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Government preferences and equilibrium inflation

A simple test of the Barro-Gordon Model *

**Freddy Heylen
André Van Poeck**

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Universitaire Faculteiten St.-Ignatius
Prinsstraat 13 - B 2000 Antwerpen

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ABSTRACT

A typical feature of the current market economies is that they all suffer from inflation to some extent. Nevertheless, there exist remarkable differences among the OECD countries with respect to the rate of inflation. The Barro-Gordon model offers a possible explanation for these differences. It shows that the level of equilibrium inflation in a country depends on (1) the policymaker's relative aversion to unemployment versus inflation; (2) the level of the natural rate of unemployment and (3) the slope of the short-term Phillips-curve.

These insights are tested, making use of cross-section data for average inflation in the OECD in the 1980s. The results show that, for these countries and this period, average inflation is higher in countries with a less independent central bank, a high natural rate of unemployment and a relatively flat short-term Phillips-curve, as predicted by the Barro-Gordon model. Further, participation to the EMS and political stability contributed to moderate inflation.

1. Introduction

A typical feature of the current market economies is that they all suffer from inflation to some extent. Nevertheless, there exist remarkable differences among the OECD countries with respect to the rate of inflation. As table 1 shows, in the period 1980-89, the average yearly inflation rate in the country with the highest inflation (Italy) was five times higher than in the country with the lowest inflation rate (Japan). More recent data confirm the existence of remarkable inflation differences among countries¹.

TABLE 1

The conclusion that inflation is obviously closely connected with the working of the modern economies does not yet offer an explanation for this phenomenon. Sure, in the 1960s the Phillips-curve was able to offer a point of departure : it showed that zero-inflation was indeed technically possible (cf. the intersection of the Phillips-curve and the unemployment axis), yet the extent of unemployment accompanying price stability (although preferable on its own) might be so high that policymaker prefers some combination of lower unemployment and positive inflation.

In the meantime, the academics' and policymakers' beliefs in a stable trade-off between inflation and unemployment have vanished. Nowadays it is generally accepted that unemployment can only deviate from its natural rate when government produces a surprise inflation. A systematic expansionary monetary policy will only result in higher inflation, without any effect on employment.

Against the background of this so-called 'expectations-augmented Phillips-curve' and the 'natural rate hypothesis' the phenomenon of a positive inflation rate comes again as a surprise. After all, if in the long term unemployment cannot deviate from its natural rate and inflation is regarded as undesirable, the only useful (economically optimal) policy is one that is exclusively directed towards price stability. How then can this insight be

reconciled with the observation of persistent inflation ?

Backus and Driffill (1985) offer two possible explanations. The first explanation refers to the 'political business cycle'-theory. According to this view the incumbent political party (or coalition) will start a deflationary policy during the first period of its term of office and then strongly change course in order to engineer a boom before the elections take place, thereby promoting its chances for re-election. All this implies that over the cycle unemployment will not deviate from its natural rate, while average inflation will indeed be positive (assuming that the Phillips-curve is non-linear).

A second explanation that has recently received a lot of attention is the theory of the preference-related equilibrium inflation². According to this view, a policy of price stability is not credible when, along with its preference for price stability, the government has some preference for high employment too. If this policymaker's preference, viz. not being completely insensitive to unemployment, is known to the public and the policymaker is able to follow a discretionary policy, the realisation of price stability is not possible, even though the economy is at its natural rate of unemployment.

The present contribution is exclusively concerned with the last explanation³. In section 2 we expound the theory of the preference-related equilibrium inflation rate. This theory has received a lot of attention since the pioneering publications of Kydland & Prescott (1977) and Barro & Gordon (1983). In the third section we present some econometric results, examining the relevance of the theory of preference-related equilibrium inflation for the observed inflation differentials in the OECD countries during the 1980s. In the last section we briefly restate the conclusions.

2. The Barro-Gordon model

The main point of the Barro-Gordon model is the insight that,

unless government is institutionally committed to price stability, each economy is characterized by a positive equilibrium inflation rate.

The argument runs as follows : assume that the monetary authorities are not completely insensitive to unemployment and that they are willing to tolerate some increase in inflation if this implies a decrease in unemployment (i.e. assume that the policymaker's utility decreases with the level of inflation and the extent of unemployment). This preference is known to the public (assumption of rational expectations). Assume further that the policymaker maximizes a social welfare function, taking into account the working of the economy, viz. the relationship between inflation and unemployment as revealed by an expectations-augmented Phillips-curve based on the assumption of the natural rate hypothesis. This implies that the actual unemployment rate will only differ from the natural rate in the case of a surprise inflation and that the economic subjects make no systematic failures when forming their inflationary expectations. In other words, the actual unemployment rate does not systematically differ from the natural one.

Barro & Gordon show that under these assumptions, although optimal from a social welfare point of view, a policy of zero inflation is not sustainable. The explanation is to be found in the fact that zero inflation, announced and started by a government that attaches a certain importance to employment, is incredible in the public's eyes since such a policy would be, in the terms of Kydland & Prescott, time-inconsistent. An economic policy measure is defined as time-inconsistent if, although optimal today (ex ante) from the point of view of the policymaker, it becomes sub-optimal at a later stage (ex post), after economic agents have adjusted their expectations.

Indeed, as soon as the inflationary expectations of the economic agents have adjusted to price stability, the policymaker has an incentive to renounce his policy of zero inflation and replace it with a policy of positive (surprise) inflation, which yields a rate of unemployment below the natural one. The resulting

combination of inflation and unemployment provides a higher utility level (lower level of disutility) than the combination consisting of zero inflation and unemployment equal to the natural rate.

The rational public knows the government's interest in surprise inflation and its dislike of unemployment (and inflation). The result of all this is that the economy will be characterized by a positive, preference-related equilibrium inflation.

More specifically, this equilibrium inflation rate is the one that goes together with a situation where (1) the public's expectations are realized and the actual unemployment rate equals the natural rate; and (2) the policymaker no longer has any interest in creating a surprise inflation (in this situation, more inflation, combined with less unemployment yields a lower instead of a higher utility level for the policymaker).

The argumentation is graphically illustrated in figure 1. The concave indifference curves I_1 , I_2 and I_3 show the relative preference of the policymaker for inflation and unemployment (the closer to the origin the indifference curve lies, the lower the level of disutility). The figure further shows some short-term Phillips-curves indexed on expected inflation and reflecting the vertical long-term Phillips-curve at the natural rate of unemployment. It is clear that the combination $(p=0, u=u_N)$ is sustainable and optimal from a welfare point of view. Nevertheless, a policy directed towards price stability (point a) will lack the necessary credibility, if the public knows the true preferences of the policymaker and knows that he disposes of the needed discretion to create a surprise inflation. In other words, a policy of price stability is in this situation time-inconsistent and therefore incredible.

FIGURE 1

Starting from the optimal combination in point a, the policymaker has indeed an incentive to originate a surprise inflation of p_1 (point b being on a lower indifference curve). However, since

expected inflation will not systematically differ from actual inflation, the economy returns to the natural rate of unemployment (point c). Again the policymaker has an incentive for surprise inflation (point d). Only in point e there is no longer such a stimulus, while in this point expected inflation also equals actual inflation. The inflation rate corresponding to point e is called the preference-related equilibrium inflation rate.

The level of the equilibrium inflation rate depends on :

- the policymaker's relative aversion to unemployment versus inflation;
- the level of the natural rate of unemployment;
- the slope of the short-term Phillips-curve.

This is first shown graphically and next derived algebraically.

Figure 2 illustrates the influence of the policymaker's preferences on the equilibrium inflation rate. Equilibrium inflation is lower if government has a relative preference for price stability (point a), compared to a government that cares more for employment (point b). In a similar way one can show that the level of equilibrium inflation depends positively on the level of the natural rate of unemployment (compare point a with point b in figure 3) and negatively on the slope of the short-term Phillips-curve (comparison of point a with point b in figure 4 shows that a flat Phillips-curve results in a higher level of equilibrium inflation).

FIGURE 2

FIGURE 3

FIGURE 4

For the algebraic derivation one can use of the following simplified model :

$$(1) \quad p - p_e = \gamma(u - u_N)$$

$$\gamma < 0$$

$$(2) \quad L = 1/2 p^2 + \theta/2 u^2$$

$$(3) p_e = E(p/L_{-1})$$

Equation (1) formalizes the expectations augmented Phillips-curve, with u and u_N being actual unemployment and the natural rate of unemployment, respectively, and p and p_e actual and expected inflation. Equation (2) is a standard quadratic loss-function for the policymaker. The level of disutility increases with the level of inflation (squared) and the level of unemployment (idem), with θ standing for the policymaker's relative preference for low unemployment. The higher the value for θ , the more weight the policymaker attaches to high employment. An alternative explanation for θ , which is used in the empirical part (section 3) is that this parameter reflects the degree of independence of the central bank (Eijffinger & Schaling, 1993b). An independent central bank is assumed to give more weight to price stability, which is reflected in a lower value for θ .

Finally, equation (3) expresses the idea of rationally formed inflationary expectations. Economic agents use all relevant information available at the beginning of the period to form their expectations of inflation (L_{-1}).

The derivation of the equilibrium inflation proceeds by minimizing the loss-function (2), after re-writing equation (1) as :

$$(1') u = [(p - p_e)/\gamma] + u_N$$

and substituting it into equation (2). One obtains :

$$(2') L = 1/2 p^2 + \theta/2 [(p - p_e)/\gamma + u_N]^2$$

Minimization of (2') yields the following first-order condition⁴:

$$(4) \partial L/\partial p = p + \theta/\gamma^2(p - p_e) + \theta u_N/\gamma = 0$$

In deriving equation (4) it is assumed that $\partial p_e/\partial p = 0$, i.e. that the policymaker pursues a discretionary policy, choosing the

inflation rate and assuming that expectations remain unchanged (cf. Barro & Gordon, p. 595).

Finally, considering that, in equilibrium, $p_e = p$ (equation 3) we obtain) the following equation for the equilibrium inflation rate:

$$(5) \quad p = - \theta u_N / \gamma$$

Equation (5) confirms the role of the three previously mentioned determinants of the preference-related equilibrium inflation rate, viz. θ (the relative aversion for unemployment), u_N (the level of the natural rate of unemployment) and γ (the slope of the Phillips-curve).

The Barro-Gordon model has a normative interpretation, since it offers a strong argument for rules instead of discretion. In a regime, characterized by discretion the model also gives a positive explanation for the level of (long-term) inflation. It is this interpretation of the model that lays the foundation for the next section.

3. Inflation in the 1980s: an empirical test

This section presents a cross-section analysis of inflation in the OECD in the 1980s. The Barro-Gordon model predicts that equilibrium inflation depends positively on the natural rate of unemployment and the relative aversion of policymakers to unemployment (relative to inflation). It depends negatively on the slope of the short-term Phillips curve. Empirically, we consider central bank independence and adherence to a fixed exchange rate mechanism with a credible anti-inflationary anchor (say the EMS) to reflect particular aversion to inflation. Our analysis takes equation (6) as a starting point.

$$p^* = \alpha_0 + \alpha_1 u_N - \alpha_2 PHC - \alpha_3 CBI - \alpha_4 EMS - \alpha_5 MAJ + \alpha_6 SIG \quad (6)$$

with : p^* : equilibrium inflation rate;

uN: natural rate of unemployment;
 PHC: slope of the Phillips curve;
 CBI: central bank independence indicator;
 EMS: EMS dummy;
 MAJ: indicator of government power;
 SIG: indicator of government instability in the 1980s;
 $\alpha_1 > 0$

This equation relies on Grilli, Masciandaro and Tabellini (1991, table 15), who also include a central bank independence indicator and an EMS-dummy to explain inflation differentials among OECD countries. Further, these authors add a number of political variables (MAJ, SIG). We shall go into these below. In line with the Barro-Gordon model we extend the work of Grilli et al. by adding the natural unemployment rate (uN) and the slope of the short-run Phillips curve (PHC) as explanatory variables.

Table 2 presents all relevant data. Some of these (HYST, DIFF) do not occur in equation (6). The reason is that, as we have mentioned, this equation is only our starting point. The additional variables will be used in a somewhat broader empirical approach. The data for p^* are the same as those presented in table 1. The data for uN are estimates for equilibrium unemployment in 1980-89 taken from Layard, Nickell and Jackman (1991, chpt. 9, table 14). PHC stands for the slope of the short-term Phillips curve. This variable is a (weighted) average of nine authors' estimates of the short-run responsiveness of wages to unemployment⁵. For the purpose of this paper the relative differences among countries are important (much more than the absolute numbers). The Phillips curve is relatively steep in Japan, Switzerland, Sweden, Austria and Norway. It is rather flat in the UK, Denmark, Spain and the US. HYST is a third labour market variable. It reflects vulnerability to hysteresis, i.e. the extent to which a rise in actual unemployment will ultimately lead to a rise in the equilibrium rate. HYST should be expected to take a value between zero and one. Analogous to PHC, the data for HYST are averages of four authors' estimates⁶. Spain, Ireland, France, Italy and the UK seem to be the most vulnerable to hysteresis, the US, Sweden and Switzerland the least.

EMS is a dummy for the countries that participated in the ex-

change rate mechanism of the European Monetary System in 1980-89. CBI is a summary indicator for central bank independence taken from Grilli et al. (1991). It reflects political, as well as economic independence⁷. Germany's central bank is found to be the most independent; Spain and Italy's the least. Sweden, Norway and Finland, for which Grilli et al. present no data, receive the same CBI value as France. Support for this choice can be found in Parkin (1987) and Alesina (1989). DIFF is a variable taken from Eyffinger and Schaling (1993, table 9). These authors have critically examined Grilli et al.'s interpretation of the (political) independence of 12 countries' central banks. For seven countries they propose a change: a positive change if Grilli et al. have underestimated a country's central bank's (political) independence (e.g. Belgium and Germany) and a negative change in the opposite case (e.g. Italy)⁸. Though these adjustments are available for only 12 countries, we do think we should take them into account. For the countries not investigated by Eyffinger and Schaling, we shall assume DIFF to equal zero in our regression analysis.

MAJ and SIG are two political variables, also taken from Grilli et al. (except for Finland, Norway and Sweden⁹). The former stands for the fraction of time between 1950 and 1989 that government was characterized by majority rule, i.e. supported by a single party that had a majority in the legislature. The idea is that strong governments are better able to execute unpopular policy programmes (e.g. cut expenditures, raise taxes), whereas weaker (coalition or minority) governments are not. The latter tend to have higher debt, deficits, seigniorage and inflation. SIG stands for the number of significant government changes in the 1980s. Grilli et al. consider a change to be significant if the following conditions are met: for a majoritarian parliamentary system and a presidential system (e.g. the Anglo-Saxon countries and France) there has to be a change in the party of the prime minister or president; for a representational system there has to be a change in both the prime minister party and the coalition of parties supporting the government. SIG is expected to raise inflation. If countries are 'vulnerable' to government instability, governing parties have a high chance of not being in

office the next year, i.e. of not having to face the burden (deficits, debts, inflation) of their policies. The expectation is that this generates higher inflation.

Table 3 reports our main estimation results. The number of observations is 18 (except in the equations 5 and 5', where it is 15). The estimation method is OLS in the equations (1) and (2). The equations (3), (4) and (5) have been estimated simultaneously (3SLS) with their counterparts for equilibrium unemployment (3'), (4') and (5'). Between brackets are absolute t-values.

The first equation is closely related to the regressions presented by Grilli et al. (table 15)¹⁰. It excludes uN and PHC as explanatory variables. Including these variables (equation 2) leads to a marked improvement of the results. The R² rises strongly and MAJ becomes significant. Further, the results tend to confirm the predictions of the Barro-Gordon model. Though significance remains weak for uN, both variables obtain the correct sign.

A reason for the insignificance of uN may concern the fact that this variable is strongly correlated to PHC (correlation is -0.66). Given that various authors have shown the favourable, negative effect of real wage flexibility on unemployment in the last two decades (e.g. Grubb et al., 1983; Alogoskoufis and Manning, 1988), this correlation is not really unexpected. By simultaneously estimating an equation for uN, the remaining regressions (3)-(5) take this result as a starting point. The main explanatory variables in the unemployment equation are PHC and HYST, since both affect the (long-run) flexibility of wages to unemployment (see also Layard et al., 1991, chapters 8 and 9). Notice however that, despite the fact that these two variables perform quite well, we had to add a dummy for Spain and Ireland in the unemployment equation. As can be seen, this approach further improves the results and the significance of the Barro-Gordon variables uN and PHC (see equation 3).

Equation (4) incorporates the Eyffinger and Schaling adjustment of the central bank policy independence index of Grilli et al.

Since freely estimated coefficients for CBI and DIFF were not significantly different, we imposed the same coefficient. Our results are hardly affected. Finally, the fifth equation leaves out Finland, Norway and Sweden. Grilli et al. do not include these countries either (so, we cannot rely on their data). Again we have to conclude that both monetary institutions, political institutions, and labour market characteristics are relevant determinants of inflation.

It goes without saying that the results presented here can still be improved. For example, for MAJ we relied on data from Grilli et al., which concern the period 1950-89. It might be more adequate to use data for the 1980s (cf. SIG). A second improvement might follow from a closer investigation of the elements underlying the dummy variable in the unemployment equations.

4. Conclusions

At the end of this article, we briefly restate our main findings. We showed that the Barro-Gordon model offers a fairly good explanation for the observed inflation differences among the OECD countries during the 1980s. Indeed, as the model predicts, average inflation is higher in countries with a high natural rate of unemployment, a relatively flat short-term Phillips-curve and a less independent central bank. Further, participation to the EMS and political stability contributed to moderate inflation.

It goes without saying, that the relatively small sample provided by the OECD countries preclude any firm conclusions to be drawn from the analysis. Indeed, a solid test of the Barro-Gordon model requires that the reported regression results be confirmed for a large number of countries and for different time periods.

Table 1. Inflation in the OECD

Country	1980-89
Australia	8.0
Austria	4.0
Belgium	4.3
Canada	5.5
Denmark	6.1
Finland	7.3
France	6.9
Germany	3.0
Ireland	8.2
Italy	11.1
Japan	1.9
Netherlands	2.5
Norway	8.1
Spain	9.6
Sweden	7.7
Switzerland	3.8
UK	7.3
US	5.0

Source: IMF, International Financial Statistics Yearbook, 1992
Note: the data refer to the average annual percentage change of the GDP deflator.

Table 2. Inflation and structural characteristics in the OECD

Country	p*	u*	PHC	HYST	CBI	DIFF	EMS	MAJ	SIG
Australia	8.0	6.10	0.50	0.89	9	0	0	26.8	1
Austria	4.0	2.95	1.45	0.75	9	.	0	39.0	0
Belgium	4.3	7.04	0.53	0.71	7	1	1	9.8	0
Canada	5.5	8.14	0.47	0.60	11	0	0	80.5	2
Denmark	6.1	7.30	0.25	0.70	8	.	1	0.0	1
Finland	7.3	4.65	0.72	0.68	7	.	0	0.0	1
France	6.9	7.81	0.61	0.96	7	1	1	41.5	3
Germany	3.0	4.04	0.50	0.67	13	2	1	9.6	1
Ireland	8.2	13.09	0.41	1.05	7	.	1	65.9	3
Italy	11.1	5.42	0.89	0.93	5	-1	1	0.0	4
Japan	1.9	2.14	3.73	0.77	6	2	0	80.5	0
Netherlands	2.5	7.27	0.60	0.82	10	1	1	0.0	0
Norway	8.1	2.50	1.37	0.68	7	.	0	29.4	3
Spain	9.6	14.95	0.31	1.15	5	.	0	50.0	1
Sweden	7.7	2.36	2.15	0.54	7	.	0	5.0	1
Switzerland	3.8	1.44	2.27	0.54	12	2	0	0.0	0
UK	7.3	7.92	0.24	0.93	6	0	0	92.7	0
US	5.0	6.36	0.38	0.50	12	0	0	41.5	1

Sources: see description in the text
 (.): data not available

Table 3. Estimation results

Estimated parameters: equations for p*										
Eq	const.	uN	PHC	CBI	DIFF	EMS	MAJ	SIG	R ²	SER
1)	9.68 (5.90)	-	-	-0.48 (3.05)	-	-1.69 (2.04)	-0.02 (1.35)	1.31 (4.11)	0.73	1.51
2)	11.0 (6.5)	0.12 (1.04)	-0.95 (2.32)	-0.51 (4.50)	-	-2.71 (4.64)	-0.03 (2.78)	1.19 (5.70)	0.91	0.96
3)	10.5 (7.4)	0.16 (1.49)	-0.86 (2.48)	-0.50 (5.54)	-	-2.65 (5.85)	-0.03 (3.26)	1.14 (7.19)	0.91	0.76
4)	9.66 (7.8)	0.17 (1.73)	-0.57 (1.79)	-0.43 (5.77)	-0.43	-2.25 (4.97)	-0.02 (3.06)	1.03 (6.36)	0.91	0.75
5)	10.2 (8.0)	0.17 (1.78)	-0.67 (2.24)	-0.45 (6.39)	-0.45	-2.68 (6.11)	-0.03 (3.63)	1.14 (7.60)	0.93	0.71

Estimated parameters: equations for uN						
Eq	const.	PHC	HYST	Dummy	R ²	SER
3')	4.0 (2.37)	-1.83 (5.47)	4.28 (2.01)	5.97 (5.02)	0.88	1.21
4')	3.9 (2.3)	-1.82 (5.46)	4.43 (2.10)	5.92 (5.00)	0.88	1.21
5')	4.4 (2.6)	-1.79 (5.28)	4.04 (1.93)	5.69 (4.94)	0.89	1.18

Notes: Dummy equals one for Ireland and Spain and is zero otherwise. The equations 3) and 3') have been estimated simultaneously (3SLS) with a constant, PHC, HYST, CBI, EMS, MAJ, SIG and Dummy used as instruments. For the 3SLS-estimates of 4) and 4') and 5) and 5') we also included DIFF as instrument.

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NOTES

1. This observation is not inconsistent with another one, viz. that of increased inflation convergence of national inflation rates during the 1980s (cf. e.g. H. Ungerer et al., 1990, p. 24-25).
2. M. Artis (1991) uses the term 'reputational equilibrium inflation rate'. However, this refers to a situation of repeated games, which is not implied by our further analysis.
3. A third possible explanation, starting from a different approach, is linked with the so-called seigniorage receipts that accompany inflation.
4. In this simple model the inflation rate and not e.g. the money growth rate is assumed to be the appropriate instrument of monetary policy. Consequently, it is assumed that the monetary authorities directly set the inflation rate.
5. These authors are Alogoskoufis and Manning (1988, table 5), Andersen (1989, table 4), Bean et al. (1986, table 3), Chan-Lee et al. (1987, table 6, from which we took data for the large countries and Spain), Grubb et al. (1983, table 1), Kawasaki et al. (1990, table 2, from which we took data for the small countries except Spain), Layard et al. (1991, chpt. 9, table 7), Newell and Symons (1985, tables 6c and 6d) and OECD (1989, table 2.6). For details, see Heylen (1993).
6. These authors are Alogoskoufis and Manning (1988, table 4), Barro (1988, table 1), Heylen and Verhulst (1990, table 1) and Layard et al. (1991, chpt. 9, table 5, first column).
7. Both aspects of independence must be taken into account. Grilli et al. define political independence as the capacity to choose the *final goal* of monetary policy. It will be greater if e.g. the governor and the board members of the central bank are not appointed by the government, if they are appointed for a long period of time (more than 5 years), if there is no government representative in the board and if government approval of monetary policy is not required. Economic independence is the capacity to choose the *instruments* with which to pursue the final goal (in particular, low inflation). It will be greater if direct credit to the government is non-automatic, if it is at market interest rates, temporary and limited. Further, it rises if the central bank autonomously sets the discount rate and if it carries responsibility for banking supervision.
8. For Belgium we do not completely follow the adjustment made by Eyffinger and Schaling (+2). Since this adjustment is partly due to the reform of the money market and monetary instruments in 1991, it is clearly not relevant for a study of inflation in the 1980s. So we put DIFF equal to +1 in Belgium.
9. For these countries our sources are Macridis (1990) and Larousse (various issues).

10. Grilli et al. also include a variable measuring the frequency of government changes (significant and insignificant changes). Adding this variable never seriously affected the results in table 3. It mostly showed up insignificant.

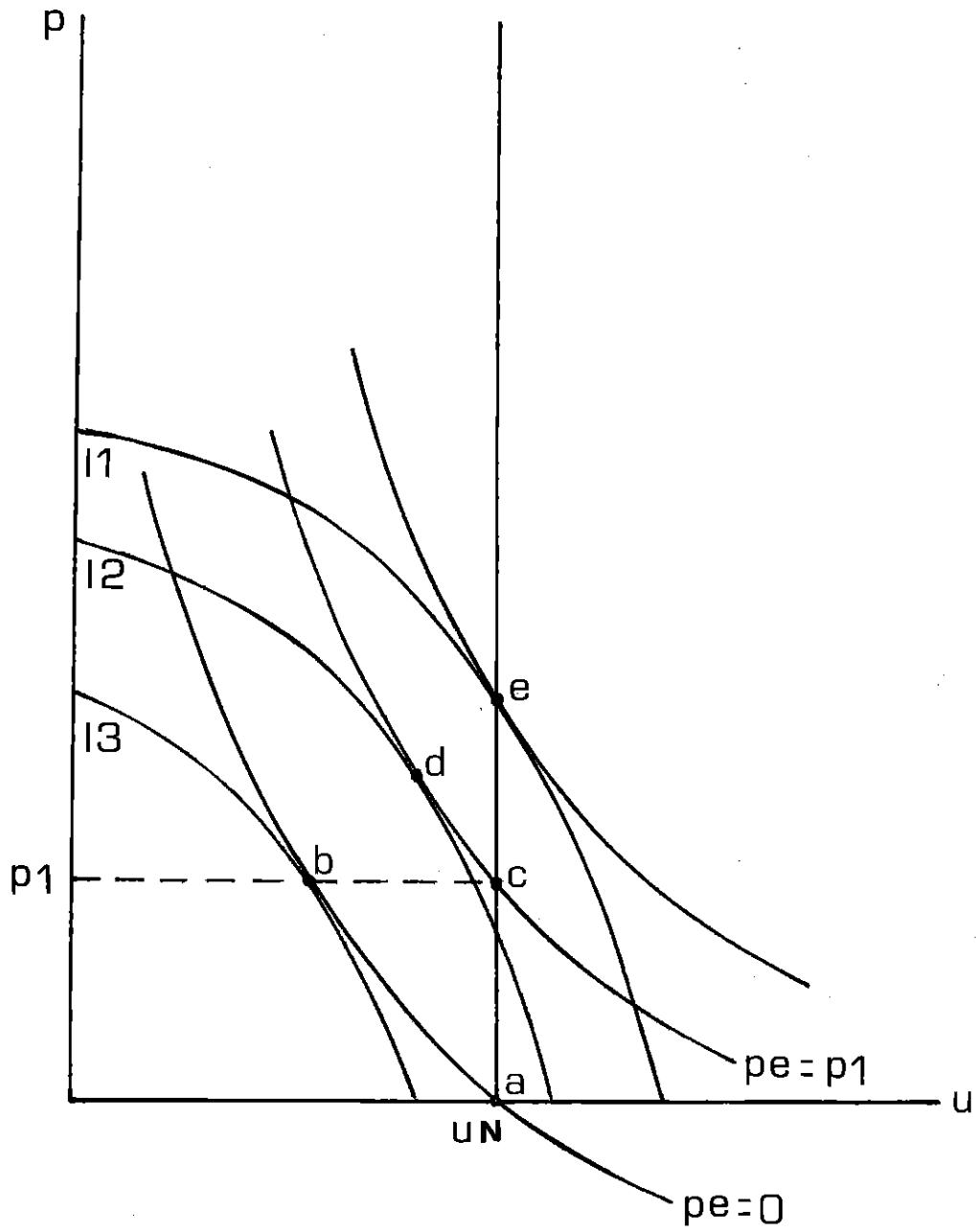


figure 1

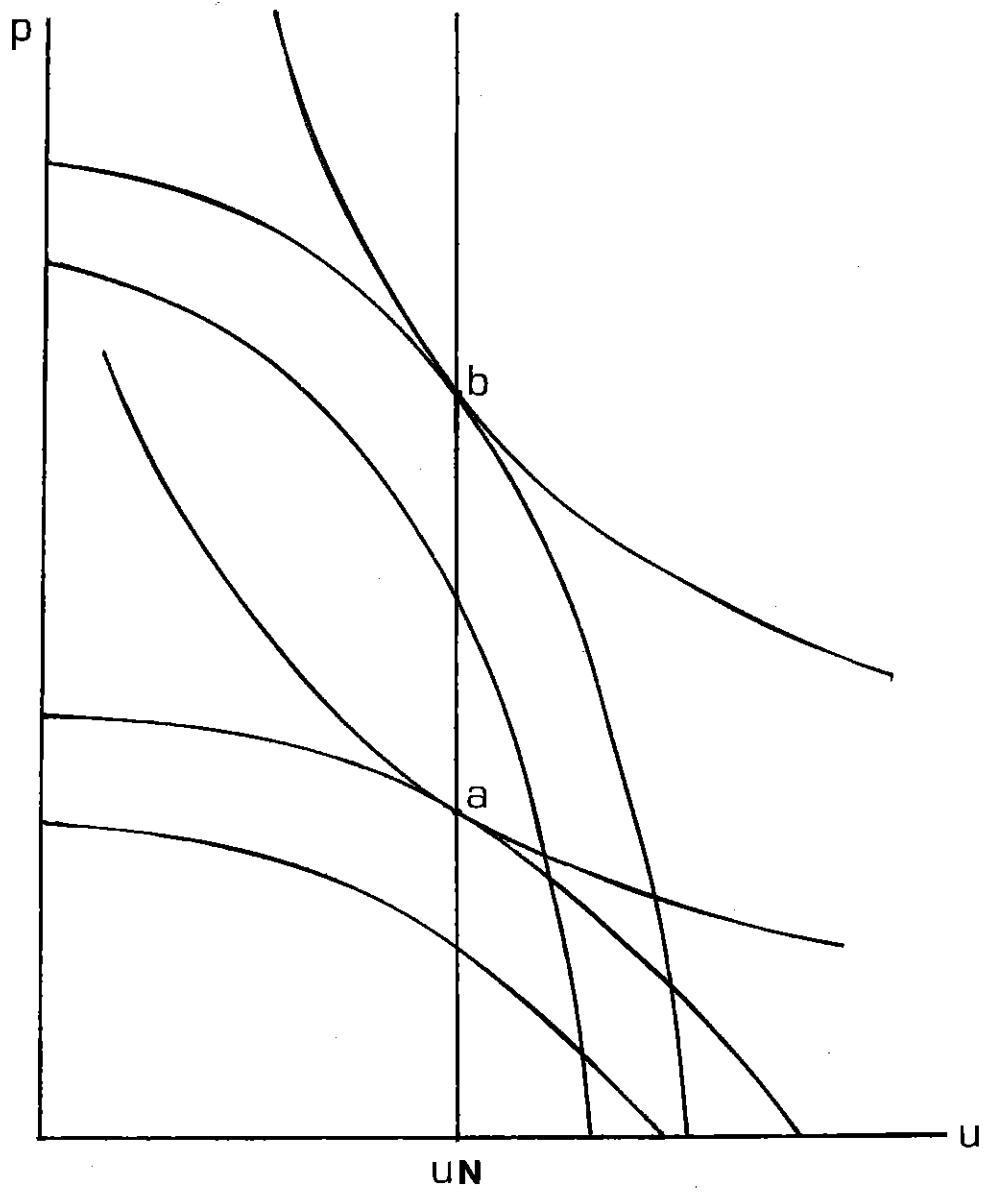


figure 2

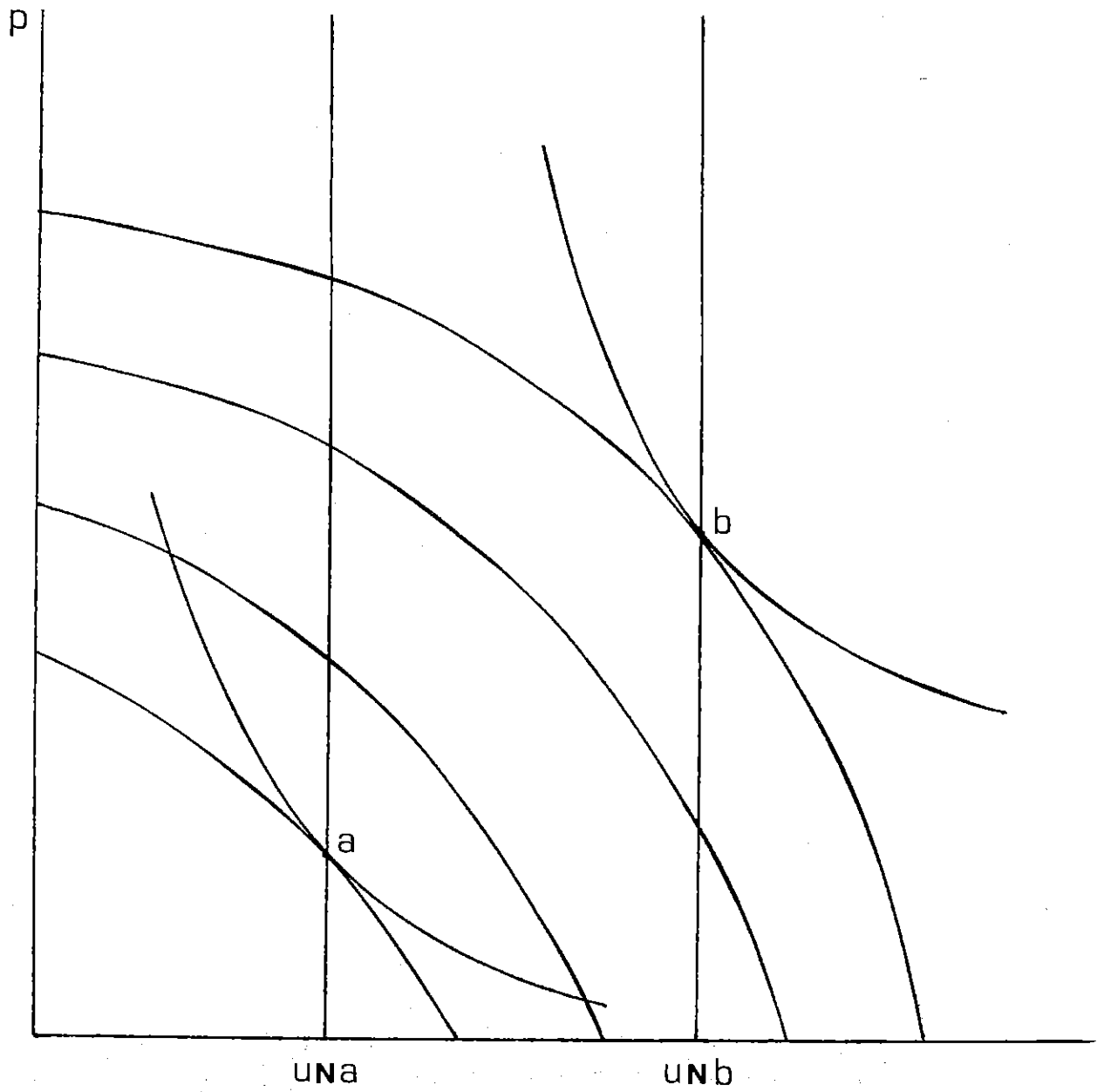


figure 3

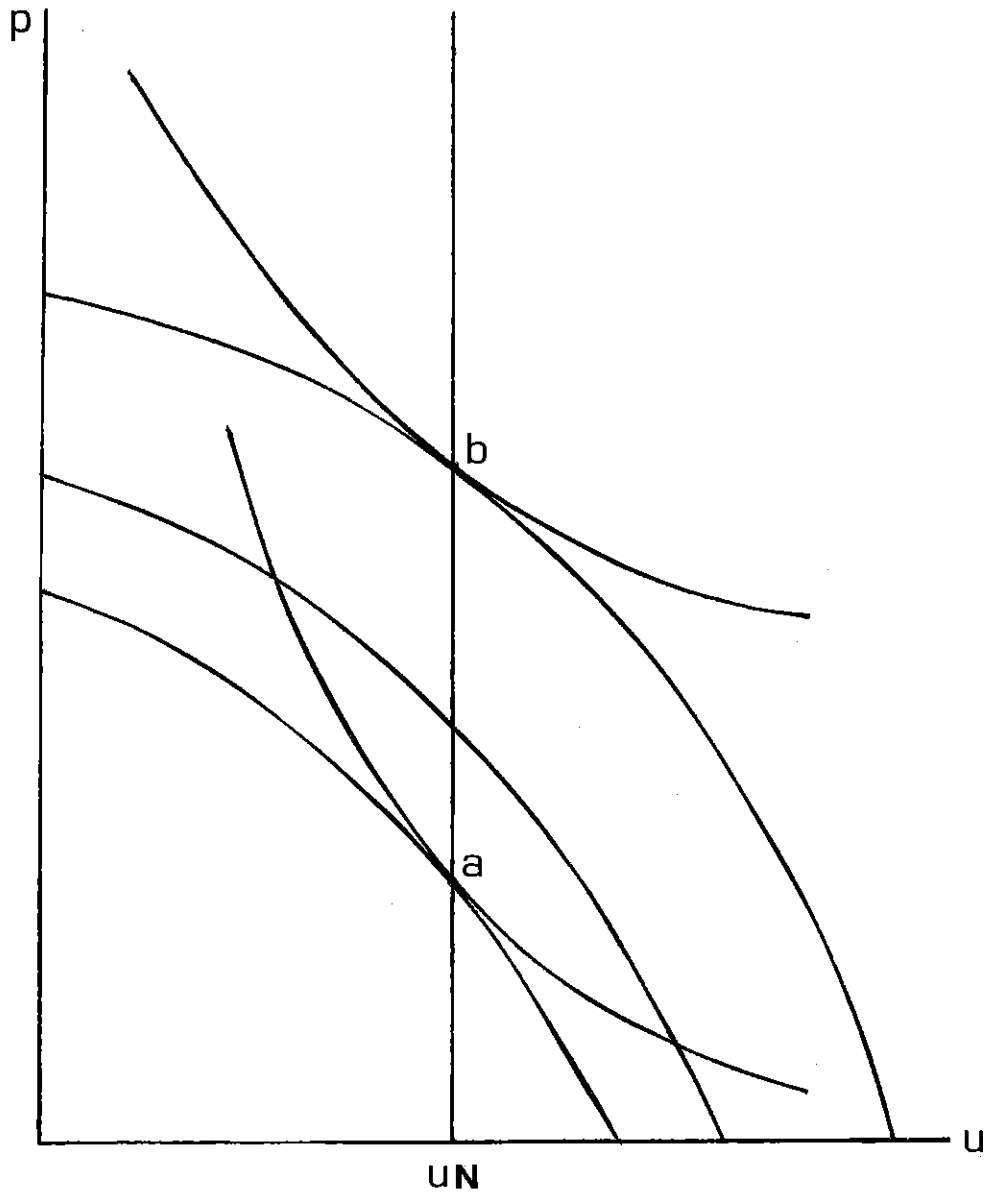


figure 4

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