

## MONEY DEMAND AND THE POTENTIAL OF SEIGNIORAGE IN CHINA:

Geneviève Boyreau Debray

E-mail: G.Boyreau@cerdi.u-clermont1.fr

**Abstract.** Since 1978 China has been experiencing a strong monetary growth. However annual inflation has not exceeded 20%. One of the outcomes has been a high level of seigniorage. This paper looks for the factors that have enabled to collect this quasi-inflation-free revenue and asks the question of whether or not China can still rely on this kind of financing. For this purpose, an augmented Cagan's money demand is specified which takes into account the transitional characteristics of this economy. A Laffer type model is derived from it and provides an analysis of the dynamics of the potential of seigniorage.

*Key words.* China, transitional economies, seigniorage, money demand, monetization, financial deepening.

**Résumé.** La Chine connaît, depuis le lancement de ses réformes en 1978, un taux de croissance monétaire de grande ampleur qui n'a pas entraîné d'inflation excessive. Une des conséquences a été un niveau de seigneurage important, de l'ordre de 7% du PIB par an. Nous recherchons les facteurs de ce revenu par la création monétaire, au travers de la spécification d'une demande de monnaie adaptée aux caractéristiques chinoises. Ces facteurs sont principalement la monétisation de l'économie et le développement financier. De cette demande de monnaie est dérivé un modèle d'inflation/seigneurage de type "Laffer", qui permet d'analyser l'évolution du potentiel de ce revenu.

*Mots clés.* Chine, économie en transition, seigneurage, demande de monnaie, monétisation, développement financier.

## 1. INTRODUCTION

One of the most striking features of the market reforms in China since the late 1970s has been its dramatic monetary growth without excess inflation. It has resulted in a high level of seigniorage, around 7% of GDP on average. This revenue has probably enabled Chinese authorities to delay the state owned sector reforms, because loss-making enterprises could be financed.

The aim of this paper is to explain how such seigniorage has been possible. Whether or not its determinants are permanent or transitory could clarify whether the Chinese economy can or cannot still rely on monetary financing. The paper is organized as follow: first the seigniorage concept is explained and its original aspects in the Chinese context are detailed, that is a high level compared to a world-wide sample; an extended base due to the quasi-monopoly of the state banks; the continuous growth of monetary balances in real terms. A model is developed in a second part, to illustrate the sequences of the seigniorage/inflation relationship. A typical Laffer curve is derived from the well-known Cagan's money demand, which is augmented to include specific Chinese characteristics (basically monetization and financial deepening). Finally, we turn to an econometric illustration of the model, which shows the changes of the potential of monetary revenue in this country (part 3).

## 1. SEIGNIORAGE IN CHINA

Seigniorage is the supplement of real revenue accruing to authorities (government and central bank) from the monopoly they have on money supply. We measure seigniorage by the cash flow definition that corresponds to the actual revenue collected by authorities<sup>1</sup>. To characterize the Chinese seigniorage, we first compare it to other countries; second we highlight its own specific features.

## (a) World comparison

We range China's average seigniorage among 107 countries, in order to get an idea of its relative size. For the comparison ease, the most common measure of seigniorage, the ratio of the monetary base or the cash variation to GDP is used for the 1986-95 and 1979-95 periods respectively (Fisher (1982)). Fig.1 and 2 show comparative seigniorage rates ranked by share of GDP.

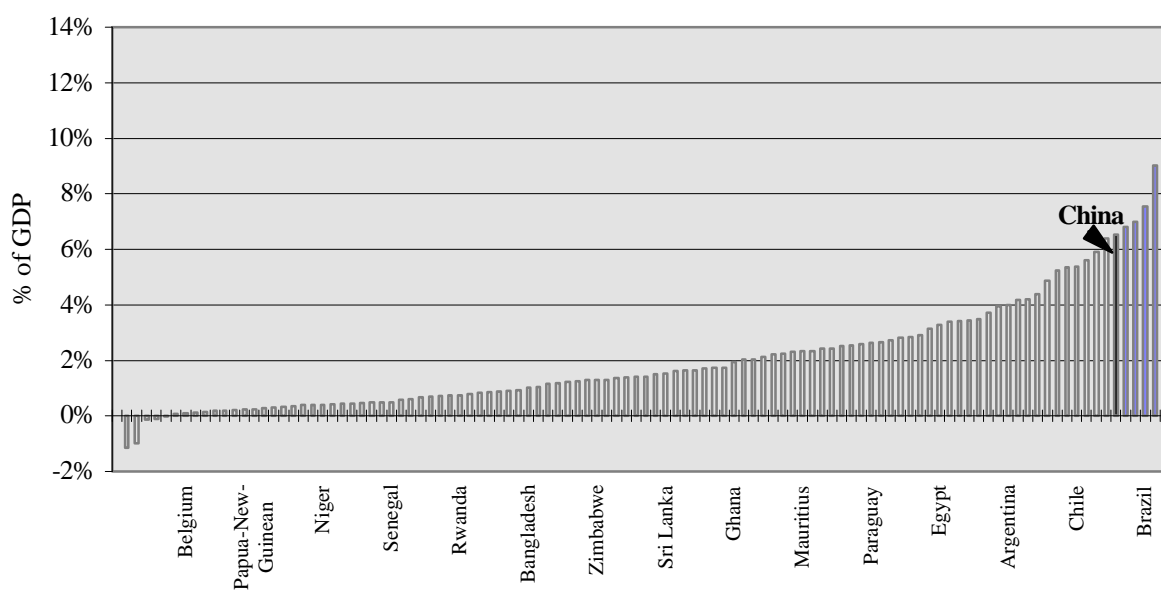
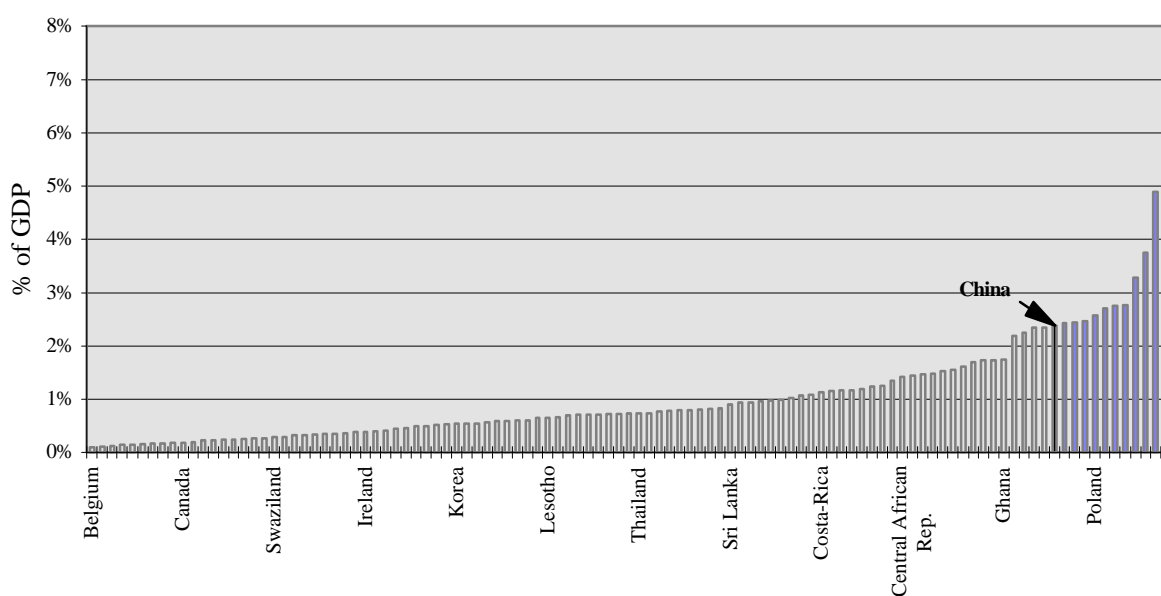


Figure 1 : *Monetary base seigniorage*<sup>2</sup>



Source: IMF International Financial Statistics

Figure 2: *Cash seigniorage*<sup>2</sup>

China is among the countries that have collected the highest revenue from money creation. Furthermore, unlike China, countries with higher seigniorage have all encountered high inflation rates like Brazil, Nicaragua, Uruguay, Chile, Poland, or Zaire.

This direct comparison shows that the level of seigniorage in China is much closer to countries that have encountered hyperinflation than to any other countries that share similar structural features. One question is thus to explain how China has collected such large amount of revenue with a much lower inflation rate.

(b) Own features of the Chinese seigniorage

*(i) The seigniorage base: cash, monetary base and sight deposits*

Taking a widespread measure, China's seigniorage ranges among the top countries. If we look now to the specific features of this country, the measure of seigniorage has to be clarified. Looking at the narrow definition of seigniorage -the difference between the face value of money and its production cost- only cash must be taken into account. If bank reserves do not bear interest, the seigniorage base can be extended to the monetary base. Finally, sight deposits can be included, to the extent that the banking sector is state-owned and that the associated interest rates stand below the market level.

In the Chinese case, seigniorage is generated from cash and sight deposits. Reserves that banks hold at the central bank receive an interest rate close to the market<sup>3</sup>. They do not correspond to a real revenue for the authorities since they have access to other financing sources at the same price. We thus exclude them. Fry (1997) recommends to include sight deposits to get a true picture of seigniorage in China. Indeed, two distinctive Chinese features justify it: first, the banking sector still largely belongs to the State<sup>4</sup>. Second, the sight deposit interest rate is much lower than the market (1.71% at the end of 1997). They represent a cheap financing source to the state sector. We thus take as the base of seigniorage the "money" aggregate of the International Financial Statistics from the International Monetary Fund (IMF), composed of sight deposits and cash (M1).

*(ii) Growth of real balances*

The cash flow definition includes both the financing and tax aspects of seigniorage as shown by the following equality:

$$S = dM/P = dm + \pi \cdot m$$

where  $S$  is seigniorage, "d" the time difference,  $M$  the monetary aggregate,  $P$  the price level,  $m = M/P$  the monetary balances in real terms,  $\pi = dP/P$  the inflation rate.

Seigniorage ( $dM/P$ ) is the amount of real resources accruing to the authorities when they issue  $dM$ . It equals the desired real balances variation ( $dm$ ) plus the inflation tax ( $\pi \cdot m$ ). The increase of money can correspond an increase of prices, which reduces monetary balances in real terms. The sign of the variation of desired real balances, depends on the behavior of money holders, hence of the sensitivity of the money demand to inflation.

Table 1. *Inflation tax and variation of real balances*

% GDP	$\pi$	$s_0$	$dm_0$	$\pi \cdot m_0$	$s_1$	$i \cdot (m_1 - m_0)$	$dm_1$	$\pi \cdot m_1$
<b>Av.</b>	<b>9</b>	<b>2.3</b>	<b>1.3</b>	<b>1</b>	<b>7.0</b>	<b>0.1</b>	<b>4.2</b>	<b>2.9</b>
<b>1979</b>	2	1.4	1.3	0.1	8.5	0.1	8.3	0.3
<b>1980</b>	7	1.7	1.3	0.4	4.9	0.1	3.5	1.5
<b>1981</b>	2	1.0	0.9	0.2	4.0	0.1	3.5	0.6
<b>1982</b>	2	0.8	0.7	0.2	2.7	0.1	2.2	0.5
<b>1983</b>	2	1.6	1.4	0.1	4.4	0.1	4.0	0.5
<b>1984</b>	3	3.7	3.5	0.2	9.6	0.1	9.1	0.7
<b>1985</b>	12	2.2	1.1	1.0	6.2	0.1	3.1	3.2
<b>1986</b>	7	2.3	1.6	0.7	8.2	0.1	6.2	2.1
<b>1987</b>	9	2.0	1.1	0.9	5.9	0.1	3.1	2.8
<b>1988</b>	21	4.5	2.5	2.0	6.0	0.1	-0.2	6.3
<b>1989</b>	16	1.2	-0.8	2.1	2.0	0.1	-3.2	5.3
<b>1990</b>	1	1.6	1.4	0.2	6.2	0.1	5.9	0.4
<b>1991</b>	5	2.5	1.8	0.6	9.1	0.1	7.5	1.6
<b>1992</b>	9	4.3	3.3	1.0	10.1	0.1	7.3	2.9
<b>1993</b>	17	4.4	2.3	2.1	14.5	0.1	8.8	5.8
<b>1994</b>	24	3.1	0.0	3.0	10.1	0.1	1.5	8.7
<b>1995</b>	17	1.0	-1.1	2.1	6.8	0.2	0.7	6.2
<b>1996</b>	8	1.3	0.4	1.0	7.3	0.2	4.3	3.1

$m_0$ : cash holdings in real terms;  $m_1 = m_0 +$  sight deposits in real terms;  $s_0$  ( $s_1$ ) the seigniorage on  $m_0$  ( $m_1$ );  $\pi$  the inflation rate,  $i \cdot (m_1 - m_0)$  the interest charges on sight deposits in real terms.

Source: IMF International Financial Statistics  
China Statistical Yearbook

Table 1 shows the values of seigniorage since 1979 split up into its component parts, less interest charges paid on sight deposits. It accounts on average for 7% of GDP. Interest charges account for only 0.1% of the reduction of the monetary revenue, which illustrates the low level of remuneration of those deposits. Compared to the 9% average inflation rate, the inflation tax is high, on average 2.9% of GDP.

Money holders usually react to high seigniorage in substituting higher interest bearing assets for money, which accelerates inflation. Once again, the Chinese case provides a counter-example: real balances variations have been positive for most of the years, accounting for 4.2% of GDP. Despite facing a depreciation of their money holdings, Chinese agents in aggregate have increased them. In other words, an increase of the tax has been followed by a voluntary increase of the base.

Seigniorage in China exhibits three salient features: the first is its size together with a modest inflation. The second is an extended base due to the predominance of the state in the banking sector. The last is the continuous growth of real money holdings.

## 2. A MODEL OF SEIGNIORAGE SPECIFIC TO CHINA: GROWTH, MONETIZATION, AND FINANCIAL DEEPENING.

We develop here a Laffer type model of seigniorage/inflation, where an increase of inflation produces two opposite effects, *ceteris paribus*: an increase of the inflation tax and a decrease of money balances, through the money demand which depends negatively on inflation (Cagan, 1956). The seigniorage is first increasing then decreasing with inflation, with a maximizing inflation rate.

### (a) *Specific features of the demand function for money in China*

The traditional money demand has to be fitted to three Chinese specific features: the monetization process, financial deepening, and shocks. They all correspond to changes of money holders behavior. We start with the well-known Cagan's function of money demand:

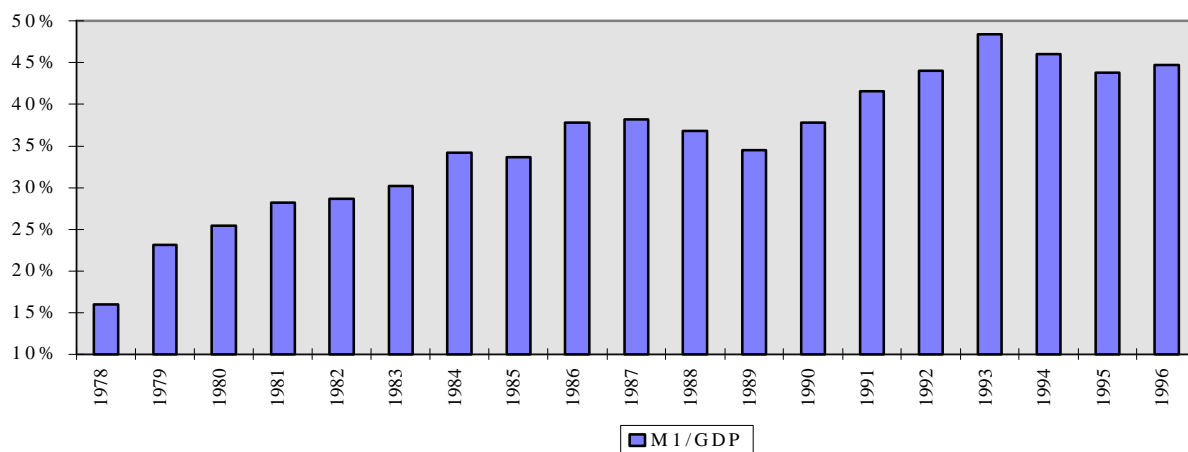
$$\ln\left(\frac{M}{P}\right) = c + h_y \ln(y) + h_p \pi^e \quad (1.0)$$

where  $c$  is a constant,  $y$  is a transactions variable,  $\pi^e$  is the expected inflation rate,  $\eta_y > 0$  is the transactions-elasticity,  $\eta_\pi < 0$  is the semi-elasticity with respect to inflation.

The fast-expanding money supply since the beginning of the reforms has not produced high inflation. The money velocity has been continuously decreasing. Fig. 3 shows the ratio of M1 to GDP increasing from 16% in 1978 to 45% in 1996.

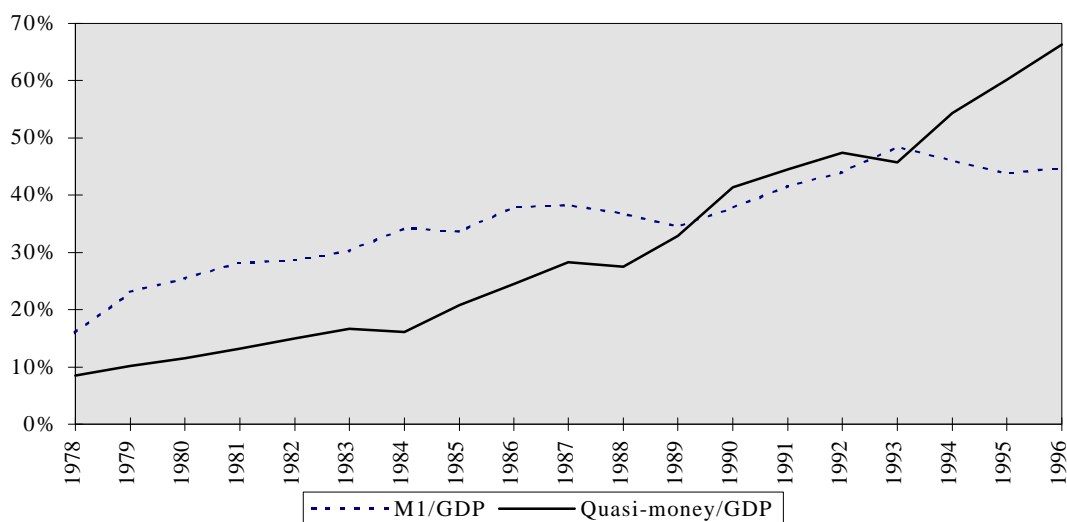
How can inflation be avoided in case of strong monetary growth ? First, monetary growth is not necessarily inflationary: from the monetarist view, to one additional unit of transaction must correspond one additional unit of money. Thus, the real growth contributes to the need of money creation. Looking at the Chinese case, one must go beyond this steady-state monetary

growth. The monetization process implies that monetary balances grow faster than the product<sup>5</sup>. The second feature that is specific to China is the financial deepening. Fig. 4 shows the ratio of M1 and quasi-money to GDP from 1978 to 1996. As M1 seems to stabilize to 45% at the end of the period, the growth of the share of quasi-money accelerates at the end of the 1980s to reach 66% in 1996.



Source: IMF International Financial Statistics

Figure 3. *Monetization*

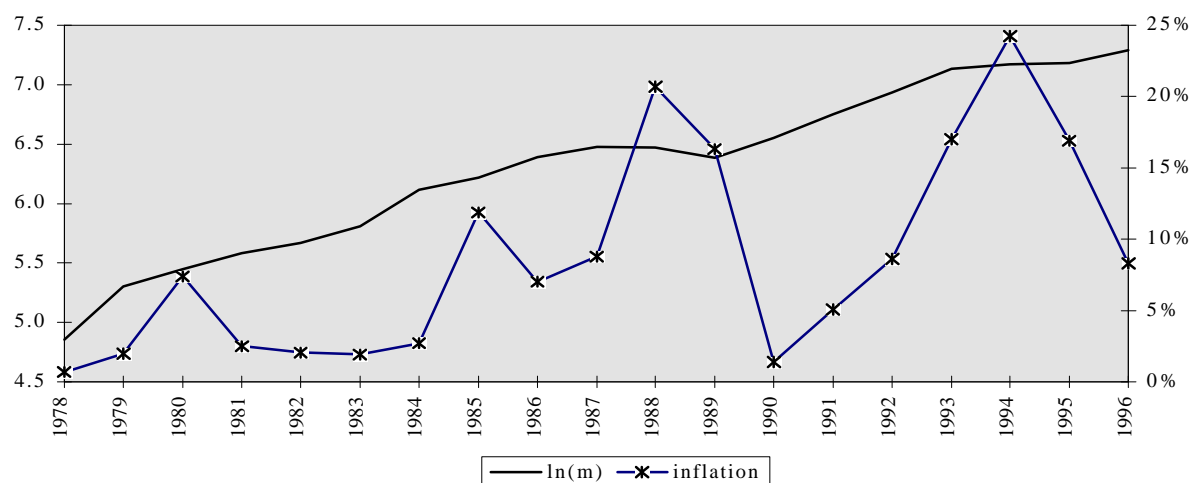


Source: IMF International Financial Statistics

Figure 4. *Financial deepening*

The shocks to money demand in China have been underlined by number of studies, particularly for the 1988-89 period<sup>6</sup>. The changes in inflation and in the log of M1 are presented in Fig.5. 1988 corresponds to an inflationary peak, followed in 1989 by a reduction of money balances

in real terms. Looking at Fig.4, this year corresponds also to a sharp increase of the share of quasi-money in GDP.



Source: IMF International Financial Statistics

Figure 5. *Shocks*

Following the growth in inflation in 1988, a tight monetary policy was implemented at the end of the year. Apart from direct controls on credit, three-years saving deposits interest rates were indexed to inflation from the end of 1988 to the end of 1989. This financial innovation succeeded in curbing the move away from saving deposits and had strong outcomes on the behavior of money holders. First, as Girardin (1997) notices, as they used before to stock consumer durables to protect themselves from inflation, they started to postpone purchasing in favor of saving. Second, they substituted saving for sight deposits.

Monetization dynamics and financial deepening alike correspond to a shift in the management of money holdings, either for transactions or speculative motives. Equation (1.1) takes these shifts into account:

$$\ln\left(\frac{M}{P}\right) = c + h_y' \ln(y) + h_y'' [\ln(y)]^2 + (h_p' + h_p'' \cdot r) p^e \quad (1.1)$$

$$h_y = h_y' + 2h_y'' \ln(y) \quad \frac{dh_y}{dy} = \frac{2h_y''}{y}$$

$$h_p = h_p' + h_p'' \cdot r$$

The elasticity of revenue  $\eta_y$  is allowed to vary according to the volume of transactions. The underlying hypothesis is that the monetization process varies over time. It can accelerate ( $d\eta_y/dy > 0$  for  $\eta_y'' > 0$ ) or decelerate once accumulation of money assets is sufficient compared to the transactions volume ( $d\eta_y/dy < 0$  for  $\eta_y'' < 0$ ). Another reason is that as financial system



develops, people learn how to better manage their monetary balances. Proportionally less money is needed for the same volume of transactions.

Second, we allow the semi-elasticity with respect to expected inflation  $\eta_\pi$  to vary positively according to the real interest rate on three-year deposits. This specification is based on a tradeoff between two alternative assets, namely consumer durables and interest-bearing financial assets. In a repressed economy, the former offer a zero but guaranteed yield. Since in China the rigidity of the administered nominal interest rates has made real interest rates strongly dependent on inflation, consumer durables have been used for a long time as a hedge against price surges. Because they are not liquid, expected inflation must be high enough for agents not to hold money. But as soon as the nominal interest rate is indexed to (or significantly higher than) expected inflation, interest-bearing financial assets are preferred to consumer durables because they are more liquid: the conversion cost to incur is smaller. In other words, when consumer durables are the only alternative asset for money, money demand is relatively inelastic to expected inflation. But when alternative financial assets offer a guaranteed or highly positive real interest rate, the absolute value of the semi-elasticity with respect to expected inflation of the money demand increases. Having specified an augmented function of money demand, we turn to the model of seigniorage.

#### (B) A model of seigniorage

The model is based on the seigniorage maximizing inflation rate literature (Cagan, 1956). Two modifications are made. First, the economy is not stationary, the two only hypothesis are that the money market is balanced and that expected inflation equals actual inflation. In other words, expectations are rational. Second, we used to derive the model the money demand specification (1.1). Equation (2) provides the cash flow definition of seigniorage.

$$S = \frac{dM}{P} = \frac{dM}{M} \cdot m \quad (2)$$

where S is seigniorage, M the money in nominal terms,  
P the price level,  $m=M/P$  are real balances.

Taking the first difference of the demand for money function (eq.(4)), we obtain an expression of the nominal monetary growth at money market equilibrium (eq.(5)):

$$\ln(m) = \ln(M) - \ln(P) \Rightarrow \ln(M) = \ln(m) + \ln(P) \quad (3)$$

$$d \ln(M) \cong \frac{dM}{M} = \left( h_y' + 2h_y'' \ln(y) \right) \cdot d \ln(y) + \left( h_p' + h_p'' r \right) dp + h_p'' \cdot p \cdot dr + p \quad (4)$$

$$\text{hyp: } dp = dr = 0, \quad p = p^e$$

$$\frac{dM}{M} = \left( h_y' + 2h_y'' \ln(y) \right) \cdot d \ln(y) + p \quad (5)$$

y is the transactions variable,  $\pi$  the inflation rate, r the real interest rate on alternative financial assets.

Substituting this into (2), we derive a solution for the seigniorage-maximizing inflation rate  $\pi^*$  (eq.8):

$$S = \left[ \left( h_y' + 2h_y'' \ln(y) \right) \cdot d \ln(y) + p \right] \cdot m \quad (6)$$

$$\frac{\$S}{\$p} = \frac{\$m}{\$p} \cdot \left[ \left( h_y' + 2h_y'' \ln(y) \right) \cdot d \ln(y) + p \right] + m \quad (7)$$

$$\frac{\$S}{\$p} = 0 \Leftrightarrow p^* = - \frac{m}{\frac{\$m}{\$p}} - \left( h_y' + 2h_y'' \ln(y) \right) \cdot \frac{dy}{y} = - \frac{1}{h_p} - h_y \cdot \frac{dy}{y} \quad (8)$$

where  $\pi^*$  is the seigniorage maximizing inflation rate

From the general model, Cagan's particular case of steady state can be inferred. The cases of growth, monetization and financial deepening follow. The diagram of the Laffer curve seigniorage/inflation illustrates both of them (see appendix).

(i) *Steady state*

$$dy/y=0, r=0$$

$$\eta_\pi = \eta_\pi'$$

$$\pi_0^* = -1/\eta_\pi$$

Steady state is characterized by a constant transactions volume, constant real balances, and by the equality between nominal interest rate and inflation. The Cagan's result follows: maximizing inflation rate equals the inverse of the semi-elasticity with respect to inflation.

(ii) *Growth, monetization and financial deepening*

$$dy/y > 0, d(dy/y) = 0, \eta_y = \eta_y' + \eta_y'' \cdot \ln(y) > 1, \eta_\pi = \eta_\pi' + \eta_\pi'' \cdot r, r > 0, d\eta_\pi > 0$$

$$\pi_1^* = -(1/\eta_\pi) - \eta_y \cdot dy/y < \pi_0^*$$

Taking the augmented money demand, we suppose a constant and positive real growth rate, a variable transaction-elasticity and a variable semi-elasticity with respect to inflation.

Monetization reduces maximizing inflation, which is smaller than in the Cagan's case, *ceteris paribus*. Similarly, seigniorage is larger for any given inflation rate. Marginal seigniorage increases. Financial deepening reduces  $\pi^*$  through the increase (in absolute value) of the semi-elasticity with respect to inflation. This one increases in the long run with the real interest rate as for a financial innovation. For a given inflation rate seigniorage decreases and so does marginal seigniorage.

### 3. APPLICATION

#### (a) *Estimation of money demand: changing behaviors*

The econometric analysis with quarterly data covers the 1983(1)-1997(3) period.  $\ln(m)$  is the log of the M1 aggregate in real terms<sup>7</sup>. The transactions variable (in log) is a proxy of the quarterly GDP  $\ln(y)$ . Inflation rate is the quarterly moving average growth of retail price index ( $\pi$ ). We select as an opportunity cost of holding money instead of interest-bearing assets the interest rate on three-years saving deposits ( $r$ ). This is precisely the one we treat as a financial innovation when indexed to inflation. The plots of the series  $\ln(m)$ ,  $\ln(y)$ ,  $\ln(y)^2$  denote a shock in the 1988 third quarter, linked to the tight monetary policy (see appendix). Furthermore  $\ln(m)$  was revised in the 1994 second quarter. Before this date, the "money" aggregate from the International Financial Statistics was composed of cash and sight deposits in the four specialized state banks and in rural credit cooperatives. From 1994, a wider statistical cover includes other financial institutions. For those reasons we use the test of Perron (1989), that allows including breaks in the slope or the intercept of the series trend. Traditional Augmented Dickey-Fuller test is used for  $\pi$  et  $\pi.r$ . Series are all integrated of order 1, except inflation  $\pi$  and its product with the real interest rate  $\pi.r$ , which are level stationary. Unit roots tests on the series are reported in appendix.

Looking for a long-run relationship, we turn to test for cointegration (Table 2). We estimate the Cagan's traditional money demand (1.0) and the money demand modified to include Chinese characteristics (1.1). For the whole period, Cagan's money demand exhibits the same results as previous econometric analyses of the money demand in China: transactions-elasticity exceeds unity and is strongly significant<sup>8</sup>. Surprisingly, inflation seems to play no role on money demand. Sub-periods results emphasize instability of behaviors. Transactions-elasticity is clearly higher between 1984(1) and 1988(3) than for the whole period (1.76 against 1.43)<sup>9</sup>. This suggests a slowing down of the monetization process. Moreover, global instability of

coefficients can not be rejected, as illustrated by the recursive coefficient estimates (see appendix).

When the augmented money demand specification is used, the elasticity with respect to inflation introduced as a positive function of the real interest rate becomes significantly negative. But compared to industrialized countries estimates its absolute value is rather small. This result can be found in other studies of money demand in China<sup>10</sup>. This difference can be explained by the fact that state owned enterprises hold a significant share of sight deposits. Because of their soft budget constraints, they react less to inflation than enterprises subject to market rules. Another explanation can be found in the cash in advance hypothesis: a surge of inflation pushes agents to increase their money holdings. They substitute cash for sight deposits to buy consumer durables. In the short run, an increase of inflation does not modify the volume of money but its composition in favor of cash<sup>11</sup>. Global stability of the estimated coefficients can not be rejected now for the 1988 shock as the Chow's test shows. In other words, to let the coefficients vary endogenizes the change of behavior of money holders. However this is not true for 1994, where a structural break is suspected. Two suggestions are made to explain a shift of the money demand in 1994. First, the larger statistical cover means that money holders not included before are now taken into account through other financial institutions<sup>12</sup>. In China the banking sector is quite segmented. State enterprises mainly go to state banks. Deposits holders in other financial institutions are more likely to obey to the rules of the market<sup>13</sup>. Their demand for money should therefore reacts more to inflation than state enterprises with soft budget constraints. The second hypothesis is inferred from the end-of-period value of the transactions-elasticity, close to unity. The monetization process could be ending. In this last case, the augmented money demand could be too restrictive for the recent years, and then could induce the global estimates instability.

Taking this last hypothesis, we estimate the money demand only during the recent period with new statistical nomenclature<sup>14</sup>. The variable transactions-elasticity does not seem to fit the recent period, as shown by the non-significance of the coefficients of  $\ln(y)$  and  $\ln(y)^2$ . Estimating a constant elasticity leads to a value of 0.5. This result supports the end of monetization hypothesis, although care has to be taken given the small number of observations. At last, the long-run semi-elasticity of inflation largely increases in absolute value (-1.93), and so does its sensitivity to real interest rate (-8.9). The corollary is the financial deepening process.

Table 2. *Cointegration analysis*

Dependent variable: ln(m)								
Sample	Cagan's money demand			Augmented money demand			Recent period	
	84:1-97:3	84:1-88:3	84:1-94:1	84:1-97:3	84:1-88:3	84:1-94:1	93:1-97:3	93:1-97:3
c	4.59	2.72	4.51	-12.19	-1.47	<b>-17.62</b>	-4.16	<b>10.79</b>
	<i>11.68**</i>	<i>4.85</i>	<i>11.64**</i>	<i>-2.96**</i>	<i>-0.11</i>	<b>-5.35**</b>	<i>-0.34</i>	<b>13.85**</b>
ln(y)	1.43	1.76	1.45	6.83	3.09	<b>8.61</b>	5.01	<b>0.53</b>
ln(y) <sup>2</sup>	<i>22.11**</i>	<i>17.98**</i>	<i>2.54**</i>	<i>5.11**</i>	<i>0.65</i>	<b>8.04**</b>	<i>1.38</i>	<b>4.84**</b>
				-0.37	-0.10	<b>-0.58</b>	-0.34	
$\pi$	0.01	-0.04	-0.05	<i>-2.31**</i>	<i>-0.25</i>	<b>-6.68**</b>	<i>-1.22</i>	<b>-1.94</b>
	<i>0.05</i>	<i>-0.15</i>	<i>-0.39</i>	<i>-2.31**</i>	<i>-2.28**</i>	<b>-2.41**</b>	<i>-4.83**</i>	<b>-5.27**</b>
$\pi.r$				-2.06	-7.58	<b>-2.10</b>	-9.61	<b>-8.91</b>
$t_{94}^1$	-0.05			<i>-1.84*</i>	<i>-3.28**</i>	<b>-4.63**</b>	<i>-3.90**</i>	<b>-4.21**</b>
				0.07				
	<i>-1.01</i>			<i>2.13**</i>				
adj. R2	0.98	0.97	0.97	0.99	0.97	<b>0.98</b>	0.95	<b>0.95</b>
obs n.	55		41	55	19	<b>41</b>	19	<b>19</b>
ADF <sup>3</sup>	<i>-7.18**</i>	<i>-3.06</i>	<i>-5.17**</i>	<i>-6.18**</i>	<i>-3.51</i>	<b>-6.43**</b>	<i>-4.42*</i>	<b>-4.25*</b>
$\eta_{y,0}$	<b>1.4</b>	<b>1.8</b>	<b>1.5</b>	<b>1.9</b>	-	<b>2.0</b>	-	<b>0.53</b>
$\eta_{y,T}$	<b>1.4</b>	<b>1.8</b>	<b>1.5</b>	<b>0.9</b>	-	<b>1.0</b>	-	<b>0.53</b>
Chow's test <sup>2</sup>		<i>2.83**</i>	1.60		2.04	<b>2.13**</b>		

All regressions include seasonal dummies.

The Newey-West correction is applied to get consistent estimates of the covariance matrix in the presence of heteroscedasticity and/or autocorrelation.

\*\* (\*): significant at 5% (10%) level.

<sup>1</sup> From the 1994 first quarter, new monetary statistics are used following the change of nomenclature. We introduce a dummy to take this last effect into account.

<sup>2</sup> Stability test (H0: coefficients stability).

<sup>3</sup> Engle et Granger (1987) cointegration test. To check for robustness, recursive coefficient estimates were run (see appendix). Indeed, one has to suspect explanatory variables to be endogenous when strong instability of associated coefficient is detected.

c: constant

ln(m): log of nominal money balances deflated by the retail price index (1990(1)=100).

ln(y): log of GDP, deflated by the retail price index (1990(1)=100), proxied by the quarterly industrial production times the annual ratio of GDP to total industrial product.

ln(y)<sup>2</sup>: square of ln(y) deflated by the retail price index (1990(1)=100).

$\pi$ : quarterly moving average inflation rate (retail price index).

r: annual real interest rate on three-years saving deposits.

$t_{94}$ : dummy taking the value of 1 from 1994(1), 0 before.

$\eta_{y,0}$ : transactions-elasticity of money demand at the beginning of the period.

$\eta_{y,T}$ : transactions-elasticity of money demand at the end of the period.

(b) *Implications for the potential of seigniorage*

Seigniorage maximizing inflation rates are calculated from the money demand estimates and the equation 8. Since money demand is not stable for the whole period, only the 1984-94 and 93-97 sub-periods results are retained:

$$84:1-94:1 \ln(m) = -17.62 + 8.61.\ln(y) - 0.58.\ln(y)^2 - (0.22 + 2.10.r). \pi \quad (9)$$

$$(5.35^{**}) \quad (8.04^{**}) \quad (-6.68^{**}) \quad (-2.41^{**}) \quad (-4.63^{**})$$

$$93:1-97:3 \ln(m) = 10.79 + 0.53.\ln(y) - (1.94 + 8.91.r). \pi \quad (10)$$

$$(13.85^{**}) \quad (4.84^{**}) \quad (-5.27^{**}) \quad (-4.21^{**})$$

Tables 3 and 4 summarize the numerical application. For the 1984-94 period, annual maximizing inflation rate is in excess of 300% par annum<sup>15</sup>. This magnitude is obviously not comparable to inflation rates that occur in China (9% per year in average, Table 3). Money demand is located on the virtuous side of the Laffer curve, on the positive part of the inflation/seigniorage relationship. For the 1984-94 period estimated seigniorage equals 6.5% of GDP per year (Table 4). Real balances variation and inflation tax account respectively for 4% and 2.6% of GDP. Interest charges on sight deposits cut seigniorage by only 0.1% of GDP.

Table 3. *Revenue maximizing inflation*

	$\pi_t$	$dy_t/y_t$	$r_t$	$\eta_y^1$	$\eta_\pi^1$	$\pi_1^{*2}$
<b>1984:1-94:1</b>	<b>9%</b>	<b>10.7%</b>	<b>1.9%</b>	<b>1.5</b>	<b>-0.26</b>	<b>372%</b>
1984:1-88:3	8%	12.4%	0.4%	1.7	-0.23	423%
1988:4-89:4	20%	-3.3%	3.4%	1.6	-0.29	351%
1990:1-94:1	7%	12.9%	3.2%	1.2	-0.28	335%
<b>1993:1-97:3</b>	<b>13%</b>	<b>10.2%</b>	<b>-1.7%</b>	<b>0.5</b>	<b>-1.79</b>	<b>50%</b>

<sup>1</sup>  $\eta_y = 8.61 - 2 * 0.58 * \ln(y)$ ,  $\eta_\pi = -(0.22 + 2.10 * r)$  for the 1984(1)-94(1) period (eq.9).

$\eta_y = 0.5$ ,  $\eta_\pi = -(1.94 + 8.91 * r)$  for the 1993(1)-97(3) period (eq.10).

<sup>2</sup>  $\pi_1^* = -1/\eta_\pi - \eta_y$ .  $dy/y$  is the seigniorage maximizing inflation rate when monetization and financial deepening and included.

$\ln(y)$ , the growth rate  $dy_t/y_t$  and the real interest rate  $r$  are averaged for each period.

The magnitude of the maximizing inflation rate is due to the low inflation semi-elasticity. The positive inflation/seigniorage relationship is thus basically linked to two factors: first, to the

low sensitivity of Chinese state enterprises to inflation; second, when inflation accelerates, to a shift of the composition of money holdings in favor of cash.

Table 4. *Estimates of seigniorage\**

	$\pi_t$	$dm_t/m_t$	$dy_t/y_t$	$dm_t$	$\pi_t \cdot m_{1,t-1}$	$s_t$	$i_t$	$s_t - i_t$	% GDP
<b>1984:1-94:1</b>	<b>9%</b>	<b>14.7%</b>	<b>10.7%</b>	<b>4.0%</b>	<b>2.6%</b>	<b>6.6%</b>	<b>0.1%</b>	<b>6.5%</b>	
1984:1-88:3	7.6%	18.3%	12.4%	4.7%	2.2%	6.9%	0.1%	6.8%	
1988:4-89:4	20%	-8.4%	-3.3%	-3.0%	5.9%	2.9%	0.1%	2.8%	
1990:1-94:1	7%	17.5%	12.9%	5.5%	1.9%	7.4%	0.1%	7.3%	
<b>1993:1-97:3</b>	<b>13%</b>	<b>2.7%</b>	<b>10.2%</b>	<b>3.8%</b>	<b>2.5%</b>	<b>6.3%</b>	<b>0.2%</b>	<b>6.1%</b>	

\* To compute the seigniorage values, we use the real balances fitted values from the regressions (9) and (10).

$\pi_t$  is the quarterly moving average inflation rate,  $dm_t/m_t$  the growth rate of real balances,  $dy_t/y_t$  the real growth,  $dm_t$  the variation of real balances,  $\pi_t \cdot m_{1,t-1}$  the inflation tax,  $s_t = s_t - i_t + \pi_t \cdot m_{1,t-1}$  the seigniorage,  $i_t$  the charges of interest on sight deposits.

Between 1984 and 1988, monetization increases the potential of seigniorage, moving upwards the Laffer curve (see the diagram in appendix). The seigniorage increases (in average 6.8% of GDP), for a maximizing inflation of 423%. During the 1988-89 recession period, the maximizing inflation and the seigniorage decrease (346% and 2.8% of GDP respectively). Estimated seigniorage broken up into its component parts explains this last point: the 20% inflation rate increases the tax on real balances (5.4% of GDP). Facing a depreciation of their money holdings along with negative real growth, Chinese agents reduce them (-3% of GDP per annum in average). At the same time, new financial assets indexed to inflation guarantee a positive real yield. As a consequence saving deposits increase at the detriment of money. The increase of the semi-elasticity with respect to inflation along with the real interest rate illustrates this process (-0.29). It is worthwhile noting here that predicted seigniorage can depart from actual seigniorage. Keeping in mind that the demand function of money is defined in terms of expected inflation, if economic agents are slow at predicting rising inflation ( $\pi^e < \pi$ ), actual seigniorage will be higher than predicted seigniorage by the Laffer curve defined by the equilibrium condition  $\pi^e = \pi$ . Finally, during the 1990-94 period monetization slows down. Marginal seigniorage decreases as the maximizing inflation progressively increases (351%). The Laffer curve moves downward to the right.

For the 1993-97 period, maximizing inflation drops to 50%. Its is now in the same range than actual inflation rate. Financial deepening increases the absolute value of the semi-elasticity with

respect to inflation (-1.79) and reduces marginal seigniorage. Looking at the diagram, the Laffer curve moves downwards to the left. The apparent end of monetization adds up to this last effect. Compared to the previous period, seigniorage revenue slightly lowers (6.1%) despite higher inflation (13%): more inflation is needed to collect less revenue from money creation. In other words, the potential of seigniorage lessens.

## CONCLUSION

Strong money demand induced by monetization explains the relatively inflation-free seigniorage in China. While the traditional Cagan's specification exhibits unstable estimates, defining an augmented one with variable coefficients seems to well characterize the transitional features of the money demand in this country. The dynamics of the monetization process appears to be slowing down. Transactions-elasticity falls from 2 at the beginning of the 1980s to unity in 1994. In the recent period, it seems to stabilize around 0.5. Though not directly, money holders start to react to real interest rate. There is a tradeoff between the liquidity of money, the real yield of financial assets which depends on inflation and risk-free consumer durables. Treating the indexation of interest rates as an innovation enables us to endogenize the structural break in the late 1980s. In the last period, money demand becomes more sensitive to inflation: economic agents behaviors seem to change as they learn how to better manage their portfolio.

China is currently situated on the virtuous side of the seigniorage Laffer curve. However, the slow down of monetization limits the potential of money creation. Moreover, improvements of portfolio management emphasize the impact of inflation on money demand, and diminish further opportunities of monetary revenue. In other words monetary growth should be restrained to the real growth of income.

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<sup>1</sup> See Drazen (1985), Honohan (1996), Dupuy (1993) for a discussion of the measures of seigniorage.

<sup>2</sup> Average seigniorage is measured by the ratio of the monetary base (cash) variation to GDP in nominal terms between 1986 (1978) and 1995.

<sup>3</sup> of 9,18% since July 1993. the market nominal interest rate corresponds to a real interest rate close to zero.

<sup>4</sup> In 1996, 69% of sight deposit were in state banks.

<sup>5</sup> See for example Yi Gang (1991) Kui-Wai Li (1997) for China, Laumas (1990), with Porter-Hudak (1986) for India.

<sup>6</sup> See Tseng and al. (1994), Girardin (1996).

<sup>7</sup> China State Statistical Bureau, IMF International Financial Statistics.

<sup>8</sup> See Girardin (1996), Huang (1994), Tseng et al. (1994), Yang (1995), Yi Gang (1993)

<sup>9</sup> More precisely, a recursive coefficients estimation not presented here shows a linear decline of the coefficient value.



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<sup>10</sup> In average, for a sample of industrialized countries with quarterly data, the semi-elasticity with respect to inflation is estimated at -2.4 (Golfeld and Sichel, 1990).

<sup>11</sup> Indeed, the ratio of cash to sight deposits seems to depend positively on inflation when running such regression.

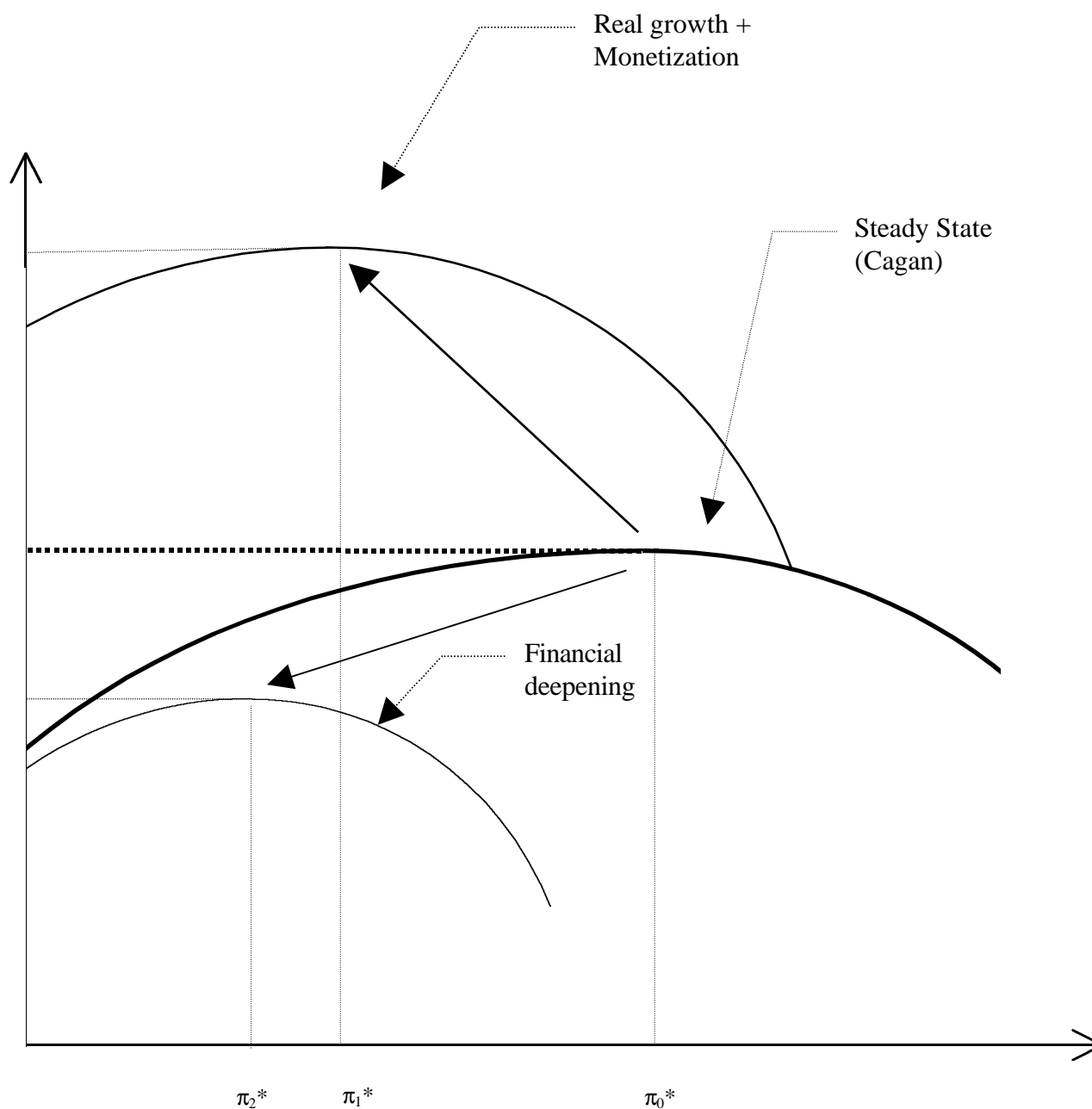
<sup>12</sup> Other commercial banks, urban credit cooperatives, non banking financial institutions.

<sup>13</sup> For instance, the urban credit cooperatives developed quickly along with the needs of the Townships & Villages Enterprises and the private enterprises.

<sup>14</sup> New statistics are available from the first quarter of 1993. Old series run up to the first quarter of 1994.

<sup>15</sup> The accuracy of linear regressions estimates is at its greatest around the data points, which are in our case observations of much lower inflation. Therefore, these estimates are clearly very imprecise and only allow us to say that the revenue maximizing point is at some high level of inflation.

### Appendix. Laffer curve Diagram



#### Steady state

$$\begin{aligned} dy/y &= 0, \quad r = 0 \\ \eta_\pi &= \eta'_\pi \\ \pi_0^* &= -1/\eta_\pi \end{aligned}$$

#### Real Growth + monetization

$$\begin{aligned} dy/y &> 0, \\ \eta_y &= \eta'_y + \eta''_y \cdot \ln(y) > 1 \\ \eta_\pi &= \eta'_\pi \\ \pi_1^* &= -(1/\eta_\pi) - \eta_y \cdot dy/y < \pi_0^* \\ d\pi_1^* &= -d\eta_y \cdot dy/y \end{aligned}$$

#### Financial Deepening

$$\begin{aligned} dy/y &= 0, \quad r > 0 \\ \eta_\pi &= \eta'_\pi + \eta''_\pi \cdot r \\ \pi_2^* &= -(1/\eta_\pi) - \eta_y \cdot dy/y < \pi_1^* \end{aligned}$$

Figure 6. Laffer curve Diagram

## Unit Root Tests

Table 5. *Augmented Dickey-Fuller(1981)'s test*

<b>84:2-97:3</b>	$\pi$	$\pi.r$
<b>Level</b>	-3.04**	-3.56**
<b>Trend</b>	no	no
<b>Lags</b>	1	1
<b>n</b>	49	49

Table 6. *Perron (1989)'s test*

	$\ln(m)$	$\ln(y)$	$\ln(y)^2$
constant	12.55	5.58	30.81
	398.4**	339.14**	144.98**
trend	0.04	0.03	0.36
	20.38**	42.28**	41.69**
t88 (=1 when t>88:2 = 0 otherwise)	-0.34	-0.22	-3.02
	-6.43**	-9.69**	-10.06**
t94 (=1 when t>94:1 = 0 otherwise)	-0.07		
	-1.32		
R2	0.99	0.99	0.99
<b>Level</b>			
Lags	4	4	4
Critical value 5%: -3.72 ( $\lambda= 0.39$ for t88)	-3.44	-2.96	-2.71
<b>First difference</b>			
Lags	4	2	2
ADF	-6.59**	-6.91**	-7.26**

\* (\*\*): *significant at the 10% (5%) level.*

*All regressions include seasonal dummies.*

The test of Perron (1989) involves a pre-cleaning of  $\ln(m)$ ,  $\ln(y)$ ,  $\ln(y)^2$  by regressing the series on a constant, trend and break. The break is for all series in the level of the trend, not in the slope: for the three variables,  $t_{88}$  equals 1 from the 1988 third quarter, 0 before. For  $\ln(m)$   $t_{94}$  takes the value of 1 from the 1994 second quarter, 0 before. The "cleaned" series are tested by running the standard ADF regression. The critical values are however not standard "t" or "DF", but have been computed by Perron. The values depend on the type of the break (level or slope of the trend) and when the break occurred. This is measured by  $\lambda=TB/T$  where T is the total number of observations and TB the trend break. Table 6 summarizes the results. The first part shows the cleaning of the series. The unit root tests stand above. The change in the slope in 1988 enters significantly the regression. The same is not true for the 1994 break. All series first difference appear stationary.

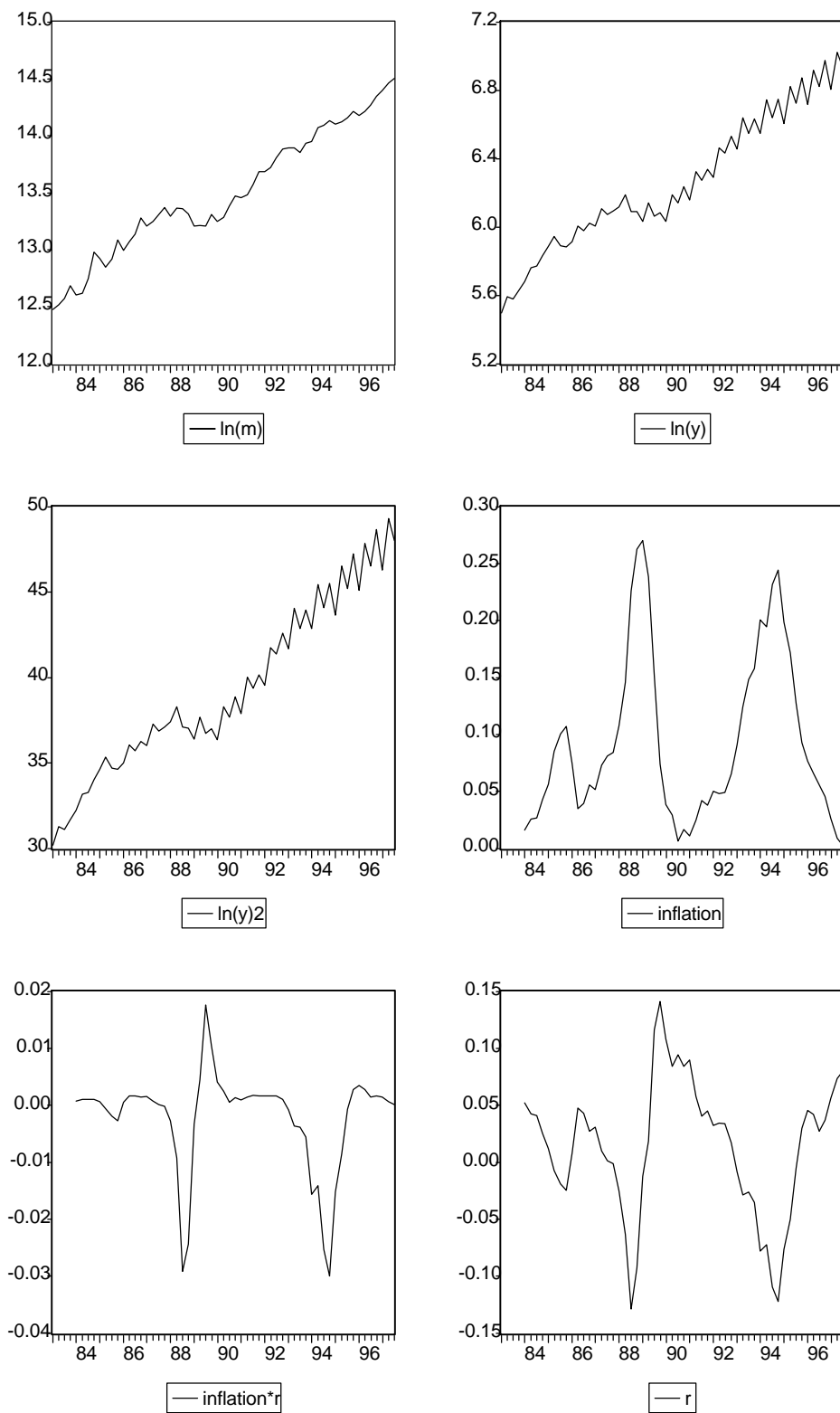
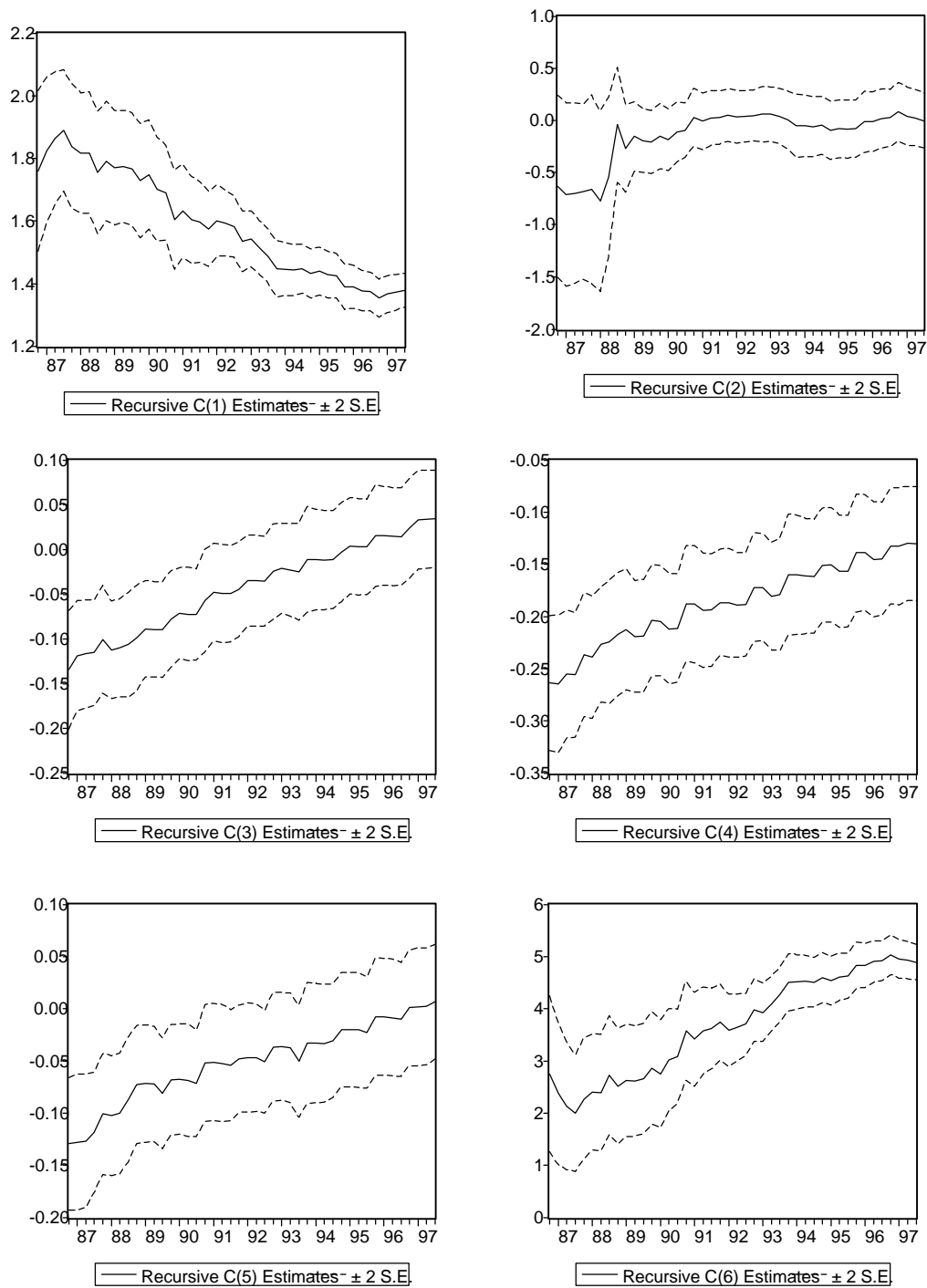


Figure 7. Statistical Series



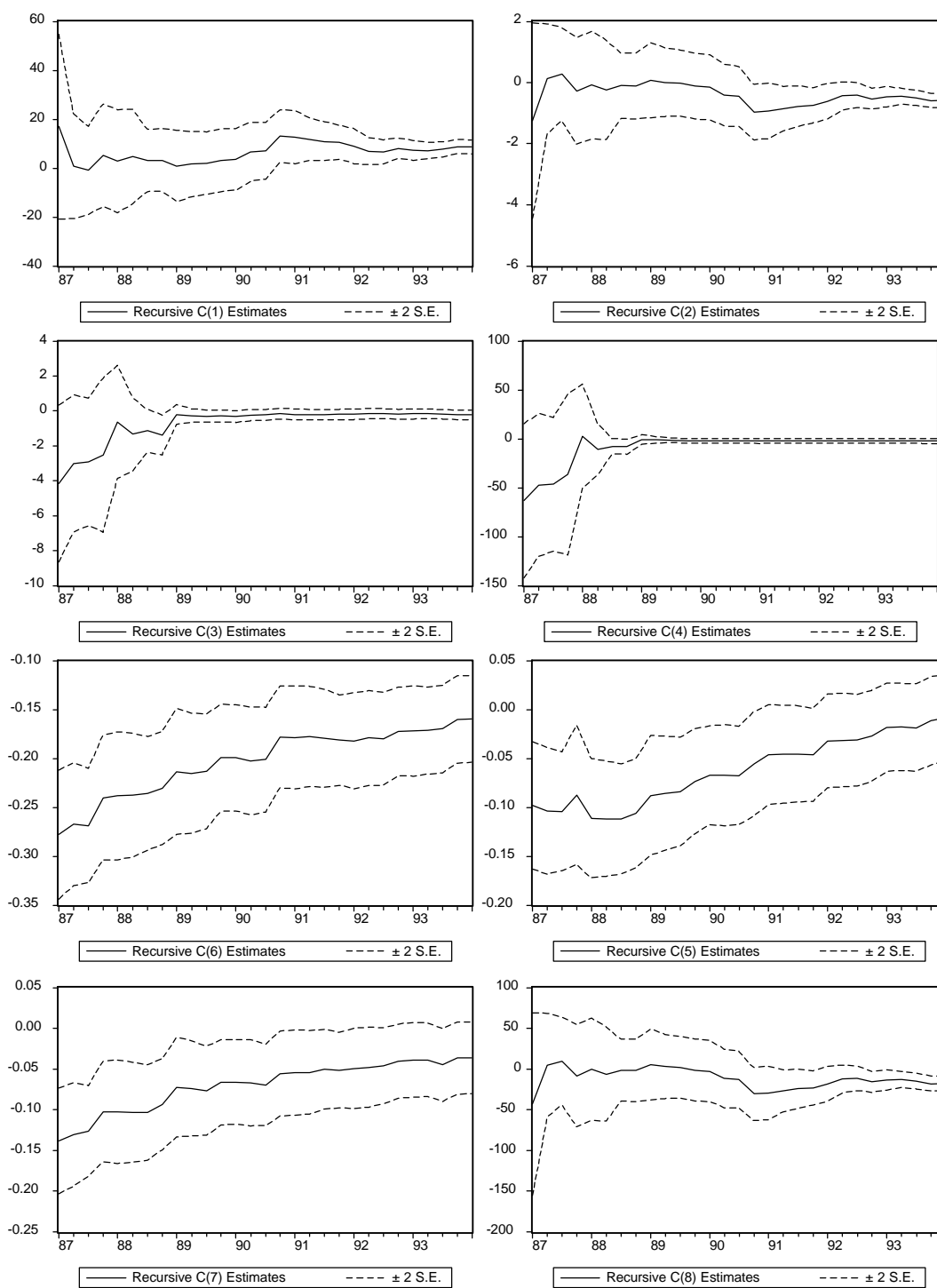
C(1) : coefficient of the transaction variable  $\ln(y)$

C(2) : coefficient of the inflation variable  $\pi$

C(3), C(4), C(5) : seasonal dummies

C(6) : constant

Figure 8. Recursive coefficient estimates (Cagan's money demand, 1984:1-97:3)



C(1) : coefficient of  $\ln(y)$   
 C(2) : coefficient of  $\ln(y)^2$   
 C(3) : coefficient of  $\pi$   
 C(4) : coefficient of  $\pi.r$   
 C(5), C(6), C(7) : seasonal dummies  
 C(8) : constant

Figure 9. Recursive coefficient estimates (augmented money demand, 1984:1-94:1)

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