (deficit not larger than 3 % of GDP and debt not larger than 60 % of GDP), which later were codified in the Growth and Stability Pact. To meet these criteria, fiscal policy throughout Europe turned restrictive. This changed only after the Euro was introduced in 1999 and participation was confirmed.

During the 1990s the central banks of the countries due to come together in Euroland borrowed their credibility from the Bundesbank (Giavazzi/Pagano 1988, pp. 1066, 1069 and Diekmann/Stark-Veltel 1993, p. 59) by accepting the Bundesbank's de-facto leadership. The ECB is eager to build up a reputation as inflation fighter as had the Bundesbank before the Euro became common currency in most countries of the European Community (EC). As a result interest rates in Euroland are higher than proper, at least for countries with high unemployment and low inflation as Germany.

In 2005, some 15 years after unification, Germany still suffers from high unemployment (10.5 %). At the end of 2004 the Sachverständigenrat estimated for 2004 an output gap of 0.5 - 1.1 % (Sachverständigenrat 2004, p. 44), i.e. a utilization rate a bit below the normal. The inflation rate was 1.6 %, a bit lower than the ECB's inflation target of 2 %. The nominal long-term interest rate was 3.7 % what gives a real long-term interest rate of 2.1 %.

In terms of our graphs (Fig. V) this means that the IS-curve is a little bit left of it's equilibrium position. Due to the lack of working places in the east, the x-u relation had turned substantially to the right, shifting up the NAIRU and thus shifting the Phillips Curve down. To build up reputation the ECB keeps interest rates higher than neccessary (from the German point of view), what mens that the MP-curve below the target inflation rate is flatter than the 45°-line. Consequently the LM-curve is above it's equilibrium position.

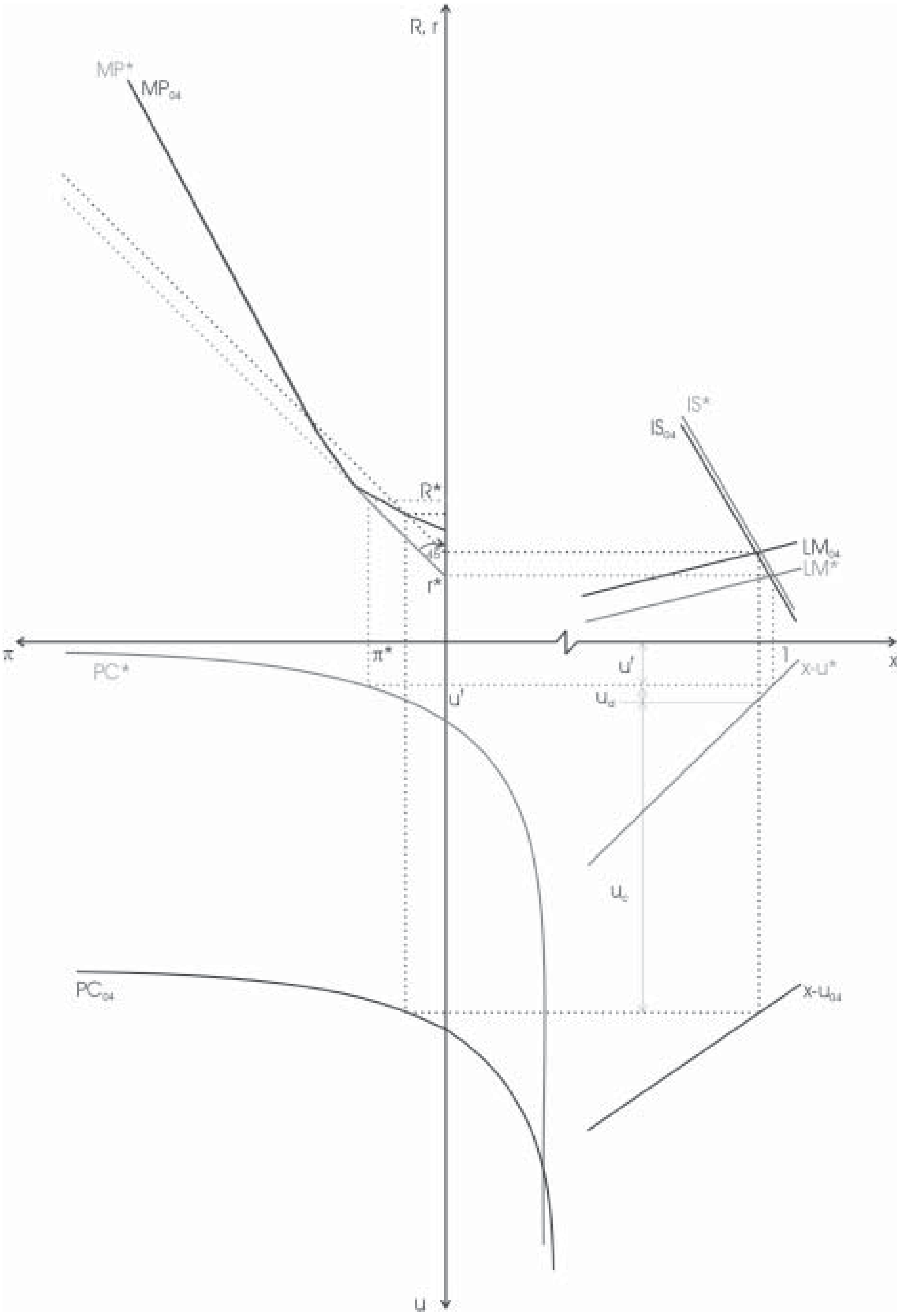

Fig. V: The German Economy in 2004

What to recommend for stabilization policy? Still the biggest task is to reduce unemployment. The graphical decomposition of unemployment shows that the bulk of it stems from missing capital stock. To reduce this capital-labour mismatch, a substantial factor substitution is required. Recent wage contracts allow for sinking real wages and more flexibility on the labour market. If this is a lasting development, factor substitution at last could turn into the right direction although the wedge still is very wide.

In the absence of inflation-expectations worth mentioning, monetary policy could be a bit more expansive as could fiscal policy. The recent appreciation of the Euro against the US-Dollar on the one hand helps to keep inflation low, but on the other hand reduces price-competitiveness of European goods in the non-Euro area. Within the Euro-area the recent moderate wage policy strengthened the German competitiveness. So there is little danger that the IS-curve shifts further to the left - away from it's equilibrium position. From the German point of view the ECB could lower interest rates to stimulate demand, but as the ECB has to conduct it's monetary policy for all Euroland and in some countries (e.g. Ireland, Spain, Greece) the inflation rate is above the target-value. Thus monetary policy will stay too restrictive for Germany.

Fiscal policy faces a different dilemma: To improve the rate of capacity utilization and to compensate for the too restrictive monetary policy, the deficit was to increase. Neglecting the Growth and Stability Pact and taking into account the need for factor substitution, the proper action for German fiscal policy is to reduce income taxes and/or social security contributions. This strengthens demand and uno actu reduces the wedge and thus makes the factor labour more competitive. But the commitment to the Growth and Stability Pact requires a reduction of the since 2002 too high deficit. In other words: To obey the Growth and Stability Pact is at the expense of those unemployed due to lack of demand or working places.

But what about the problems ahead? Beginning arround 2014 the baby boomers will leave the labour force and the potential labour force will shrink substantially. This means that on the one hand the capital-labour mismatch is reduced, but on the other hand the pensions-system will run into enormous financial problems. How to prepare for that? The reconstruction of the social-securitiy system and immigration policy will have effects on the state of the economy, that can be analyzed with our framework, but the answers are beyond the scope of this paper.

VI. Concluding Remarks

All in all the framework proved capable for what we expected: In describing the overall situation of an economy it is an useable instrument to discuss stabilization policy in a comparative static manner. As the positions of the curves relative to their equilibrium positions elucidate the problems of the economy, it gives useful informations for stabilization policy, and it helps to give recommendations what contemporary is the „right“ stabilization policy.

The analysis basically is short-term: the situation in a certain point of time is plotted and compared with a hypothetic equilibrium situation. Thus the method is comparative statics, but the ceteris paribus clause is tempered. As short-, medium- and long-term considerations are mixed up, the movements of the curves over time have to be taken into account, i.e. several exogenous variables change. As presented, it is not able to describe any dynamics. The analysis is completely qualitative and in no respect quantitative.

Although this framework is not empirically fitted to one specific economy, the empirical background is Germany and thus the framework is biased to German structures. This is especially apparent when we focus on the determinants of the NAIRU. The next steps are to apply the framework to other European economies and to analyse wether modifications have to be made. To apply it to the US-economy will maybe an even greater effort, because at least US-wages are much more flexible than the German ones.

The useful lesson of this framework is to describe the overall situation and thus historic or present problems of an economy in a graphical and even for non-economists seizable way. In so far as they do not dispute the underlying pieces of theoretical analysis, even economists could discuss stabilization policy in this simple framework.

SUMMARY

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Symbols

The curves:
IS IS-curve
LM LM-curve
x-u x-u relation
PC Phillips Curve
MP Monetary Policy Function

The axises:
R nominal rate of interest
r real rate of interes
x rate of capacity utilization
u rate of unemployment
π inflation rate

The variables:
Q GDP
QP potential GDP
QP^C potential GDP restricted by capital
QP^L potential GDP restricted by labour
H hours worked
H^S standard hours
L number of employed people
L^F labour force (number of people employed if there is no shortage of capital or demand)
U number of people unemployed because of shortage of capital or demand
U^t total number of people unemployed
U^C number of people unemployed due to lack of capital
U^d number of people unemployed due to lack of demand
U^f number of people unemployed due to frictions
u^n natural rate of unemployment, Non-Accelerating-Inflation Rate of Unemployment (NAIRU)
u^f frictional rate of unemployment
u_d cyclical rate of unemployment
u_c structural rate of unemployment
V volume of labour (in hours)
μ normal labour productivity
ν normal capital productivity

dsv ECO

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