Chapter 4

Theory and practice of inflationary finance

4.1) Introduction

For many authors the collection of the so called "inflation tax" provides the main justification for the existence of inflation in genaral and of hyperinflations in particular. Most economists are, however, receptive to non-monetary causes of inflation, but for such extraordinary cases this is rarely found. Conventional views on the hyperinflations are heavily influenced by the works of Philip Cagan [1956] and Thomas Sargent [1982], which, as it is well known, carry extreme views on the nature of the inflationary process that do not enjoy this same acceptance as far as "ordinary" inflations (these being OECD type inflations and even Latin American inflations) are concerned. The experience of the 1970s and early 1980s did much to blur the frontier between what should be conceded to these extreme views, and what should be explained by other influences. This is not merely a product of economists celebrated pragmatism: there is an extensive list of suggestive similarities between the 1970s and the 1920s, including huge external shocks, large transfers, impossible debts, flexible exchange rates and high inflations[1]. It makes little sense, at least at a first sight, to imagine that the so called hyperinflations would have been less affected by such non-monetary influences than the semi-hyperinflations of today.

Inflationary finance occupies a distinguished place in descriptions and explanations of hyperinflations, but as this chapter will try to argue, the purely monetary models of inflation display a surprisingly little explanatory power when applied to these episodes. This chapter provides a revision of these models and a number of observations and tests of their applicability to the hyperinflations. The next section reviews seigniorage maximizing models and also models of the monetary dynamics of inflation improving upon the original Cagan's model. It also checks whether the observed patterns of collection of seigniorage and the so called "inflation tax" are consistent to the predictions of these models. The poor performance of monetary models to explain the hyperinflation leads one to conjecture that after all it might have been that other non-

[1] M. de Cecco (1983 and 1985); T. Balogh & A. Graham (1979); R. Aliber (1980); J. A. Frenkel (1978); and A. Fraga (1984).

monetary influences were the true driving forces of these episodes. Section 4.3 advances this conjecture and considers several indications pointing towards the endogeneity of money. Section 4.4 summarizes the main fundings.

4.2) Monetary model of high inflations

There is a great variety of models in which inflation is determined solely from the demand and supply of money. These models can be distinguished by their specification of the demand for money, the process of expectations formation and the government's budget and objective function. The money demand most usually assumes an exponential specification - following the pioneering work of Cagan (1956)[2] - that sometimes considers changes in real income and wealth[3] and sometimes is defined in a dynamic context[4]. Adaptative expectations are commonly found, though this had generated objections even before the more recent efforts towards reconciling rational expectations and the autoregressive structure of money demand[5]. As regards the government's budget and objective function, a common alternative is to consider a government maximizing the proceeds of the inflation tax[6], sometimes considering the welfare costs of inflation[7]. The most usual procedure, however, is to assume that, following Cagan (1956), the inflation tax should finance an exogenous budget deficit, which may be also sensitive to the effects of inflation over tax revenues, that is, to the "Oliveira-Tanzi" effect[8].

The great variety of models could in principle justify the wide diversity of predictions, especially as regards the dynamics of inflation. Yet, with respect to the "optimal" inflation - something that evidently only makes sense in maximizing models - it is interesting to note that the great majority of models lead to variations around the

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[2] There has been some experimentation with other functional forms, such as in R. Jacobs (1977a), R. Barro(1972) and J. A. Frenkel(1977 and 1979).
[3] For example M. Friedman (1971), R. Mundell (1971) , A. L. Marty (1973) and E. Tower (1971).
[4] As in C. Cathcart (1974) and B. Aghevli (1977) and also in some of the more recent intertemporal rational expectations models: G. Calvo (1978), R. Barro (1983) and N. G. Mankiw (1987).
[5] As for example in L. Sjaastad (1976) and H. Johnson (1977).
[6] As in M. Friedman (1971), C. Cathcart (1974) and R. Barro (1983).
[7] As in M. Bailey (1956), C. Cathcart (1974) and A. L. Marty (1973).
[8] As in J. H. G. Oliveira (1967) and V. Tanzi (1977 and 1978). See also B. B. Aghevli (1977) & M. Khan (1978) and L. Summers (1981).

classical Friedman & Cagan solution, namely that inflation should be constant and equal the reciprocal of the interest semi-elasticity of the demand for money[9]. Yet high inflations are invariably unstable and observed rates are often higher than the "optimal" seigniorage maximizing levels, as recognized by Friedman himself[10]. The hyperinflations are no exception, as seen in Table 4-1:

Table 4-1
Alternative Definitions of the "Optimal" Inflation and Actual Inflations

Country	"Optimal"	Actual	Standard deviation	Period
Austria	20.2	32.6	35.7	Feb.1921/Sep.1922
Hungary	46.8	29.6	26.2	Jul.1922/Feb.1924
Germany	24.9	41.8	61.0	Aug.1920/Jul.1923
Poland	39.5	52.8	61.7	Apr.1922/Jan.1924

SOURCES and OBSERVATIONS: ßs are medians from Table A4-1. Figures from J. P. Young (1925), vol.I p. 530 and vol.II pp. 322 and 349 and in J. Van Walré de Bordes (1925) p. 83.

Table 4-1 shows estimates for "optimal inflations" according to the classical Friedman & Cagan criteria, computed from estimates of the interest semi-elasticity of the money demand discussed in the appendix. More important than the large discrepancies between "optimal" and actual levels is the extraordinary variability of actual inflation rates, by consequence of which the averages for observed rates are very sensitive to the choice of period. If, for exemple, we included the last four months of the German inflation in the period relevant for the definition of the actual rate in Table 4-1, this would raise it to 1,310%, which evidently turns meaningless the notion of an "optimal" inflation. Althought it has been conjectured that the discrepancies might be due to bad estimates of the interest semi-elasticity of the demand for money[11], the important pont is that no arbitrary concept of "optimal" inflation, especially when predicting a constant inflation rate, is consistent with the variability displayed by the data[12].

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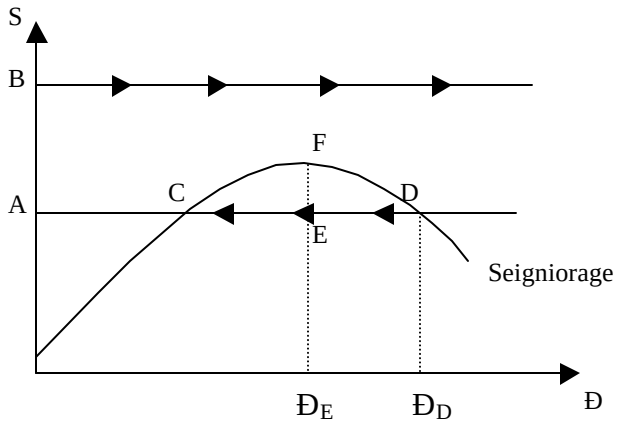
[9] That follows from maximizing the revenues of the inflation tax, namely .(M/P), subject to a money demand function with an exponential specification.
[10] M. Friedman (1971) p. 853.
[11] T. Sargent (1977) p. 429.
[12] Alternative concepts are offered by C. Cathcart (1974), R. Jacobs (1977a) and R. Barro(1972 and 1983) for example.

There are, however, two interesting alternatives, both of which derive seigniorage maximizing inflation rates that are random walks. One is provided by Barro (1983) in whose model the government's objective function includes a stochastic term as it is assumed that its willingness to pursue inflationary finance is described by a random walk. The other, recently advanced by Mankiw (1987), is based on the idea that the smoothing of tax rates and seigniorage over time implies that inflation should be also smoothed which would make it a random walk[13]. Promising as it seems, however, a convincing explanation of the dynamics of hyperinflation along these lines has not yet been produced.

4.3) The monetary dynamics of the hyperinflations

As one moves towards the family of monetary models of inflation built around Cagan's original work, the landscape becomes much more diffuse, as the great variety of models deliver many different stories about the dynamics of inflation. Many different uthors improved Cagan's model in many directions, as discussed in the appendix, in order to obtain better estimates for the demand for money. There has been, on the other hand, relatively less effort to explain some quite peculiar empirical aspects of the hyperinflations, most notably the observed patterns of seigniorage collection[14]. The way the dynamics of inflation relates to the collection of seigniorage varies according to the specifics of each model, but some common features are surely to be found. It is generally agreed that the steady state representation of the behavior of seigniorage collection - which in this case is identical to the inflation tax - is given by a Laffer curve type function, as seen in Graph 4-1:

[13] That follows from the equality of the marginal social cost of inflation today and in the future; actually the same principle through which the smoothing of consumption by consumers makes consumption a random walk.
[14] Some exceptions are T. Sargent & N. Wallace (1973) and A. Cukierman (1988).



Graph 4-1: Seigniorage and the inflation tax

The graph pictures the revenues from the collection of seigniorage, or the inflation tax revenues, if expectations of inflation are correct. The curve's format implies that the same revenue can be obtained by low inflation and a high level of real money balances or the reverse: high inflation and low real balances. When the economy is out of the steady state, or when seigniorage is different from the inflation tax, the adjustment of inflation is described by the arrows in the graph. The reasoning is quite simple: if money growth outpaces inflation, of if seigniorage exceeds the inflation tax, the money issuing authority is attempting to force agents to hold more real balances than they otherwise would. Inflationary expectations, and inflation, should then be adjusted upwards and real balances would fall further. It might be, on the other hand that money growth is set equal to inflation, or that real money balances are constant, in which case if the economy is above the steady state curve in Graph 4-1, this means that the inflation tax collected at this given level of inflation is higher than what would be possible in steady state. This would imply an underestimation of inflation, and consequently an upwards adjustment of expectations[15]. In sum, if seigniorage collection exceeds the inflation tax, as in the region above the curve, inflation should be accelerating and conversely should be deccellerating if the economy is inside the curve.

There are basically two ways by which a hyperinflation could be generated in this

[15] It should be, in this case, that Ï.á.exp(-ß.Ï) > Ï. á.exp(-ß. Ïe), which implies that Ïe > Ï. If Ï=ö.(Ï-Ïe), if follows that Ï >0.

model[16], one is to consider a budget deficit that is larger that the maximum steady state seigniorage collection given by point F, represented by point B in Graph 4-1. This would correspond to a strictly monetary hyperinflation in the sense of no other influence intervening in the process: once the budget deficit is fixed at B, inflation would accelerate continuously. The other is when the economy is outside the curve at its right side or for points, for instance, to the right of D. Note that in this case, it is assumed that some non-monetary shock has to drive the economy to the instability region. Another shortcoming of this sort of model is that no indication is provided on how the initial levels of inflation, as for example point D in Graph 4-1, were reached. In ignoring this problem one is actually doing away with the most important and perhaps the only relevant part of the problem, namely how monthly inflations of 30% or 40% developed. In any event, it is generally assumed that the hyperinflations of the 1920s corresponded to a process of the first type, a claim whose empirical verification could surely be undertaken simply by computing the amounts of seigniorage collected and the amounts of revenues through the inflation tax.

Note, however, that while seigniorage collected is an empirically observed magnitude - deflated additions to high powered money - the "inflation tax" is not, since expectations are not directly observed. On the basis of money demand equations, however, one can compute the inflation tax that could be collected if inflation is correctly predicted, namely (Ï.á.exp (-ß.Ï)). By comparing this magnitude with the one for seigniorage collected one would have an indication for the direction of the adjustment of expectations or of acceleration of inflation as determined by the monetary dynamics discussed above.

Table 4-2 below shows quarterly averages for the ratios between the amount of seigniorage effectively collected - changes in the money supply deflated with exchange rates - and the inflation tax under correct antecipations, and also the quarterly averages for monthly inflation rates in the respective quarter. Methodological details and sources are discussed at lenght in the appendix. Note that for ratios greater than one, i. e.

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[16] Some exceptions are T. Sargent & N. Wallace (1973) and A. Cukierman (1988).
An explosive inflation may also take place if the adjustment of expectations and the response of real cash balances to expectations is "too fast", which takes place in the case of what has been called a "self-

seigniorage greater than the "virtual" inflation tax, an accelerating inflation should be observed, and for ratios lower than one the opposite obtains, namely a deccelerating inflation.

The table shows a number of high ratios early in the hyperinflation period; except for the first quarter in Austria and Poland all these quarters correspond to periods of price stability or deflation, so that these are situations in which the economy was outside the seigniorage curve but at the left side. Other than that consistently low ratios are observed for Hungary, and ratios on the high side in Poland and Austria. In Germany after 1922-IV and in 1921-IV Austria we observe ratios greater than one that coincide with jumps in inflation, yet an explosive inflation is not observed after that; Austria would return to the inside of curve the next quarter and the German ratios would show declining values until 1923-III. Polish and Hungarian ratios show a high value in the very last quarter though for the latter this corresponded to the post stabilization remonetization of the economy. Only in for the very last quarter in Germany, Poland and Austria there is indication of these economies being well out of the curve. It should be noted, however, that these quarters encompass the stabilizations, which, by virue of the remonetization process, might have biased these ratios upwards. In any event, only in Germany an unambiguous inflationary "explosion" is observed.

The ratios reveal, therefore, that these countries did not experience Cagan hyperinflations of the second sort except perhaps at their very ends; that means basically that the model does not explain how the extremely large level of inflation of the pre-explosion quarters (61% for 1922-III Germany, 42.9% for 1924-I Hungary, 57.8% for 1923-III Poland and 35.5% for 1922-II Austria) were reached. Aparently, therefore, these levels of inflation were generated by non-monetary influences.

These conclusions are reinforced in the context of a simple and interesting extension of this basic framework, namely the consideration of the Oliveira-Tanzi effect. When considering an "endogenous" budget deficit one should note that government should be aware that some of the revenues it gains from inflation - if on the rising portion of the seigniorage curve -is wasted by decreases in the yield of ordinary taxation. In this

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generating" inflation. Cf. P. Cagan (1956) p. 72; B. M. Friedman (1975) and D. A. Peel (1978). This possibility however is of a reduced practical interest.

connection, governments should be concerned with total revenues, namely taxes plus seigniorage.

Table 4-2
Seigniorage Actually Collected as a Proportion of Steady State Levels
(quarterly averages-the number in parentheses indicate average monthly inflation rates in the respective quarter)

		Germany		Hungary		Poland		Austria	
date		ratio	inflation	ratio	inflation	ratio	inflation	ratio	inflation
1921 -	I	0.23	-3.6	-0.27	-5.2	1.07	15.0	1.24	6.6
	II	3.93	0.7	0.21	-8.2	4.50	2.2	2.70	2.2
	III	0.35	15.3	0.39	15.3	0.44	19.5	0.53	8.6
	IV	0.72	20.0	0.47	7.4	-4.07	-1.4	1.33	64.0
1922 -	I	0.21	16.4	0.29	9.6	0.26	8.9	0.77	14.8
	II	0.51	9.1	0.29	11.4	0.70	6.1	0.69	35.5
	III	0.69	61.0	0.43	27.4	0.70	20.5	3.67	85.5
	IV	1.83	76.0	0.42	8.3	0.57	31.5	-	-
1923 -	I	1.60	59.0	0.16	27.2	0.76	43.3	-	-
	II	1.37	66.9	0.40	30.2	0.62	26.7	-	-
	III	$8.1x10^{31}$	1942	0.79	59.8	0.97	57.8	-	-
	IV	-	-	0.55	12.9	6.87	177	-	-
1924 -	I	-	-	0.35	42.9	-	-	-	-
	II	-	-	4.78	2.1	-	-		

SOURCES and OBSERVATIONS: see appendix

It has been shown that the format of the "toatal revenues" curve is similar to the one of the seigniorage curve in Graph 4-1. The peculiar features are that the maximum for total reveunes obtains at a level of inflation lower than the one that maximizes seigniorage, and that under price stability total revenues are positive and identically equal to tax revenues. The implied dynamics of inflation is also quite similar to the one pictured in Graph 4-1. Since taxes are collected on the basis of observed inflation, i. e. T=T(Ï), if the economy is above the total revenues curve, or if government expenditure G is greater than T(Ï) + Ï.á.exp(-ß. Ï), then the fiscal deficit G - T(Ï) which is identically equal to the amount of seigniorage collected - is greater than the inflation tax which is given by Ï. á.exp(-ß.$Ï^e$), so that, as in the previous case, one would have an acceleration of inflation.

Table 4-3 repeats the exercise of Table 4-2 by showing ratios between revenues actually collected as seigniorage and taxes and the revenues that could be collected at that rate of inflation in a steady state, i. e. the relevant point of the total revenues curve. Since

it amounts to summing tax revenues to both terms of the ratio, Table 4-3 reproduces the results of Table 4-2 though in a reduced scale: the instability region is still at one but all ratios are now uniformly reduced. For Hungary, for exemple, the ratios does not reach one not even in the very last quarter. For Germany and Austria the economy is driven out of the curve in 1922-IV and 1921-IV respectively, when inflations registered a large jump. Yet, the tendency was for these economies to return to the curve; in 1923-II Germany appeared to be nearly on the curve and Austria well inside in 1922-II. Again an unambiguously "explosive" behavior is only observed in 1923-III Germany.

Table 4-3
Total Revenues (Seigniorage plus Taxes) Actually Collected as a Proportion of the Steady State Levels
(quarterly averages-the number in parentheses indicate average monthly inflation rates in the respective quarter)

		Germany		Hungary		Poland		Austria	
date		ratio	inflation	ratio	inflation	ratio	inflation	ratio	inflation
1921 -	I	1.77	-3.6	0.77	-5.2	0.55	15.0	0.74	6.6
	II	1.17	0.7	0.53	-8.2	0.66	2.2	0.83	2.2
	III	0.55	15.3	0.42	15.3	0.32	19.5	0.51	8.6
	IV	0.61	20.0	0.43	7.4	0.58	-1.4	1.12	64.0
1922 -	I	0.40	16.4	0.37	9.6	0.37	8.9	0.56	14.8
	II	0.58	9.1	0.37	11.4	0.53	6.1	0.59	35.5
	III	0.64	61.0	0.41	27.4	0.47	20.5	2.01	85.5
	IV	1.06	76.0	0.32	8.3	0.42	31.5	-	-
1923 -	I	1.01	59.0	0.23	27.2	0.54	43.3	-	-
	II	0.97	66.9	0.32	30.2	0.61	26.7	-	-
	III	$2.6x10^9$	1942	0.73	59.8	0.71	57.8	-	-
	IV	-	-	0.46	12.9	1.87	177	-	-
1924 -	I	-	-	0.40	42.9	-	-	-	-
	II	-	-	0.96	2.1	-	-	-	-

SOURCES and OBSERVATIONS: See appendix.

In sum the evidence displayed in Tables 4-2 and 4-3 suggest that these hyperinflations were not generated by the necessity to collect seigniorage above the steady state values, or the values for the inflation tax. Apparently, this would have been observed, and not in an unambiguous manner, in the very last quarters of these episodes. Even if it is case of a hyperinflations of the second sort, the important conclusion is that the monetary dynamics does not explain how these hyperinflations started and how they

reached the extremely high levels observed in the months preceding their entrance in the instability region.

4.3) Endogenous money?

Last section presented a disapointing picture of the performance of monetary models in explaining the hyperinflations. The provocative hypothesis that the hyperinflations could be generated by non-monetary forces emerges from these findings and should surely be given a further examination. This section attempts to assess the extent to which one can legitimate consider "passive money" as a sound description of the dynamics of the money supply during these episodes.

The fact that the predicitons of seigniorage maximizing models have not been borne by the evidence leaves the empirical support to monetary models of (hyper)inflation restricted to the remarkably successful empirical performance of money demand estimations. It is indeed extraordinary that money demand relationships have held their own under such extreme conditions. No doubt the success of Cagan's pioneering work have certainly played a part in the initial impulse given to the "monetarist couter-revolution" by Friedman's 1956 classic "Studies in the Quantity Theory of Money".

Yet, the empirical stability of the money demand relation does not bring any implication as regards the monetary origin of inflation. Causality might certainly run both ways; the correlation in itself would establish nothing. In this respect Granger causality tests involving money and prices have been performed by authors such as Frenkel [1977] and Sargent & Wallace [1973], and their results favored strongly the hypothesis of prices Granger-causing money creation. Using wholesale prices data for Germany, Frenkel rejected the hypothesis that prices did not "cause" money and was unable to reject that money did not "cause" prices; using CPI figures Frenkel detected a two-way causality [pp. 666 - 667]. Similarly, Sargent & Wallace rejected the hypothesis that prices did not Granger-cause money creation for Germany, Austria and Hungary (though not for Poland), and did not reject that money did not Granger-cause prices for all four countries [p. 419]. Box Jenkins time series analysis were employed by Frenkel and also by Evans

[1978] for the German case, and the former rejected the hypothesis of independence between money and prices [p. 665] and the latter more specifically rejected the exogeneity of money [pp. 202-204]. The latter result has been challenged by Protopapadakis [1983] who also argued that the money supply process appears exogenous with respect to the revenue needs of the government [pp. 86-91]. Steven Webb [1984; 1985]'s modeling of the money supply process in Germany concludes that, in addition to the government needs, corporate needs for credit and expectations of inflation were also prime determinants of the money supply.

A second indication favouring the passive money hypothesis is the fact that the implied patterns of collection of seigniorage under passive money are consistent with the evidence presented in tables 4-1 and 4-2. To see this consider that significant inflationary shocks are generated outside the monetary sector, as one knows was exactly the case in the twenties. Jumps in prices (in the exchange rates for example) then catch both the public and the central bank by surprise. Note that in these conditions prices have gone up before the increases in the money supply necessary to accommodate the shock have been implemented, so that the "surprise" does not imply in any extra seigniorage collection. Yet, the inflation tax is effectively collected, no matter the speed of adjustment of agents' expectations. The amounts collected can simply be read in Graph 4-1's curve, if expectations adjust very fast. Since the seigniorage revenues have not materialized because the Central Bank was surprised it follows that it is a charateristic feature of non-monetary shocks that the ratios of tables 4-2 and 4-3 - i. e. between seigniorage and the inflation tax under correct antecipations - fall below one. The hesitation of the central bank in accommodating the shock - which exactly what produces ratios below one - should produce a monetary stringency i. e. high real interest rates or credit rationing, as indeed observed in these episodes. Therefore, if inflation is predominantly governed by non-monetary shocks the economy should remain mostly inside the seigniorage (or the total revenues) curve.

Another indication of the the feasibility of the passive money hypothesis is provided by Table 4-4 assessing the extent to which budget deficits explain the expansion in the money supply. The reasoning is the following: after a non-monetary shock the amounts of seigniorage, which are equal to the budget deficit, are lower than the value of

the inflation tax, which generates a monetary stringency as the central banks takes some time to accommodate the shock. Banks of issue working under the "real bills" doctrine would then expand the money supply discounting private bills, thus solving the stringency and collecting seigniorage that the government abstains from collecting once the budget deficit, or the discounting of government bills at the central bank, is assumed fixed. The relative importance of private bills vis-à-vis government bills - the floating debt - provides then a measure of the importance of this mechanism for the expansion of the money supply. Table 4-4 shows actually the importance of increases in the floating debt as determinants of the money supply.

Table 4-4
Increases in the Floating Debt as a Proportion of the Increases in the Money Supply
(quarterly averages)

date	Germany1	Hungary2	Poland2	Austria3
1921 - I	-	-	1.38	-
II	1.91	-	1.29	3.20
III	1.75	-	0.95	1.05
IV	0.84	0.21	0.56	0.74
1922 - I	0.80	0.51	0.52	0.75
II	0.94	0.67	0.06	0.51
III	0.74	0.07	0.65	0.60
IV	0.60	0.46	1.01	0.54
1923 - I	0.56	0.80	1.03	-
II	0.71	0.43	0.72	-
III	1.01	0.38	0.95	-
IV	-	0.43	0.88	-
1924 - I	-	0.50	-	-
II	-	0.53	-	-

SOURCES and OBSERVATIONS: (1)Considering only floating debt held at the Reichsbank as proportion of the increases in note circulation plus demand deposits, from J. P. Young [1925, vol.I, pp. 527-529]. (2)Figures from J. P. Young [1925, vol.II, pp. 347-348 and 321-322]. (3)Figures from J. van Walré de Bordes [1924, p. 54].

Table 4-4 reveals that monetary expansion in excess of the government budgetary needs is very often observed. For Hungary the ratios are consistently low indicating that "private inflation", or note issuing against credit creation through discounting of "legitimate" trade bills, was the more important source of money creation during the

whole period[17]. This is also true for Austria[18]. For Poland, high numbers for the first three quarters of 1921 and after 1922-IV are observed. For the earlier period this could still be associated with aftermath of the war with the Soviet Russia, and for the later period the higher ratios are consistent with the significant increase in government investment expenditure (and budget deficits) after the collapse of the Michalski's stabilization experiment and the annexation of Upper Silesia in the summer of 1922. Government deficits were the main determinant of money creation from then on, but for the last three quarters of 1923 "private inflation" was still significant. For Germany one observes especially high ratios in 1921-II and III, a period in which money creation was held off but reparations payments under the London schedule precluded the corresponding fiscal restraint. The ratios are generally high for Germany indicating that government spending was indeed the major determinant of money creation; but as for Poland "private inflation" remained quite significant throughout 1922 and 1923.

The importance of budget deficits as determinants of the money supply in Germany and Poland in itself is not inconsistent with inflationary shocks being generated from non-monetary forces, for what might be taking place is that government expenditure would be adjusting to the availability of funds created by the seigniorage generated in accommodating the current levels of inflation. The government could very well perceive that as the bank of issue accommodates a shock it generates sizeable amounts in the form of seigniorage, which would ultimately benefit these bank's shareholders. Thus, it might surely be that governments raise expenditure to capture these funds; the levels of expenditure would be endogenous. This can also be subject to verification; it is fortunate that Poland and Germany are precisely the two countries for which there are figures available for government expenditure on a monthly basis.

If the level of government expenditure adjusts fully to the availability of seigniorage one should expect the former to be always on the total revenues curve, so that the relation between government expenditure and inflation would be described by a

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[17] This finding is in full accordance with the detailed account of E. Boross (1985) of the activities of the Hungarian Note Institute during the inflation period, esp. pp. 208-209 .

[18] The high ratios observed in 1921-II and III are due to the fact that up to this point the discounting of Treasury bills was not distinguished from private bills and when this started to be done we observe a large "statistical" increase in the floating debt at the central bank. J. van Walré de Bordes (1924) p. 54 ff.

parabola, i. e. it would have the shape of the total revenues curve. If, instead, government expenditure adjusts only partially, money creation against "real bills" would take up the "slacks" and place the economy always on the curve. The relation between government expenditure and "private inflation" is subtle: if the level of government expenditure is low, presumably in the beginning of the process, both expenditure and "private inflation" could move in the same direction so as to approach the economy to the total revenues curve. But as expenditure is progressively adjusted upwards the "slack" under the curve is reduced and expenditure and "private inflation" begin to "compete". In this case government expenditure most likely "crowds out" credit creation against "real bills". In this case a negative correlation would be observed between the two, while for the first case (low levels of expenditure/low levels of inflation), a positive correlation can be observed. These possibilities, along with the exogeneity of government expenditure, could be given a preliminary empirical check by means of the estimation of the following equation:

$$G(\ddot{I}) = a.\ddot{I}^2 + b.\ddot{I} + c + d.(B/P)$$

If the relation between G and Ï is described by a parabola it should be that $a<0$ and $b,c>0$. The coefficient for the "private inflation" variable - here measured as the real value of credit extended to the private sector (B/P) -would be negative, i. e. $d < 0$, if the economy is close to the total revenues curve, and could be positive if the economy is inside the curve. Alternatively, if the hyperinflation is governed by a "helicopter drop" process, or if uncontrolled additions to the money supply determined by a huge budget deficit provide the driving force of the process, then G should show no correlation with inflation, so $a = b = 0$, and neither with the amount of credit given to the private sector. The results of the estimation of the G(Ï) equation are reported in Table 4-5. Table 4-5 reports regressions for Germany and Poland. The Polish equation includes a trend term which has to do with the fact that Poland as a country was created in 1918; one observes during the first years of the new republic, at least until the mid 1920s, a continuous growth of the public sector as natural part of the process of nation building. A simple yet certainly imperfect way to control for that is to introduce the trend term which appears in th table as positive and significant. The "private inflation" variable was the real value of the change in the stock of commercial bills and advances extended to the private sector.

All equations include dummy variables accounting for a few outliers observed in the series for G.

Table 4-5
Regressions of Government Expenditure on Inflation and "Private Inflation"
(t statistics in parentheses)

country	aÏ^2	bÏ	const.	d B/P	dummy	trend	R^2	DW
Germany[1]	-0.07	22.3	459.7	-1834	394.8	-	0.751	1.42
	(-4.88)	(4.93)	(10.1)	(-2.63)	(4.96)			
Poland[2]	5.15	-29.5	45.6	25.0	41.9	2.13	0.875	1.71
	(1.56)	(-3.42)	(11.5)	(1.72)	(4.34)	(5.54)		
Poland[2]	-	-18.5	42.1	-	39.7	2.59	0.844	1.63
		(-5.21)	(10.9)		(3.93)	(10.3)		
Poland[2]	-	-21.6	19.1	-59.3	44.2	4.16	0.875	1.69
		(-4.60)	(1.94)	(-1.12)	(4.39)	(4.38)		

SOURCES and OBSERVATIONS: (1)Government expenditure data in millions of gold marks deflated with exchange rates. The period considered was January 1921 to June 1923. The figures are from Republic of Germany[1924, p. 32]. The "private inflation" variable was the real value of the change in the stock of bills discounted and advances extended to the private sector as reported in J. P. Young [1925, vol.I, pp. 526-529] deflated with exchange rates. (2)Government expenditure data in millions of zloty for January 1922 to April 1924 from Republic of Poland [1926, pp.173-177]. The "private inflation" variable considered was the real value of the change in the stock of bills discounted to the private sector from J. P. Young [1925, vol. II, pp.348-349] deflated with wholesale prices.(4)For sources for price data see Table 2.

The regression results for Germany provide full support for the hypothesis of government expenditure adjusting to changes in inflation rates; the signs are the ones predicted, namely $a<0$ and $b>0$, and all coefficients are significantly different from zero at 1%. The hypothesis of an exogenously given level of government expenditure is rejected. The results for Poland are less clear, which to a significant extent is explained by the small size of the sample, which includes obsrvations only for the high inflation period. A negative correlation between G and Ï is observed suggesting that the sample includes observations in the declining portion of the curve.

4.4) Summary and conclusions

This chapter reviewed the monetary models of inflation that are usually assumed to describe the hyperinflations and considered their empirical relevance. Theories of

"optimal" - seigniorage maximizing - inflation were shown to be inconsistent with the extreme variability of inflation rates observed in these episodes, and the observed patterns of collection of seigniorage and the inflation tax were shown to be inconsistent with the descriptions of the dynamics of inflation provided by models of the Cagan family. In fact, it was shown that the monetary dynamics could only have had some effect at the very end of these episodes, most likely in Germany. This is, however, hardly a victory for monetary models since no explanation is provided on how the "pre-explosion" rates of inflation were reached (German inflation averaged between 60% and 70% monthly for the quarters before she fell into the instability region).

This poor record leads one to conjecture on the role effectively played by money in these episodes. Several indications are then provided that point towards the hypothesis of passive money, and the idea that inflation was governmed by shocks originating from the outside of the monetary sector. In fact, the hypothesis of a passively determined money supply is consistent with the evidence presented that seigniorage revenues fell most often below the amounts collected as inflation tax. Causality tests were shown to be consistent with "passive money" and also the fact that monetary expansion was very often far in excess of the government budgetary needs points likewise. Where budget deficits seemed to governed the money supply, namely in Poland and Germany, it was possible to show that government expenditure seemed to adjust according to the availability of seigniorage funds created by the accommodation of non-monetary shopcks.

In sum, the evidence presented in this chapter provides no support for the presumption that the collection of seigniorage was the one and only purpose of the four hyperinflations examined. These governments not only did not maintain inflation at their "optimal" levels, but they also failed even to reach the total revenues (seigniorage) curve. These conclusions certainly help to do away with preconceived ideas about the hyperinflations, but they provide little information on how these episodes were generated. This is a challenge yet to be properly faced.

Appendix

The computation of the magnitudes of the inflation tax (and the ratios reported in tables 4-2 and 4-3) is crucially dependent on assumptions regarding the money demand function, or more precisely - if we accept the usual exponential specification (á.exp(-ß.Ð) - on the estimates of the parameters: á and ß, respectively the demand for money at zero inflation and the interest semi-elasticity of the demand for money. For á we had to consider the observed values for the years imediately following the stabilization - 4,200 million gold marks for Germany, 394 million gold crowns for Hungary, 550 million zloty for Poland and 543 million gold crowns for Austria - since estimates for this parameter are not usually reported in money demand equations. For ß, on the other hand, there are many different estimates. Since Cagan's seminal work on money demand equations during the hyperinflations there has been more than one dozen reviews, refinements and replications of Cagan's results using the most varying methodologies[19]; Table A4.1 reports a somewhat arbitrary sample of estimates of ß obtained in several of these revisions.

Table A4.1
Alternative Estimates of the Interest Semi-Elasticity of the Demand for Money

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
country	Cagan	Khan	Jacobs	Khan	Frenkel	Jacobs	Jacobs	Sargent	median	mean
Austria	8.55	5.41	7.67	4.50	-	7.71	2.78	0.31†	4.96	4.88
Hungary	8.70	1.09	-	1.90	-	3.88	2.37	1.84	2.13	3.23
Germany	5.46	1.12	3.70	4.34	3.51	4.34	3.03	5.97†	4.02	3.34
Poland	2.30	1.23	-	2.53	-	3.65	2.62	2.53	2.53	2.48

† Not significantly different from zero. SOURCES and OBSERVATIONS:(1)P. Cagan [1956, pp. 43, 45]. (2) M. S. Khan [1975, p. 359]. (3) R. L. Jacobs [1977b, p.118]. (4) M. S. Khan [1977, p. 823]. (5) J. A. Frenkel [1979, p. 86]. (6) R. L. Jacobs [1975, p. 343]. (7) R. L. Jacobs [1977a, p. 292]. (8) T. J. Sargent [1977, p. 447].

The estimates for each country reported in Table 1 are sensitive to the choice of methodology, but except for a few odd estimates - such as for example Sargent's for Austria (which is not significantly different from zero), Cagan's for Hungary and Khan's1975 for Germany - there seems to be a fair amount of consistency. Any one

[19] A critical survey could be found in S. B. Webb(1983) .

choice for purposes of computation would be arbitrary, and would reflect a judgement as regards methodology. Simplicity appears to be a safe criterion, and perhaps the simplest possible choice would be the estimates obtained considering Cagan's basic model corrected for serial correlation. This would leave aside Jacobs[1977a] and Sargent[1977] who consider different models. Cagan's own estimates, as well as Jacobs[1975], show strong serial correlation, especially as regards Germany and Hungary[20]. The remaining estimates were obtained by procedures that were attentive to this problem: Khan[1975] simply corrected Cagan's original estimates by considering that residuals followed a first order autoregressive process. Jacobs [1977b] reestimated the equations for Austria and Germany correcting for specification errors, from which he obtained a substantially higher value for the estimate for Germany. Khan [1977] produced new estimates considering the possibility of a variable speed of adjustment for money balances, and Frenkel [1979] reconsidered Cagan's model using the forward premium on foreign exchange to measure expected inflation.

It is significant that by considering only the latter estimates our choices would not be much different from what is expressed by the medians and means: a value around 5.0 for Austria, between 3.5 and 4.0 for Germany, about 1.5 for Hungary and a little less than 2.0 for Poland. Although essentially an ad-hoc procedure, by using medians for purposes of computation we do no violence to these authors efforts, though it should be kept in mind that each estimate was obatined in a different context and that these medians are not really meaningful in any theoretical sense. In fact differences between medians and averages, and between these and the estimates proposed by Khan [1977], Frenkel [1979] and Jacobs [1977b], are small enough to have nearly negligible effects in our results[21].

In using these medians for computing "optimal" inflations one has to note that the time dimension of the "optimal" inflation should be the same as the one of the data used for the estimation of the interest semi-elasticity of the demand for money, which in this case is monthly. This is often overlooked leading to serious inconsistencies. Money

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[20] Durbin-Watson statistics for Cagan's model produced by M. S. Khan(1975) p. 358 and for Cagan's model corrected for problems related with structural specification see R. L. Jacobs(1977b) p. 343 .

[21] It is quite significant that the ranking of the estimates is exactly the one one should expect a priori. Austria and Germany, the more open and financially developed economies, would show the largest elasticities, while the lowest ones would be observed in the more agricultural and financially backward economies. See on this issue D. A. Nichols(1974)

demand equations generally use monthly, quarterly or annual data, so that the implied "optimal" inflation should have this same time dimension. Friedman himself seemed confused with the issue: while computing "optimal"inflation rates on an annual basis considered Cagan average estimates of ß "converted" for an annual basis to be around 0.5, from which the optimal annual inflation rate would be 200% yearly[22]. Cagan's average estimate for ß was 4.68, from which the "optimal" inflation would be of 20.4% monthly or approximately 892% yearly. Friedman's mistake was observed by R. Barro[23], and has been reproduced here and there in the inflationary finance literature[24].

As regards the comparison between estimates of "optimal" inflations and actual rates it is interesting to note that Cagan compared his estimates of the "optimal" inflation with the average compounded inflation rates for the hyperinflation period, according to his definition; this period is different from the one utilized for the estimation of the interest semi-elasticity of the demand for money. He defined the hyperinflation period as starting the month in which prices rose by more than 50% and as ending at the month it falls below that number and remains so for at least an year. Cagan used longer period for his estimates of money demand equations generally including more observations for the months preceding the hyperinflation period. This meant to include 10 more observations for Austria , 8 more for Hungary and Poland and 23 more for Germany[25]. In Table 4-1 we considered for purposes of calculation of actual inflations the longer period, namely the period covered by the figures used for the estimates of ß and á.

The value of seigniorage collected was computed by deflating with exchange rates the additions to the money stock. The sources used for tables 4-1,4-2 and 4-3 were: for Germany money supply figures from J. P. Young [1925, vol. I, pp. 527-529], converted in gold marks with exchange rates from F. Graham [1930, pp. 156-158], and tax revenues from Republic of Germany [1924, p. 32] and Table 8-6. For Hungary money supply figures from J. P. Young [1925, vol.II, pp. 321-322], exchange rates from L. L. Ecker-Rácz [1933, p. 61] and tax revenues considered annual figures from Table 8-3

[22] M. Friedman (1971) p. 851.
[23] R. G. Barro (1972) pp.988-989.
[24] See, for example, M. S. Khan & M. D. Knight (1982) p. 348 ff. 6.
[25] P. Cagan (1956) pp. 26, 43 and 59.

evenly distributed by quarters. For Poland money supply figures from J. P. Young [1925, vol.II, pp. 347-348] and exchange rates and tax revenues from Republic of Poland [1926, pp. 126 and 173]. For Austria money supply and exchange rates figures from J. van Walré de Bordes [1924, pp. 46-50 and 116-139] and tax figures considered annual figures from Table 8-3 evenly distributed by quarters.