Chapter 5

Inflation and adjustment

5.1) Introduction

The basic message of the last chapter was that inflationary finance played a much less active role to the hyperinflation processes than usually assumed, a point to be also emphasized in Chapter 7. The crucial question that emerges then is what alternative explanations there are "outside" the monetary sphere. Indeed, since the releasing of the brakes does not create movement[1] the case against the Cagan/Sargent view of the fundamental causes of the hyperinflations can only be sustained if an acceptable alternative is provided. This chapter takes over this challenge.

The model developed in this chapter is an attempt to rationalize the problems described in Chapter 3. No claims for generality are advanced; the model is conceived as a description of this particular set of relations and circumstances in their very historical context. Its basic concern is the generation of high inflation by the perverse combination of overwhelming adjustment problems and an irresistible pressure from a much strengthened labor movement to regain pre-war levels of real wages. "Inconsistencies" of this sort have been extensively modelled; they have been normally associated with theories, that have been termed "structuralist", advanced to explain chronic inflation in Latin America[2], but have been extended in many directions by a number of recent models[3].

This chapter's model considers these inconsistencies with two additional ingredients: (i) flexible exchange rates and the possibility of "vicious circles", which is one of the characteristic features of the early 1920s and also of the 1980s[4]. (ii) inflationary "inertia" created, for instance, by the adoption of backwards wage indexation, and progressive dollarization. An interesting feature of this model is that the hyperinflation is not generated by arbitrarily placing the economy on some unstable path

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[1] As observed in this very same context by Joan Robinson (1938) p. 512.
[2] A classical example is J.H.G. Oliveira (1964)
[3] See for example L. Taylor (1979). W. H. Branson & J. J. Rothemberg (1980); T. Gylfason & A. Lindbeck (1984); E Bacha & F. L. Lopes (1984); A. Canavese (1982); S. G. Turnovsky (1979); F. Modigliani & T. Padoa-Schioppa (1978) and more speciafically C. P. Kindleberger (1985).
[4] As observed by M. De Cecco (1983).

of a dynamic system but by cumulating shocks and pressures onto an inflationary process with "memory". It is important to note that these hyperinflations were not "explosive" inflations except in the last four months of the German inflation and some very special circumstances contributed to this outcome, as seen in detail in Chapter 10. By and large the models developed during the last decade to account for the experience of some exceptionally high inflations in Latin America during the early 1980s - at least one of which a hyperinflation according to Cagan's definition - provide a rich and powerful description of the "classic" hyperinflations. This is actually the major purpose of this chapter.

The chapter is organized as follows: the next section sets up the basic model, obtaining an equilibrium level of inflation and real exchange rates (real wages) from an external balance relation and a price equation carrying a wage push term and "inertia". Section 5.3 studies the repercussions of external imbalances and considers the issue of monetary accommodation. Lastly, section 5.5 is addressed at providing econometric support for the model, though it is observed that the lack of data for some key variables allows but a partial testing.

5.2) A model of inflation in an open economy

5.2.1) External balance

Consider an economy that produces one single composite tradable good out of labor and a foreign input whose price is assumed equal to one for simplicity. The following identity can be written:

$$P = m.(b.w + c.e) \tag{1}$$

where P stands for output price, m represents the mark-up factor or the profit margin, b and c are the labor and foreign input requirements per unit of output and w and e are the nominal wage and the exchange rate. From equation (1) a simple linear relation between the real wage and the real exchange rate can be obtained:

$$(w/p) = \acute{a}_o - \acute{a}_1 \, . \, (e/p) \tag{2}$$

where $\acute{a}_o = (1/b.m)$ and $\acute{a}_1 = (c/b)$. One should be careful with the notion conveyed by equation (2) that increases in real wages necessarily reduce real exchange rates or that, as often observed, in order to increase competitiveness a reduction in the standard of living must be produced. In this simplified model substitution in consumption and in production are not considered nor changes in productivity, structural adjustment, and changes in profit margins. These issues belong to the discussion of lasting solutions for "fundamental" imbalances which, for simplicity, will not be discussed in the context of the short run dynamics of inflation.

Short-term external balance is described by a balance of payments equation given by:

$$ß_e.(e/p) + ß_u.u_t + ä.(r_t - r^*_t - ê_t) = R \qquad (3)$$

where the ßs and ä are positive coefficients, r and r* nominal interest rates home and abroad, u_t the unemployment in excess of the natural rate and R is a shift factor[5]. The terms on ß corresponds to the trade balance, which is positively related to the real exchange rate and to the unemployment rate; the term on ä establishes the capital inflows are triggered by differences between the rates of return of securities at home, r_t - $ê_t$ and abroad, r^*_t.

It will be useful to consider that exchange rate depreciation is given by the following expression:

$$ê_t = Ï_t + î.\{ ø_e - (e/p)\} \qquad (4)$$

where $ø_e$ is to be considered the long run or "normal" real exchange rate. Expression (4) says that exchange depreciation[6] is, in principle, equal to inflation but it might differ if the real exchange rate is not at its long-run equilibrium level. This is a common assumption in recent models of exchange rate dynamics that was modified to consider an inflationary environment[7].

The "long run" real exchange rate will be defined by the following expression:

$$ß_e. ø_e + ä.(r_t - r^*_t) = R \qquad (5)$$

according to which $ø_e$ is defined as the real exchange rate that is compatible with external

[5] Note that we could write the current account as ßo + ß1.(e/p) and the capital account as äo + ä1.(r-r*+Ï), in case of which ßo and äo would correspond to autonomous elements. The reopening of international capital markets, for example, would be like an increase in äo which would be represented by a reduction in R. Similarly, the annexation of a territory which maintains a trade surplus with the outside world would be like an increase in ßo which is also like a reduction in R.

[6] We are implicitly assuming covered arbitrage or rational expectations as we are treating expected depreciation as equal to actual depreciation.

[7] For example in J. A. Frenkel & C. A. Rodrigues (1982) p. 6 and R. Dornbush (1976) pp. 1163 and 1167.

balance when expected depreciation is equal to zero, or external balance at fixed exchange rates, and when unemployment equals the natural rate. The expression conveys the notion that in the long-run, external balance should obtain under the gold standard. This is surely a fair description of the attitudes of these years, as extensively discussed in Chapter 2.

Finally, combining (3), (4) and (5) there results an expression for external balance as as function of $(e/p)_t$, $Ï_t$ and r_t- r^*_t:

$$(e/p)_t = (1/ß_e) . \{R- ä.(r_t - r^*_t)\} + \{1/(ß_e + ä. î)\} . \{ä.Ï_t - ß_u(u_t)\} \qquad (6)$$

5.2.2) The dynamics of inflation

The key for the dynamics of inflation, and the possible occurrence of "spirals", is the interaction between exchange rate dynamics, as given by expression (4), pricing decisions, namely the determination of profit margins, and the behavior of wages. To see how these factors interact it is necessary to rewrite equation (1) as follows:

$$\Pi_t = \hat{m} + \theta.\hat{w}_t + (1-\theta).\hat{e}_t \qquad (7)$$

for è representing the share of labor costs on unit price.

Usually wage determination is described as governed by three factors: (i) the "inertial" factor stemming from the fact that nominal wages suffer periodical readjustments, often automatically given by some indexation provision, (ii) pressures related to the desired level of real wages and the union's bargaining strength; and (iii) the level of employment. The division between (i) and (ii) serves the only purpose of distinguishing from the analytical point of view the process of defending from past and future inflation and the real wage bargaining process proper. There are many alternatives to model wage indexation; one simple alternative that is commonly found in countries with chronic though not hyperinflationary levels of inflation is to consider full, or even partial, backwards indexation. Another alternative, more appropriate to the hyperinflation environment is to consider wages as dollarized, or readjusted according to exchange rate depreciation. In fact, as documented in Chapter 6, it can be argued that, along the hyperinflation process, a transition was made from backwards indexation to a dollarized system. Equation (8) considers the extent to which indexation provisions are adopted as an institutional factor related to the structure of labor relations; it is assumed to be described by a parameter ë, representing the degree of inflationary inertia. It also considers that wages are partly indexed to observed inflation - which amounts to past (last month's) inflation - and partly to exchange depreciation. The parameter ã that stands for the degree of dollarization, is assumed to be positively related to inflation.

$$_t = \text{ë}.\{(1-\text{ã}(\text{Ï})).\text{Ï}_{t-1} + \text{ã}(\text{Ï}).\hat{e}_{t-1}\} + (\text{Ï}).\{\overline{w} - (w/p)_t\} - \text{ó}(u_t) \quad (8)$$

Equation (8) includes the negative effect of the level of unemployment and also a wage push factor according to which nominal wages accelerate according to an adjustment factor if the current real wage is lower than a target real wage defined as $\overline{w}$ [8]. This rule may appear mechanical and convey the idea of systematic fooling of workers demands. One form of preventing this departure from rational behavior is to assume that the adjustment factor is positiv ely affected by inflation. This seems to represent fairly well the strong attachment of the labor movement in the 1920s with pre-war levels of real wages that discussed in Chapter 3[9].

The interaction of exchange rate dynamics and wage determination is crucially affected by pricing decisions, or the speed with which prices respond to changes in costs. By following the usual alternative of considering mark-ups as constants, in a context of flexible exchange rates, one establishes a "spiral", in the presence of adverse external shocks, in which exchange rates affects prices and then wages, which would act residually. Mark-ups might surely be affected by other factors: it is generally found that mark-ups respond to capacity utilization, though with uncertain sign[10], and it is also common to observe that under high inflations price variability might induce additional "defensive" profit margins. Yet, these are empirical issues to be considered in section 5.5 ahead.

Now using the expressions for $_t$ and $\hat{e}_t$ given by (8) and (4) in equation (7) and using equation (2) to express real wages as their corresponding real exchange rates the rate of inflation can be written as:

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[8] Note that since in this model the level of employment is constant the level of real wages define the share of labor in income. The target wage in this connection should be interpreted as a "fair" income distribution that workers are reluctant to depart from in either direction.

[9] During the war real wages had fallen to levels of about half of pre-war levels in all four countries, which was regarded as one of the "dislocations" generated by the war. After 1918 a much strengthened labor movement actively pursued the recovery of 1914 wages as shown in Chapter 3.

$Ït = Ö_i + á_1 .\{(e/p)_t - ø_w\} + è'.î.\{ø_e - (e/p)_t\} - ó(u_t)$ (9)

where $è' = (1-è)/è$ and $Ö_i = (ë.(1- ã).Ï_{t-1} + ë.ã.ê_{t-1})$ stands for the inertial components of inflation as given by indexation and dollarization. Note that equation (2) is used to express the wage gap in terms of its corresponding real exchange rate; the parameter $ø_w$ corresponds to the real exchange rate associated with $\overline{w}$ the target real wage.

According to equation (9) two main factors are responsible for inflation namely inflationary "inertia" and "fundamentals", which in this particular case relates to incompatibilities between target wages and external balance and, of course, the conventional Phillips' Curve effect. Equation (9) describes the way by which inflation renders wage demands compatible with desired profit margins, exchange rate determination and the inertial characteristics of the inflationary process. This sort of description of inflation has been used in modern restatements and improvements of structuralist theories developed in connection with Latin American inflations[11]; it is also very similar to the trade-offs explored by Modigliani and Padoa-Schioppa in connection with Italy[12].

The role of the two "targets" $ø_w$ and $ø_e$ is crucial for the determination of inflation. If, for example, $ø_w > ø_e$, then the level of wages required to achieve external balance would be lower than the one workers would consider as fair, or under the fair wage the economy would enjoy a payments surplus. That is not much of a problem as either the fair wage can be easily revised upwards or the payments surplus can be used in capital exports, in freer trade regimes or merely in the accumulation of reserves. If the two targets were fully compatible, or if $ø_w = ø_e$, it would be that, in equilibrium, or when $ê_t = Ï_t = w_t$, all targets would be met or $e/p = ø_e = ø_w$; inflation in this case would be entirely determined by its inertial characteristic. If the degree of inertia ë is less than one then the "long-run" equilibrium or the "steady state" - for which $Ï_t = Ï_{t-1}$ - would be a state of zero inflation[13].

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[10] L. Taylor (1986) p. 6.

[11] For example L. Taylor (1979) ch. 5 and A. Lara-Resende (1979).

[12] F. Modigliani & T. Padoa-Schioppa (1978).

[13] This "steady state" might be of little relevance for economies subject to high indexation. Considering, for instance, an economy experiencing a monthly inflation rate of 20%, no dollarization and ë= 0.90. The "steady state" would obtain at a zero inflation yet it would take a very long time to be reached. It would

The real problem arises when $ø_e > ø_w$, or when wages compatible with external balance are lower than those demanded by workers as fair. Since exchange markets are auction markets and firms are generally price setters workers become the weak link of the chain, or they act more or less residually given what has been established by the former. External balance always obtains for the market for foreign exchange always clear at some price. Firms pass these new quotations immediately to prices but workers are granted automatic readjustments (if indexation arrangements are in operation) that are either lagged or partial so that exchange depreciation does reduce real wages. As workers realize their loss, or that a wage gap has been opened, they react by pushing nominal wages up; since producers pass this to prices in full inflation is generated. So basically a "gap" between target and actual wages can be sustained so long as a chronic inflation is maintained. That happens not exactly because workers are "fooled", in the sense of having less than rational expectations, or having too rigid wage adjustment rules, but essentially because workers are price takers. Their reaction might certainly be an increase in , but even so their demands would always be frustrated because the macroeconomic compatibility of external balance, desired profit margins and target wages would always assign the burden of adjustment to price takers. Effective gains in real wages, or the avoidance of losses, can only be obtained at the expense of profit margins for there is no way to circumvent the external constraint.

5.2.3) Equilibrium

These issues can be more clearly explored if one considers the equilibrium configuration in this model and its implied dynamics. In this connection it will be convenient to rewrite equation (9) as:

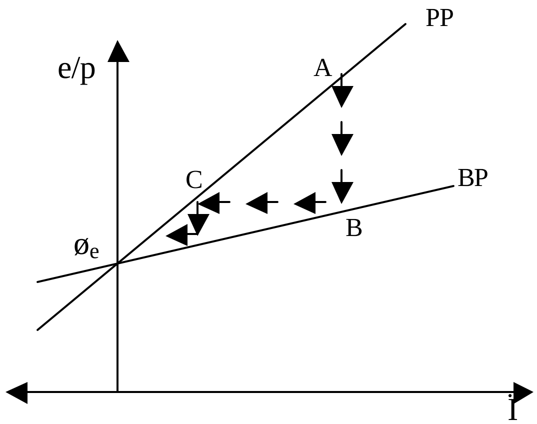
$$(e/p)_t = [1/(\ .\ á_1 - è'.\ î)].[(\ .á.ø_w - è'.î.ø_e) - Öi + Ï_t - ó(u_t)] \qquad (10)$$

The slope of relation (10) on a (Ï, e/p) space, or the sign of the relationship between inflation and the real exchange rate depends on the term [$.á_1$ - è'.î] that measures the relative strength of the wage push *vis à vis* the foreign exchange push.

take about one year to have partial indexation reduce inflation below 6% a month.

When (e/p) rises (or wages are reduced) workers force nominal wages and thus inflation up according to ; meanwhile as (e/p) approached (or surpassed) $\o_e$ exchange depreciation would slow down (or an appreciation would ensue) reducing inflation. The net effect of these two influences on inflation is given by the term [.á - î.è'] and stability would require it to be positive or the wage push to dominate. That means that inflation would be positively related with the real exchange rate (or negatively with the real wage), which is, in fact, confirmed by the empirical evidence presented in section 5.5.

Graph 5-1 shows equations (6) for external balance and (10) for internal "balance" labeled as BP and PP respectively. The PP curve is upward sloping because it is assumed that [.á – î.è'] >0. For the BP curve the reasoning is straightforward: enhanced competitiveness should be matched by capital outflows which, under constant interest rates, are produced by expectations of more rapid depreciation or by increased inflation. Note that Graph 5-1 shows a long-term equilibrium without inflationary inertia and without adjustment incompatibilities or for $\o_w = \o_e$. It is easily verifiable from equations (6) and (10) that both curves cross at their intercept with the e/p axis at the long run equilibrium $\o_e$ with zero inflation.



Graph 5-1: Equilibrium under zero inflation

The relative slopes of the two curves is what ultimately secure the existence of equilibrium in the presence of incompatibilities and inertia. In fact the BP curve needs to be steeper which means:

[1/(.á - î.è')] > [ä / (ß + ä.î)] (11) or that the slope of PP be greater than the slope of BP. This is very likely the case when and î are close (and > î) and it is certainly the case when the sensitivity of capital movement to interest rates is low in absolute terms or relatively to the sensitivity of the current account to changes in the real exchange rate. The condition expressed by equation (11) is likely to be violated in economies which are very open from the financial point of view and where international transactions in capital account predominate over those in current account. This does not seem to be the case for any of the countries experiencing hyperinflation.

The condition expressed by equation (11) and also our assumption that [.á – î.è']>0 are both plausible and both most likely will hold in "well behaved" economies. It must be recognized, however, that there are no *a priori* reasons to justify that. It is true that it is not difficult to produce unstable models if one violates these conditions. In such circumstances it would not be difficult to conceive situations characterized by explosive inflations, yet it is less easy to find plausible economic justifications for instability in the mathematical sense. The truly meaningful challenge is to understand how big inflations are built in economies that face problems, sometimes dramatic ones, but no pathologies. Besides, an "explosive" inflation is a very rare occurrence and one of little empirical importance, as argued in several contexts in this work, even for these hyperinflation cases. It is only observed during the last four months of the German inflation, and for very special reasons, as argued in Chapter 10. No such "explosion" is observed in Austria, Hungary and Poland at any moment, which suggests that mathematical instability is probably not involved in the process.

The comparative statics results are mostly the expected ones: inflation and real exchange rates are higher if inertia is stronger (say a higher ë) or if the country's external position deteriorates (higher R). Dear money does reduce inflation, which, however, might be insignificant in view of the magnitude of inflation. The same holds for increases in unemployment, which increases the current account surplus and moderates wages demands. The Phillips' curve effect is significant, and does work to reduce inflation, but most likely its contribution is marginal when compared to magnitude of inflation. This is actually extensively observed as regards recent high inflations in Latin America.

Some interesting issues arise in connection with changes in $ø_w$. By revising their wage targets downwards, or by increasing $ø_w$, inflation and real exchange rates are reduced or actual real wages are increased. This means that workers could make gains by exercising restraint, which is somewhat paradoxical. The reason for this result is associated with the fact that as workers attempt to close the wage gap creating inflation, the external position is worsened for inflation generates capital outflows or "flights" from the currency. In such conditions the terms of the incompatibility between $ø_w$ and $ø_e$ are worsened for the latter assures external balance only at zero inflation. Under a positive inflation an even higher real exchange rate (a lower real wage) would be necessary to secure external balance. The wage push is actually self defeating, not only because the targets are not met but also because their action causes a further reduction in actual real wages. This is one of many instances in economics of an undesirable social outcome resulting from the individual actions guided by rational self interest. There is no implicit "irrationality" involved for the collective behavior of a multiplicity of individuals does not exhibit "rationality" properties as usually defined for individuals.

Lastly one should consider the adjustment mechanisms implied by the arrows in Graph 5-1. Consider a point like A off the BP curve, for which the exchange rate is too high, or "undervalued", or that $e/p > ø_e$. For inflation being determined, at least momentarily, by past history, equation (4) would tell us that the (nominal) exchanges would tend to appreciate (or to depreciate more slowly). In such conditions, and for interest rates maintained constant, r_t-$\hat{e}_t$ increases with respect to r^*_t bringing capital inflows and further appreciation. That goes on until $\hat{e}_t$ becomes constant (when the gap $ø_e$ - e/p is equal to $(\hat{e}_t - Ï_t)/î$); no further capital inflows are generated and the tendency for appreciation ceases. At point B external balance holds but the economy is off the PP curve. At B workers observe that real wages are too high, or that $e/p > ø_w$; that determines some moderation in wage demands and a deceleration in the rate of growth of nominal wages, producing a falling inflation rate and a movement towards point C. At C we would still observe $e/p > ø_w$ but the existing level of inflation is such as to match the deflationary wage pressure with the inertial component of inflation. At C the economy is again off the BP curve like in A, so that the tendency will be for the economy to go towards D and eventually $ø_e = ø_w$ will be reached.

An interesting aspect of this sort of adjustment process is that the action in the "goods market" is usually assumed to take place in a slower pace; foreign exchange markets are commonly considered auction markets in which adjustment is instantaneous. This asymmetry in speeds of adjustment is quite common in the recent models of flexible exchange rate; in the context of this model the path of the economy from A towards $ø_e$ = $ø_w$ would be like a "jump" to B after which the economy would reach $ø_e$ = $ø_w$ at zero inflation moving along the BP curve. This is an interesting possibility yet one should be careful with it in the examination of the dynamics of external shocks in the next sections; this model is a simple discrete time system in which, in principle, all the action takes place simultaneously.

5.3) External imbalances and the generation of high inflation

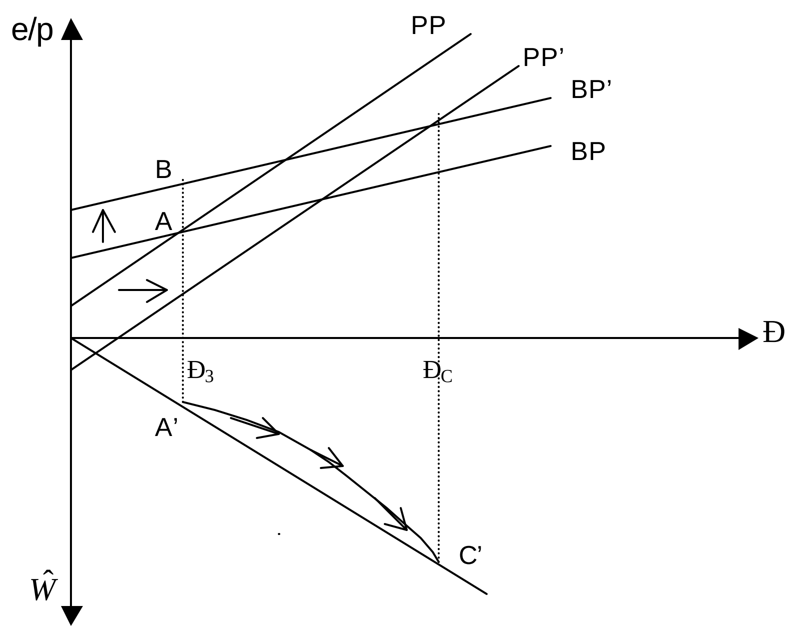
5.3.1) The vicious circle

Adverse external shocks are assumed to take the form of increases in R in equation (3), though they could also be considered less simply as changes in ä or ß [14]. Changes in R affect both BP and PP curves as shown in Graph 5-2. The external balance relation is shifted upwards (inwards), as the preexisting combination of e/p and Ï now corresponds to a payments deficit, that should be reduced by a real depreciation (an increase in e/p) and/or a reduction in inflation (expected depreciation). The PP relation is shifted outwards (downwards) because the increase in R also increases $ø_e$: a worsening of the country's long run payments position raises the long run equilibrium real exchange rate. A distributive tension is thus generated as now we have that $ø_e$ > $ø_w$ or that the fair wage is no longer compatible with external balance. Similar effects are produced by a decrease in $ø_w$, or an upward revision of workers fair wage, yet this would not shift the BP curve. As discussed in great detail in Chapter 3, there is strong evidence that both things, external imbalances and more ambitious wage demands, took place in the 1920s.

The effects of an adverse external shock are illustrated in Graph 5-2. Our description of the implied dynamics is actually only an approximation for in this simple

[14] Changes in ä or ß would shift and rotate equation BP of Graph 5-1. Though interesting theoretically this does not add much substance to our story for external shocks and can introduce more complications.

discrete time model everything happens simultaneously. The first effect is on the foreign exchange market; since under a regime of freely floating exchange rates it may be considered that the economy is always on the BP curve meaning that external "balance" always obtains at least in the sense that the market for foreign exchange always clears at some price.



Graph 5-2: Adverse External Shock Fully Accommodated

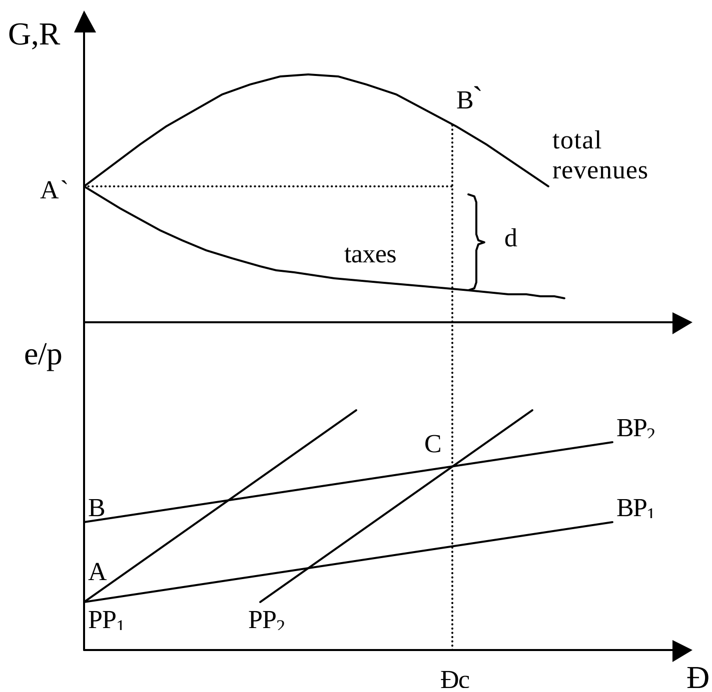
As the economy moves from A towards B in Graph 5-2 at a much higher e/p it follows that exchange depreciation runs ahead of inflation, and inflation ahead of wage growth as indicated in the lower half of the graph. With the jump in the exchanges workers perceive that their real wages have been reduced with respect to the level corresponding to $\o_w$; they respond to this by pushing nominal wages up in a proportion to the newly created wage gap. For the mark-ups to remain constant this pressures result in an accelleration of inflation which starts to catch up with exchange rate depreciation; a higher inflation on the other hand creates capital flights and worsens the external balance requirement. But as the implied deterioration in the capital account, which is given by ä.[á - î/è] is not as big as the improvement in the current account generated by the reduction in real wages - or that ß> ä.[á - î/è] as determined by equation (11) - a point is eventually reached in which wages are low enough to assure external balance with the increased R and with the increased inflation that workers themselves created. Workers never really recover the initial loss, much on the contrary the wage push generates more depreciation and in so doing determines a further deterioration in real wages. As shown in the lower half of the graph during the whole period of adjustment wage growth was below inflation; our stability conditions assure that wage growth accelerates more than inflation so that the spiral is dampened and an equilibrium is eventually reached for $\hat{w}_t$=ê$_t$=Ï$_t$ at point C'. The level of inflation at C depends on the parameters of the model or on how "tight" the condition expressed in equation (11) is met.

5.3.2) Monetary accommodation

Graph 5-2 pictured the simultaneous determination of inflation and real exchange rates (real wages) for interest rates taken as given, or under the assumption of full monetary accommodation. It is interesting, in this connection, to consider explicitly the combination of this chapter's treatment of the process of determination of inflation with the hypothesis of passive money considered in the last chapter. The graphic representation of this chapter's model can be very easily combined with a variation of Graph 4-1 that pictures "total revenues", that is seigniorage plus tax revenues, considering the latter as subject to the Oliveira-Tanzi effect; this is done in Graph 5-3 below.

It was strongly suggested in the last chapter that the determination of government expenditures and also of the growth of the money supply seemed to respond to inflation rather than otherwise. This process can be illustrated with the help of Graph 5-3. Consider first the equilibrium with no "incompatibilities" and zero inflation at point A in the lower half of Graph 5-3 with ø$_w$ = ø$_e$. At zero inflation the total government revenues are equal to the collection of taxes or it is equal to A', so that the budget is balanced at this point. Consider now an adverse external shock, that may or may not be simultaneous with a downwards revision of ø$_w$, that generates a new equilibrium at C with a much higher rate of inflation. Consider, for the time being, that the shock is so big that the government does not regard as feasible to deny accommodation for Ïc. As inflation starts to accelerate, the economy drives to C and tax revenues start to be adversely affected. If expenditure is maintained constant at A', a budget deficit progressively develops, as shown in the upper half of Graph 5-3, untill reaching the value of d.

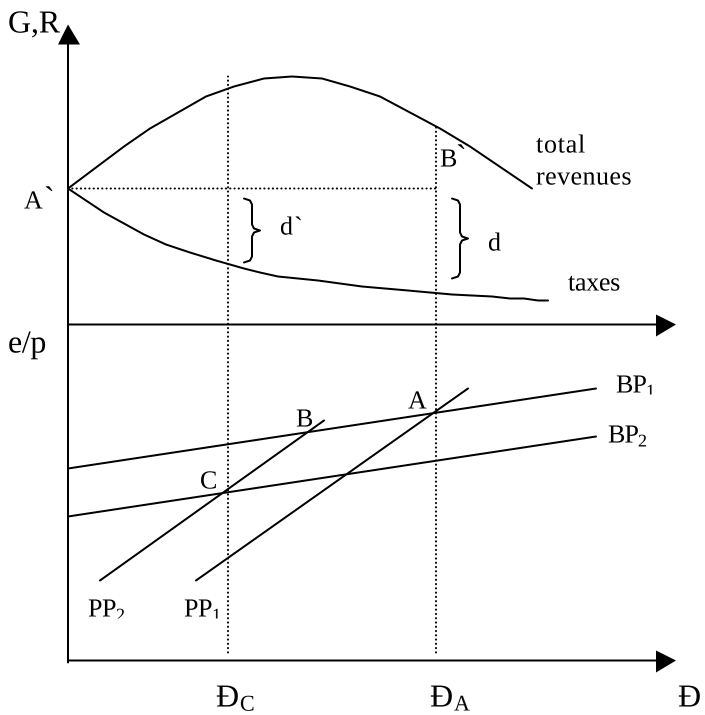
$ø_w = ø_e$



Graph 5-3: External shocks under full accommodation

As monetary accommodation is provided the central banks start issuing new money not only to finance the budget deficit but also to satisfy the private sector's demand for money. The seigniorage created reaches the value of B', though only a portion of it is appropriated by the government. Monetary expansion then runs ahead of the government budgetary needs, as indeed observed during the hyperinflations according to the evidence provided in Chapter 4. As the government perceives that by providing unrestricted monetary accommodation the central bank generates seigniorage that the government does not use, the tendency is for government expenditure to increase in proportion to this "surplus", which would have further inflationary implications.

Graph 5-4: Contractionary monetary policies



The effects of dear money are straightforwards, as seen in Graph 5-4. Dear money shifts BP downwards for it triggers capital inflows and shifts PP inwards for it improves the long run external constraint, or it reduces ø̧. These shifts are reinforced by effects of dear money on aggregate demand and levels of employment[15].

As regards the possible refusal of the monetary authorities to provide accommodation for an external shock, such as the one that drove the economy from A to C in Graph 5-3, it should be noted that at least in theory interest rates could go as high as to erase altogether the inflationary repercussions of the adverse shock. In fact, interest rates should be set in such a way as to prevent any movement of the exchange rate, or to compensate the adverse shock R in full by increased capital inflows ä. r_t and by reductions in the level of employment. The feasibility of such policy choice would

[15] Higher interest rates would also shift the total revenues curve downwards in the upper half of the Graph.

depend on the parameter ä, the responsiveness of capital movements to interest rate differentials, and how high unemployment rates might go and obviously on the "size" of the shock. Similarly, if one thinks on the effectiveness of dear money to bring inflation from an equilibrium point all the way back to zero, the same factors would be important, though instead of the size of the shock it would matter the "size", or the level of inflation.

In more general terms, however, the "existence" of such zero-inflation level of interest rate means little as far as the practical effectiveness of monetary policy is concerned. Interest rates that are too high might have serious effects over the levels of employment, so that one can think of limits beyond which interest rates should not go, and also on the maximum duration of spells of dear money. In fact this brings us back to the issue of the costs of stabilization by means of monetary policy. Open economies can get more mileage out of the monetary restraint, but for high inflation this "bonus" might simply not help and besides it is not clear whether this "bonus" should not be repaid back at some point in the future. As far as the hyperinflations are concerned there are several reasons to be skeptical about the powers of dear money to produce capital inflows or the dishoarding of foreign currencies from domestic residents. In some cases, such as in Hungary and Poland, financial backwardness and low openness combined perversely to reduce the scope for monetary policy. This was not the case for Germany and Austria, though these countries, more than the other two, faced very visible risks of political and economic collapse.

The hyperinflation environment was perhaps the worst possible atmosphere for the workings of a process of arbitraging rates of return. For speculators with foreign exchange there was a problem in responding to high interest rates in the inflation country in the risks involved in reconverting the capital into foreign exchange. This could be solved by purchasing foreign exchange forwards, but this possibility was available only in Germany. In the others three countries interest arbitrage was uncovered, and given that the variance of the errors in exchange depreciation forecast can be thought as proportional to the levels of depreciation, the risks involved were very high. In addition to that, even where arbitrage was "covered", investors could not hedge against errors in the inflation forecasts embodied in nominal interest rates in the inflating country, for changes in these expectations would produce changes in the prices of domestic securities that could inflict capital losses on arbitrageurs. Since the variance of inflation forecast errors was also positively related to the levels of inflation, these risks were certainly very considerable[16].

5.4) A preliminary look at the evidence

The estimation of the model developed in the last sections involves equations in which inflation is explained by inertial factors, by unemployment rates and by interest rates differentials. Since there are no figures for the latter[17] one alternative is to imagine the capital account as governed by the difference between domestic inflation and exchange rate depreciation, which leads to reduced forms in which interest rates do not appear. Another difficulty is that many of the parameters of the model are affected by inflation, such as and ã for example. This implies that a proper econometric estimation may involve techniques that might become very complex. We opted, however, to proceed as if these parameters were unaffected by inflation, which certainly means that better equations can be provided if these interactions are considered.

As a preliminary effort the option of taking these parameters as constantsThe alternative is to estimate a structural equation corresponding to the internal "balance" segment of the model; using equations (7) and (8) one derives:

$$\Pi_t = \hat{m}_t + \theta.\lambda.\gamma.\Pi_{t-1} + \theta.\lambda.(1-\gamma).\hat{e}_{t-1} + (1-\theta).\hat{e}_t - \theta.\sigma.u_t + \Omega.\theta.[\overline{w} - (w/p)_t] \qquad (12)$$

By rewriting equation (3) as:

$$ß_e.(e/p) + ß_u.u_t + ä.(Ï_t - ê_t) = R \qquad (13)$$

it is possible to write:

$$ê_t = Ï_t + (1/ä).[R - ß_e.(e/p) + ß_u.u_t] \qquad (14)$$

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[16] Consider that the rate of return of a security in the inflation country is given by $(r+Ï^e+ê^e)$. Forward markets can eliminate exchange risks and make this equal to $(r+Ï^e+ê)$. It might be that, for instance, this expectation of inflation underpredicted inflation, so that for an unchanged real rate of interest the price of a bond reflecting this rate of return will fall to a discount inflicting a capital loss on the investor. This risk is related to the exchange risk because $Ï_t$ and $ê_t$ are highly correlated, yet there is an independent component that basically relates to changes in the real exchange rate.

[17] For all countries there exist series for the discount rates of Central Banks, which in some cases were not altered more than half a dozen times during the whole episode. Credit rationing was extensively practiced,

which can be substituted into (12) to generate an equilibrium expression for inflation in which interest rates do not appear. The equilibrium expression is:

$$\Pi_t = \phi_0 + \phi_1.\hat{m}_t + \phi_2.\Pi_{t-1} + \phi_3.\hat{e}_{t-1} - \phi_4.u_t - \phi_5.(w/p)_t \qquad (15)$$

where:

$\phi_0 = (1/\delta.\alpha_1).[(1-\theta).R.\alpha_1 + \Omega.\psi_w.\delta.\alpha_1 - (1-\theta).\beta_e.\alpha_0]$

$\phi_1 = (1/\theta)$

$\phi_2 = (\lambda.\gamma)$

$\phi_3 = [\lambda.(1-\gamma)]$

$\phi_4 = [\sigma + (1-\theta).\beta_u/\delta$

$\phi_5 = [\Omega - (1-\theta).\beta_e/\delta.\alpha_1]$

Equation (15) should not be estimated as it stands for there would be a problem of multicolinearity, as lagged inflation and lagged exchange depreciation are correlated, and also in view of the usual problem of residuals correlated with regressors present in regressions with lagged dependent variables. In order to eliminate this problem lagged versions of (15) can be used to substitute recursively for the lagged inflation terms, from which one gets an expression relating inflation to distributed lag versions of exchange depreciation, the real wage and the mark-up change:

$$\begin{aligned}\Pi_t &= \phi_0(1+\phi_2+\phi_2^2+\ldots) + (\phi_1.\hat{m}_t + \phi_1.\phi_2.m_{t-1} + \phi_1.\phi_2^2.m_{t-2}\ldots) + \\ &+ (\phi_3.\hat{e}_{t-1} + \phi_3.\phi_2.\hat{e}_{t-2} + .\phi_3.\phi_2^2.\hat{e}_{t-3}\ldots) - (\phi_4.u_t + \phi_4.\phi_2.u_{t-1} + \phi_4.\phi_2^2.u_{t-2}\ldots) - \\ &- (\phi_5.(w/p)_t + \phi_5.\phi_2.(w/p)_{t-1} + \phi_5.\phi_2^2.(w/p)_{t-2}\ldots)\end{aligned} \qquad (16)$$

In principle an equation like (16) poses no difficulty other than the large number of regressors; successive experimentation shows that the higher order terms are hardly significant so that this does not seem to be a problem. The factors governing the behavior of mark-ups are the level of capacity utilization - which is captured by the unemployment rate - and the variability of inflation. The basic idea is that increasing uncertainty about costs and demand conditions, which is produced by accelerating inflation rates, works like imputed adverse effects on costs and demand which would take the form of increases

so that these rates are certainly not appropriate as expressions of the state of money market; the work done with these rates, understandably, produced questionable results. Cf. S. Webb (1984) and (1985b).

in mark-ups. In this connection, mark-ups should be positively related with inflation variability, and consequently with inflation.

Table 5-1

Hyperinflation countries: Regression results for the inflation equation

(t statistics in parentheses)

country	constant	$\hat{e}_t$	$\hat{e}_{t-1}$	$\hat{e}_{t-2}$	$(w/p)_t$	$(w/p)_{t-1}$	U_t	$ä_t$	R^2	DW
Germany[1]	110.5†	0.23†	0.24†	-0.18$^{\#}$	-1.32†	-	1.81	2.54	0.94	1.63
	(4.3)	(7.4)	(2.8)	(-2.3)	(-4.3)		(1.0)	(1.5)		
Germany	111.2†	0.23†	0.24†	-0.17$^{\#}$	-1.28†	-	-	2.60	0.94	1.62
	(4.3)	(7.5)	(2.8)	(-2.2)	(-4.2)			(1.5)		
Austria[2]	78.1	0.72†	-0.12	-	-2.06$^{\#}$	1.09	0.05	0.12$^{\#}$	0.82	1.37
	(0.9)	(4.8)	(-0.8)		(-1.8)	(0.8)	(0.4)	(2.0)		
Austria	120.8$^{\#}$	0.65†	-	-	-1.55$^{\#}$	-	0.13	0.11$^{\#}$	0.81	1.42
	(2.1)	(5.2)			(-2.0)		(1.3)	(1.9)		
Hungary[3]	-11.2	0.89†	-0.25$^{\#}$	0.15	-	-	0.53	0.11$^{\#}$	0.90	1.58
	(-0.8)	(6.3)	(-2.0)	(0.8)			(0.7)	(2.0)		
Hungary	-11.9	0.90†	-0.26†	-	-	-	0.56	0.10$^{\#}$	0.90	1.45
	(-0.9)	(8.9)	(-2.5)				(0.8)	(2.4)		
Poland[4]	52.0	(1.2)	(13.1)	(2.8)	-0.46$^{\#}$	(-0.6)	(-1.0)	(0.0)	(0.5)	
Poland	72.2†	0.63†	0.13†	-	-0.26		-		0.96	1.96
	(3.2)	(14.4)	(3.0)		(-1.0)	(-2.1)				

SOURCES and OBSERVATIONS: † significant at 1% # significant at 5%. Price data from J. P. Young (1925) vol. I p. 530 and vol. II pp. 322 and 349. Exchange rates figures from Table 4-2. (1) Figures for wages and unemployment from C. Bresciani-Turroni(1937) pp. 449-450, variability indexes from Z. Hercowitz(1981) p.338. The period considered was February of 1921 to July 1923. (2) Wage figures are averages from 8 categories reported in ILO(1925) pp. 85-86, unemployment figures from E. Wicker(1984) p. 11. The period considered was March 1921 to May 1923. (3) Unemployment figures from J. Vägo (1925) p.348. The period considered was June 1922 to March 1925. (4) Wage figures are averages of nine categories reported in ILO(1925) pp.115-116, unemployment figures are from E. Wicker (1984) p. 5. The period considered was March 1922 to April 1924. (5) Moving sum of absolute values of changes in inflation rates except for Germany.

Equation (16) was then estimated by ordinary least squares and the regression results are reported in Table 5-1. Real wages were considered under the assumption that **Ÿw** referred to 1914 levels; Austrian and Polish figures correspond to averages of several categories computed from the reports of the International Labor Office and German figures correspond to wages in the mining industry. Unfortunately there is no available data for wages in Hungary on a monthly basis. Unemployment figures correspond to unionized workers only and the inflation variability index was derived following the methodoloy developed by Blejer (1979)[18].

It is very important to observe that, except for Germany, the periods considered for the estimation of the regressions of Table 5-1 included observations before and after the stabilization. It is remarkable that in[19] view of the dimensions of the data the model could account for the apparent discontinuity represented by the stabilization without revealing any problem of serial correlation; indeed all Durbin-Watson statistics lie on the inconclusive region or rejected serial correlation[20].

The estimated coefficients[21] for exchange depreciation are generally positive and strongly significant except for the twice lagged term for Germany and once lagged term in Hungary. The estimated coefficents for current exchange depreciation for Austria, Hungary and Poland were much larger than the ones for lagged exchange depreciation and also much larger than their degrees of openness, which, according toTable 2-3, are respectively 0.24, 0.18 and 0.12 respectively[22]. This is a powerful indication of the presence of dollarization.

The wage push terms present everywhere the right sign and are generally significant. Note that according to (13) the coefficients for (w/p)t should be equal to .ø , considering the values of ø as determined by one minus the observed degree of openness mentioned above, one would obtain values for of 1.54, 2.10 and 0.68 respectively for Germany, Austria and Poland. In Germany, for instance, if real wages are only 80% of

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[18] According to whom the inflation variability index is defined as a five period moving sum of absolute values of changes in the rate of inflation. See M. Blejer (1979) and E. Foster (1978) for a discussion. For Germany an index for the variability of relative prices computed by Z. Hercowitz (1981) was used with similar results.

[19] We did not consider the last four months of the German episode for which inflation rates reached an entirely different order of magnitude, appearing to explode. Something qualitatively different seems to happen at this point and it appears that this should be taken as the true frontier between an ordinary high inflation and an hyperinflation .

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[21] For simplicity the influence of inflation over and © was ignored in the econometric exercise.

[22] Degrees of openness are defined as the ratio of the value of foreign trade divided by twice the value of GNP or the average of exports and imports divided by GNP from Table 3-3.

the target then the wage push would add between 5% and 8% to the inflation rate every month if the gap persists; for a similar gap in Poland the wage push would result in additional 10% to 15% on the inflation rate and for Austria the results are less clear[23]. The unemployment coefficient is nowhere significant[24] and it also appears with a positive sign which is not consistent with the usual Phillips' curve effect and seems compatible with mark-ups being negatively related to capacity utilization. The inflation variability coefficient is everywhere positive as expected though it is significant only for Hungary and Austria.

These results should be seen with caution as we are estimating a structural equation and we do not have the proper instruments to correct for possibly inconsistent estimates. Another difficulty relates to the fact that the degrees of indexation ë, dollarization (1-ã) and wage push strenght are positively related with inflation; this would create non-linearities that would require substantially different methods of estimation. Yet, in order to assess the damage that could produced by this problem Chow tests separating the first and the second half of the period used for the regressions of Table 5-1 were performed. The test statistics did not indicate significant differences in the coefficients[25], which could be an indication that the process of adoption of indexation had already taken place before.

5.5) Summary

This chapter's basic objective was to model what emerged from Chapter 3 as the fundamental imbalances behind these inflationary spurts in light of the results of the last chapter, namely that money most likely played a passive role in these episodes. The

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[23] The computation procedure is straightforward: the wage-push contribution to inflation is equal to the intercept minus .ø times the level of real wages considering the target as equal to 100. Considering the first regression for Germany, for example, it would be 110.5 minus 1.32 times 80 equaling 4.9%. For Austria the second regression appears to indicate that the wage push would cease for real wages approximately equal to 77% of pre-war levels, which might be due to poor estimates.

[24] One possible explanation could be multicolinearity as (w/p) appear simultaneously with unemployment in the equations. But removing (w/p) from the equations does nothing to improve the estimates of the coefficients for the unemployment variable.

chapter developed a simple model of "inertial inflation" following the more recent work of Latin American inflations of the 1980s in which the presence of significant external imbalances and a wage push in a flexible exchange rates framework could generate very high levels of inflation. Both the model itself and the econometrics could surely be subject to improvement, but the very essential point of the whole exercise was to argue for the viability of an "alternative" or a non strictly monetary explanation for the hyperinflations. This attempted rehabilitation of the "balance of payments" explanation of the hyperinflations is not seriously damaged by the simplified nature of the exercise. In fact, having performed well in such simple terms does just the opposite.

[25] The test statistics were 1.06, 0.61, 1.32, and 3.02 for Poland, Germany, Austria, and Hungary; the critical value of the F statistics for all cases was around 4.5.