

Paper Money Inflation, Prices, Gresham's Law and Exchange Rates in Ming China*

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I. Introduction

In an earlier article (Bernholz 1989) I have shown that historical experiences with paper money inflation follow certain regularities which seem to be common to all such cases. Partly motivated by ideas already published by *G. Subercaseaux* (1912), the concept of an inflationary cycle with its qualitative characteristics was developed and modelled in this paper. In the model, the inflationary cycle begins with the introduction of paper money to finance a constant real budget deficit, turns to its subsequent use as stable currency besides some commodity money (e.g. gold, silver or copper coins) and next sees first dwindling official reserves of the commodity money and second, the replacement of the commodity money by paper money both driven by the rising circulation of paper money caused by the budget deficit. In the final phase of the inflationary cycle, the parity between paper and commodity money cannot be maintained and accelerating inflation follows as a consequence of the financing of the budget deficit by the issue of new paper money. In time the paper money is substituted by commodity money until it is perfectly replaced by the latter.

In the earlier paper (Bernholz 1989) it was demonstrated that in at least four historical cases, high inflations ran through the complete inflationary cycle described in the model. These cases were the United States during the war of independence (1776 - 81), France during the great revolution (1789 - 97), Peru during the Andean War (1875 - 87) and Mexico during its revolutionary war (1913 - 17). In other historical examples of hyperinflations beginning in the 1920s up to the 1990s, only a

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part of the inflationary cycle was present. Also, from the 1930s stable foreign exchange took the place of commodity money.

In the present article we extend our study to another example of paper money inflation, namely Ming China from 1375 - 1448/88, with the intention of testing whether our theory of the inflationary cycle can be successfully applied to this early case. Such an empirical test is important to check the generality of the model, its robustness relative to changes of the cultural setting and especially of time. In Europe paper money, properly speaking, was only invented in the 17th century. In 1661 the first European banknote, the Credityf-Zedel was issued by the Stockholms Banco founded by the merchant Palmstruck (*Deutsche Bundesbank* 1971, XI - XII). The first relatively mild paper money inflations took place in France under the direction of John Law (1716 - 21) and in Sweden (1730 - 1763). As shown in my earlier paper (*Bernholz* 1989) qualitative characteristics of the inflationary cycle were also present in these cases.

Since no earlier European historical experiences are available, a further study had to turn to China, where not only paper and printing, but also paper money and paper money inflation have first been invented. Though it seems that several Chinese regimes after 1000 A.D. went through the full inflationary cycle, I selected the Ming inflation since it seemed to be best documented in the secondary literature. It is regrettable that even here there remain gaps, especially as the author is not able to read Chinese primary sources. But the available qualitative evidence seems to be sufficient to judge whether the model of the inflationary cycle allows an adequate description of the Ming paper money experience.

The present paper is organized as follows. In Section 2, the model of the inflationary cycle is described more fully in verbal form (for the mathematical model, see *Bernholz* 1989). Section 3 provides a historical introduction to the development of Chinese paper moneys and paper money inflations. In section 4, it is shown that the model of a complete cycle of paper money inflation can be successfully applied to explain the events during the Ming dynasty. Section 5 contains some conclusions.

II. The Four Phases of a Complete Inflationary Cycle and Their Characteristics

In the beginning of the first phase of the inflationary cycle paper money notes are introduced at a fixed exchange rate (parity) with commodity monies (or, later in history, to relatively stable foreign monies)

into which they are fully convertible. The paper money issued is used to cover a constant real budget deficit of the government from the very beginning (in historical cases sometimes only later on). Since foreign countries use a money based on the same commodity, the exchange rates of the new domestic paper money are fixed to their currencies.

During the first phase the public is willing to accept the new paper money, since it is for many purposes more convenient than, let's say, gold, silver or copper coins. Thus no problem arises with the new money until the public has reached an optimal portfolio of paper and commodity monies. The commodity money substituted is used to settle the balance of payments deficit which develops since there is an excess demand for goods of government and public taken together. The superfluous commodity money flows to foreign countries.

In the second phase, however, problems arise since more and more paper money is created to finance the budget deficit.¹ With the exchange rate to commodity money still fixed, the public do not want to hold the additional paper money exceeding the sum wanted for optimal portfolios. Thus, with full convertibility, people turn in the unwanted paper money to the monetary authorities in exchange for commodity money. Monetary authorities lose reserves. Since there is again an excess supply of money in the total domestic economy during the second phase, this implies an excess demand for goods and a balance of payments deficit. The commodity money taken out of official reserves is used – at fixed exchange rates with foreign countries – to pay for the deficit.

In the third phase the reserves of monetary authorities are exhausted, but new paper money is still being created. Consequently, convertibility of paper money into the commodity money at the fixed parity is suspended. But the government still maintains the parity by introducing stiffer and stiffer fines and penalties for paying a premium on the commodity money in terms of the paper money and/or for concluding contracts in and asking for payment with the commodity money, etc. Under these conditions Gresham's law that bad money drives out good money will be at work.² People use paper money to pay their debts and their

¹ We assume zero growth of the economy and thus no growing demand for money. With a positive growth rate no problems would arise as long as the additional paper money corresponded to it.

² It seems that Sir Thomas Gresham did not formulate "Gresham's Law" and that it has already been known before him. The term "Gresham's Law" was probably coined by MacLeod (1863, 464). For evidence, see Jastrow (1923, 45 - 50) and for a formal description of Gresham's law Bernholz and Gersbach (1992).

taxes. They try to hoard the commodity money. The balance of payments deficit is still present because of the excess supply of money. Thus, more and more commodity money is leaving the country.

Finally, at the end of phase three, all commodity money has vanished from domestic circulation. Consequently, in phase four fixed exchange rates to foreign currencies cannot be maintained any longer. For, barring foreign exchange controls, the excess demand for foreign exchange implied by the excess supply of money resulting from the still ongoing issues of new paper money, can only be balanced by increasing exchange rates. Inflation begins in earnest, since the domestic quantity of money can no longer be exported, and rises all the time, whereas prices for imported and exported goods increase with exchange rates in terms of domestic paper currency.

Subsequently, the rate of inflation increases in each period. For to finance even a constant real budget deficit the government (or its monetary authorities) have to create bigger and bigger amounts of paper money (in nominal terms) because of the rising price level and exchange rate. Moreover, it is probable that the real budget deficit will even grow, since taxes assessed and paid in paper money lose value before they can be spent by the government. This is the so-called *Olivera-Tanzi effect* (*Tanzi* 1977). Also, in this phase, one usually gets an undervaluation of the domestic currency, since the increase of the exchange rate is more pronounced than that of the domestic price level (for empirical facts see *Bernholz*, 1982, *Bernholz*, *Gärtner* and *Heri* 1985; the latter also develop a model to explain the historical phenomena starting from *Bhandari* and *Turnovsky* (1982), a paper which is itself influenced by *Dornbusch* (1976)).

As a consequence of the developments sketched above, inflation accelerates and in time turns into high or possibly into hyperinflation. Now under such inflationary conditions, the real value of money holdings erodes rapidly. The public tries to escape from these negative consequences and to substitute stable commodity money (or foreign exchange) for the inflating paper money. The government, however, want to prevent an erosion of the base of their inflation tax and introduce heavy penalties and fines for holding and using commodity money (or foreign exchange) as a medium of exchange. But with increasing rates of inflation this is all to no avail. Currency substitution goes on, the good money drives out the bad. The reverse of Gresham's law, *Thiers' law* is working (*Bernholz* 1989). It has been called *Thier's law* since this French historian described nicely the above process for the hyperinflation of the Great French Revolution (*Thiers* 1825).

In the end of phase four, paper money falls into disuse. Even before that time, the government has to begin to demand payment of at least some taxes in commodity money. Otherwise its revenue would move towards zero in real terms, taking into account that the real revenue from the inflation tax also tends towards zero. Finally the good money is legalized and the paper money formally abolished.

Our sketch of the complete inflationary cycle provides, of course, a highly simplified picture of the main features of the process. But it is exactly this fact which allows us to compare many historical cases and to analyse whether they showed the relevant qualitative characteristics.

Also, as mentioned above, the inflationary cycle need not be complete in all empirical cases. E.g., a successful currency reform can stop high or hyperinflation during phase four and thus end and reverse currency substitution. Also, in reality, different phases, especially the third and fourth phases, may overlap. E.g., even stiff fines and penalties may not be sufficient to prevent a black market with a premium for the commodity money, or black markets with lower prices for goods in terms of the commodity money and a beginning of inflation already in the third phase in terms of paper note prices especially for goods not traded internationally. Also, the process may start with phase two, if no commodity money is circulating. Or phase two may be missing because no official reserves exist.

III. Historical Background: Chinese Paper Money Inflations

The Chinese first invented paper, printing and, thus, before 1000 A.D. paper money. Their governments were the first to monopolize the issue of paper money and to create paper money inflation. Chinese paper money probably first evolved from deposit certificates, the so-called “flying money”, which were introduced during the reign of Emperor Hsüan-tsung (806 - 820 A.D.) of the T’ang dynasty. But the deposit certificates themselves were in fact only like drafts used to “send” money to other places and therefore not money in the proper sense (*Chüan* 1938, *Liao* 1941, *Yang* 1952). The first true paper money appeared as convertible private money before 1004 under the Northern Sung Dynasty. It was called chiao-tzu or “exchange medium” and was limited to Szechuan and thus not a national currency. Later on, the government forbade the use of this private paper money after several runs on the issuing firms led to inconvertibility or bankruptcies.

But since a real need for paper money existed the chiao-tzu were issued again, but this time (1024) by a government monopoly. This money later spread to other Chinese provinces. In the beginning the issue of this state paper money was strictly limited and official reserves sufficient to maintain convertibility into the copper coins used as commodity money. But from 1072 the government issued more and more paper money to finance its budget deficit. Inconvertibility and inflation were the consequence. The Chinese thus were the first in history to suffer from paper money inflation (*Liao* 1941, *Yang* 1952).

From then on, about each Chinese dynasty up to the Ming began by issuing some stable and convertible paper money and ended with pronounced inflation caused by circulating ever increasing amounts of paper notes to finance budget deficits (*Tullock* 1957, *Liao* 1941, *Yang* 1952; for an econometric study of developments under the Southern Sung along the lines of *Cagan* (1956) see *Lui* (1983)). The inflationary cycle sketched above was, however, not completed under the Northern and Southern Sung dynasties, since they were conquered before the end of phase four by the Nu-chen Tartars establishing the Chin dynasty in Northern China in 1127 and the Mongols occupying South China in 1276, respectively (*Gernet*, 1972). It seems also that the Northern Sung succeeded with a currency reform to stabilize their money shortly before their downfall (*Liao* 1941, p. 186). Whether this would have been a permanent success must remain open to question.

During the last years of the Mongol (Yüan) dynasty, paper money inflation accelerated and it seems that the public repudiated the notes:

“In the capital paper money was only calculated in units of ten ting (= 500 kuan)³; and for this one could even not get 50 liters (a tou) of millet. Moreover, the whole exchange of goods for the paper money stapled at government agencies and by private persons came to a total halt, so that people considered it to be worthless paper and the government household soon dried up” (Yüan-shih, History of the Yüan, chapter 97, 3asq.; quoted and translated from *Franke*, 1949, p. 96).

From this quotation it seems that the paper money was driven out by barter and/or good copper money. The latter interpretation is supported by the establishment of copper mints in 1351, though they were abolished again in 1354. But *Franke* adds (p. 100):

³ Originally, when in 1260 the chung-t'ung yüan pao-ch'ao paper money was introduced by the government of emperor Kublai Khan, one kuan was set equal to one kuan (string) of 1000 cash copper coins.

"These very ephemeral issues of money [by the leaders of the uprisings against the Mongols] would be unimportant if they all had not had one common characteristic: in all cases they speak of metallic and not of paper money. This amounts to a clear hint that a return to a metallic currency was more popular than as a continuation of the badly reputed Mongolian paper money regime."

As far as inflation is concerned, the available data are very rudimentary (*Franke*, pp. 144 - 155). Moreover, they often refer to prices officially fixed by the government and not to market prices. Still "we can observe for grain an increase of prices by a factor of 25 to 50 or more between 1261 and 1355, depending on the local supply situation" (*Franke*, p. 148). Salt prices increased by a factor of 55 to 60 between 1261 and 1343 (p. 149). And whereas in 1309 the official price for one pound of salt was 0.25 kuan tshung-t'ung paper money, it rose to more than 1 kuan in 1343.

It seems, therefore, that only the Mongol (Yüan) dynasty (*Franke* 1949) and the Ming dynasty (see Section 4.2) completed the inflationary cycle. In the later Ming dynasty (until 1644) no paper money circulated. The same was true for most of the rule of the Mandchu (Tsing) dynasty conquering it until 1852.

IV. The Complete Inflationary Cycle During the Ming Dynasty (1368 - 1448)

1. The First Two Phases of the Ming Inflationary Cycle

In 1368 the Mongols had finally been defeated by Chinese revolutionary forces and power been consolidated by one of the military leaders, who made himself Emperor under the name of Hung-wu (1368 - 1398) and founded the Ming dynasty (1368 - 1643).

Given the bad experience of the population with paper money inflation and the repudiation of paper notes, it is perhaps not surprising that the Ming regime only ordered the minting of copper coins in 1368, whose face value corresponded to the value of the metal. But already in 1375 the Ming government began again to issue paper notes in denominations of 1 kuan = 1000 cash, 500, 300, 200 and 100 cash (*Liao* 1941, *Li* 1956; a reproduction of a 1 kuan note of the Ming can be seen in *Deutsche Bundesbank* 1971).

"One string (kuan) in paper currency was worth 1000 copper cash, or 1 tael of silver; 4 strings were equal to one ounce⁴ of gold. People were forbidden to use

⁴ *Li* (1956) translates liang for silver with tael, but for gold with ounce (p. 283, footnote).

gold, silver or goods as the media of exchange, but the exchange of gold or silver for paper notes was allowed. In the collection of commercial taxes both copper and paper currencies were used; they were paid 30 per cent in copper cash and 70 per cent in paper notes. For amounts less than 100 cash, however, copper was used exclusively" (*Li*, p. 283).

From this it follows that gold and silver were convertible at fixed parities into paper notes, but this does not imply that paper notes were convertible at the fixed parities into gold and silver bars or into copper coins. Thus *Li* (p. 284) states that "the paper currency ... was not limited in amount by the currency regulations, and was not convertible." But though the first statement is obviously true, the second may not be quite correct for the beginning of paper note issue. For 70 % of commercial taxes could be paid in paper notes at the parity of 1 kuan paper money = 1 kuan string of copper coins = 1000 cash copper coins. Land taxes, too, could be partially paid in paper notes at the official parities with copper coins or silver (*Li*, 1941, p. 206). Thus the government may well have thought that these parities could be maintained without a monetary authority being obliged to exchange paper notes into copper coins, silver or gold at the parities (*Huang*, p. 69). Otherwise the fixing of parities would not make sense. We may in fact speak of a limited convertibility for tax purposes. On the other hand, it is obvious that such a limited convertibility could not be maintained when soon too many paper notes were issued to cover the budget deficit. Unfortunately nothing is reported by the authors mentioned above about the years immediately after 1375, since the next facts given refer to 1385 and 1390. It may well be that this shows that everything was "normal" for a few years, i.e., that the public accepted the paper money to build up their optimal portfolios of copper coins and paper notes and that no immediate inflationary pressure resulted. But, of course, we cannot know for certain.

There is, however, some other evidence which seems to support our hypothesis, that the parity with copper money was maintained during the first years of paper money circulation. According to *Li* (1956, p. 284) "there was a steady increase in the amount of paper notes issued, while the supplementary coins, being a good commodity with real value, were driven off the market."

It follows that Gresham's law that bad drives out good money was at work, which presupposes, as is well-known, a fixed exchange rate (*Bernholz and Gersbach* 1992), here between paper and copper money. From this it can be concluded that a fixed parity must have been maintained not only in the third phase, but also in the first phase of the Ming

inflationary cycle. But this would suggest that tax-based convertibility was working during the first years of paper money.

It is important to note, however, that the second phase of the model sketched above was probably missing in the Ming inflationary cycle. For, as mentioned, we hear nowhere about official reserves of commodities as existed during the early Yüan monetary regime (*Franke* 1949, pp. 38sq.), which could have been used to convert against paper notes offered by the public at the fixed parities.

On the other hand, it seems to be clear from the sources, that the inflationary cycle was driven all the time by paper money creation used to cover the budget deficit. *Ray Huang* (1974) concludes that in 1390 “the emperor handed out no less than 95 million kuan of paper currency. The state income in government notes is recorded that year at totalling 20,38299 million kuan. Deducting the latter figure from the former, one may conclude that in the year 1390 alone the Ming founder inflated the market with some 75 million kuan of new notes. At the official rate of exchange, 1 kuan per picul of husked grain, the amount of new money in circulation was thus equivalent to two and a half year’s income from the land taxes” (p. 69sq.)

Already “in the Chinese year of 1385, the workers in the superintendency produced somewhere between 27 million and 34 million kuan of new notes” (p. 70).

2. Phases Three and Four of the Ming Inflationary Cycle

We have already mentioned that Gresham’s law was at work (phase three), since the bad paper notes drove the good copper coins off the market. *Li* (1956, p. 289) also quotes from an Edict to the Board of Finance from 1394: “Those who dare clandestinely use or bury them (copper coins) shall be convicted.” The latter obviously means that these coins were withdrawn from circulation and hoarded by people.

Finally, *Huang* (1974, p. 76) states that “Moreover a large proportion of the coins minted in the early Ming circulated overseas.” Huang seems to attribute this fact mainly to Cheng Ho’s naval expeditions of the 15th century and to the amounts of copper coins granted to foreign emissaries. But this must only have accounted for part of the outflow, because of the general validity of Gresham’s law and the outflow to be expected already during the first phase.

Given the huge size of the Chinese empire and the, compared to modern times, underdeveloped communication and transportation system, it had to be expected that phases three and four of our model would widely overlap each other for the Ming inflationary experience. For under such conditions, the government was often not able to enforce the parities of paper notes with copper coins, gold and silver rather early in the third phase even with high fines and penalties. And, in fact, already in 1394 the government issued the following edict (quoted from *Li* 1956, p. 289):

“Edict to the Board of Finance: Let the proper government agencies recall all [copper] cash into the government and exchange it with the same amount of paper currency; copper coins should henceforth be banned from circulation. All copper coins owned by soldiers, civilians and merchants must be delivered to the government within half a month. Those who dare clandestinely use or bury them shall be convicted.”

This probably shows that former efforts of the government to prevent a premium on copper coins (compared to the parity) and/or the quotation and appreciation of higher prices in paper notes than in copper coins had been in vain. Otherwise the complete banning of copper coins could not be understood.

Also, though the price data gathered by the authors mentioned above from the original sources are very scanty, they seem to show that inflation must have begun already around 1380 and that at least the silver and copper coin parities of paper notes must have broken down before 1390 (Table 1). In spite of the older prohibition (of 1375) to use (unminted) gold and silver as means of payment, they were, because of the inflation in terms of paper money and the recent edict banning copper coins, more and more substituted for paper notes in market transactions. Thus their use was again strictly forbidden in 1397 and this regulation strengthened in 1403 (*Liao* 1941, p. 204). The edict of 1403 states:

“The use of gold or silver as the medium of exchange is prohibited. Those transgressing against this shall be adjudged guilty of a major crime. Anyone who provides information leading to their capture shall be rewarded with the gold or silver involved in the case” (*Li* 1956, p. 289).

That the penalties were severe is shown by an order of 1404 that the death sentences of those convicted of the infraction of this law should be commuted to exiling them and their whole families to modern Jehol (*Li*, p. 285).

As can be seen from Table 1, inflation went on in spite of these drastic measures. Moreover, it even accelerated, since more and more paper notes were issued (*Huang* 1974, p. 70). As a consequence, gold, silver and

Table 1
Commodity, Precious Metal and Copper Coin Prices in Ming China
in Terms of Paper Money Notes (Kuan)

Year	Gold 1 Liang Index		Silver 1 Liang Index		Copper Coins 1 Kuan Index		Copper, Refined 1 Catty Index		Rice 1 Tan Index		Grain 1 Picul Index	
1375	4	100	1	100	1	100	0.16	100	1	100	1 ⁶⁾	100
1385			3 ³⁾	300							2.5	150
1386									2.5	250		
1390			5 ³⁾	500							4	400
1393					6.31	631						
1402 ¹⁾	400 ²⁾	10000	80 ²⁾	8000	80 ²⁾	8000	4 ²⁾	2500	25 ²⁾	2500	25 ²⁾	2500
1404											30 ²⁾	3000
1407	400	10000	80	8000								
1403/24	400	10000	83.33	8333					25 ⁴⁾	2500		
1425											55 ⁷⁾	5500
1426	8000	200000	2000	200000								
1432									15 ⁵⁾	1500		
1436			1000	100000								
1440s			500	50000								
1448					500	50000						
1488			333 ²⁾	33300								
1488/1505			750 ²⁾	75000								

1) The figures for 1402 are from a table published by *Torao* (1903) and contained in *Li* (1956), who discusses it extensively. The date to which the table refers is not known. According to *Li* (p. 288), a date about 1407 is probable. Comparing the figure for grain for 1404 with that in the table, it seems probable that the date should be earlier than 1404 given inflation. Thus we have inserted 1402. – 2) Officially fixed price, with market price probably much higher. – 3) *Liao* (1941, p. 205) writes “Not long afterwards (i.e., after 1375) paper money devalued to 3 to 5 kuan per liang silver.” We have dared to translate this statement into two entries of 3 and 5 kuan, respectively, for 1385 and 1390, which seemed best to correspond to 6.31 kuan paper notes for 1 kuan copper coins in 1393, and to 2.5 kuan for one picul of grain in 1385. – 4) Average of 20 – 30. – 5) Officially fixed price for calculating salaries of government employees. The market price was probably much higher. – 6) Assumed from the fact that the officially fixed price in 1390 was still 1 kuan, whereas the market price amounted to 4 kuan per picul grain. – 7) Average of 40 – 70.

Sources: *Liao* (1941), *Li* (1956) and *Huang* (1974).

barter were mainly used for transactions in the market already about 1425 (*Liao* 1941, p. 205; *Huang* 1974, p. 70). In a vain effort to prevent this substitution of good money⁵ and of commodities for paper notes, a government order ruled as follows in 1428:

⁵ Here we consider unminted gold and silver as a primitive form of money. This is justified, since they were used as means of payment and because the paper money was later, to a large extent, driven out rather by silver bars than by copper coins.

“Those who refuse to use the paper notes shall be fined 1000 strings (kuan) for every string refused. The relatives, neighbors and neighborhood heads who are cognizant of these matters but do not report them shall be fined 100 strings for every string so refused. Those who clandestinely carry on business behind closed doors, and those who raise commodity prices, shall be fined 10'000 strings; the relatives, neighbors and neighborhood heads who conceal such information shall be fined 1000 strings” (*Li* 1956, p. 289).

Beside such efforts the government introduced in 1425 shop franchise fees levied on shopkeepers, which had to be paid in paper money. In 1429 the rates of these levies were increased five-fold and their scope widened. The idea was to decrease the amount of paper notes circulating. A report at the year-end of 1431 showed that 200 million kuan in paper notes had been collected. In 1433 the revenue increased to 288 million kuan. The deflationary effort seemed to be successful and the emperor declared: “Now both within and outside the capital paper money is circulating well” and ordered a reduction of the tax rates to about one third. Further reductions reduced the rates until 1442 to 10 % of those of 1429 (*Huang* 1974, p. 71).

It should be mentioned that already in 1404 a salt tax fully to be paid in paper had been introduced with the same purpose (*Huang*, p. 70; *Liao* 1941, p. 206). The land tax was also to be paid in paper notes from 1407 (*Liao*, p. 206).

As *Huang* puts it (p. 71): “Clearly a golden opportunity for currency reform presented itself at this point” in 1433. But the government did not seize the opportunity, issued again more and more paper notes to cover the budget deficit, and thus prepared the ground for the completion of the fourth phase of the inflationary cycle.” ... by 1448 the use of copper coins had become prevalent, the rate of exchange being two copper cash for one string. Palace guards were therefore sent to inspect the markets in the capital; anyone found using copper cash in the transactions was fined ten times (the sum involved in the original transaction). Actually, however, these restrictions were not effective. On the contrary, most business transactions were conducted with silver or copper currency” (*Li* 1956, p. 289).

Already in 1435/36 the government had legalized the use of copper coins, a decree which was interpreted by the population as legalizing the use of silver and gold payments, too (*Huang* 1976, p. 72; *Li* 1941, p. 205). Twelve years later this edict was, however, rescinded (*Li*, p. 205). In 1436 the court authorized the collection of land taxes in silver (*Huang*, p. 72).

After the last strong effort in 1448 to enforce the sole circulation of paper money had been abolished, the prohibitions on the use of silver and copper coins were rescinded in 1450 (*Huang*, p. 76). The commutation of taxes into silver or copper coins proceeded more slowly, though it was unescapable to bring up government revenues again. The household salt tax was commuted in 1468 to silver or copper cash. But only after 1488 the commutation of taxes into silver became the usual practice (*Li* 1956, pp. 290sq.). The government went on to pay part of the salaries of its officials in paper money for about a hundred years after paper money had fallen into disuse, though taxes were seldom collected in paper notes. "Such whittling away of official salaries in effect compelled the officials to engage in corrupt practices in order to maintain themselves" (*Li*, p. 292).

One last characteristic of phase four of the inflationary cycle mentioned above can also be documented for the Ming dynasty inflation. In fact, the evidence for an undervaluation of paper money in terms of copper coins, silver and gold is rather strong. From Table 1 we can see that at least from 1402 (i.e., from the table presented by *Torao* (1903), the date of which cannot be exactly determined, see Note 1 of Table 1) the prices of gold, silver and copper coins had moved well ahead of those of rice, grain and, importantly, of refined copper (bars). But the prices of the former have to be considered to be exchange rates, for gold and especially silver bars and copper coins were used as alternative means of payments and could also be used for payments in foreign countries. Quantitatively, the undervaluation was also quite pronounced. In 1402 it amounted, if we take silver or copper coins into account, to 3.2, where purchasing power parity relative to 1375 has been set equal to 1. Even if we assume that the official price list set the prices of refined copper, rice and grain relatively too low, the undervaluation must have been substantial, as seen by the later market prices. Also the magnitude itself is not unreasonable if we compare it with some extreme undervaluations in modern hyperinflations. In the German inflation of the 1920s, e.g., an extreme undervaluation of about 3.192 was reached in February 1920 (*Bernholz, Gärtner and Heri* 1985, p. 25, Table 1; see also *Bernholz* 1992b).

Obviously, if one takes the 1402 exchange rate for copper kuan and transforms the prices of goods expressed in paper notes to such expressed in silver or copper coins, one gets very low prices by long-term historical standards. This has been done by *Li* (1956) in the table republished (pp. 285 - 286) by him for 29 goods (of which only three are contained in our Table 1). He concludes (p. 286):

"According to the above table, one bolt of cotton cloth cost only 250 copper cash or 0.25 tael of silver; one tan of rice, only 312.5 copper cash or 0.3125 tael of silver; and one catty of beef, only 125 copper cash or 0.125 tael of silver. These figures would seem to be unreasonably low, even for the old days of lower costs of living. Since price fluctuations had become erratic, however, the people did not at all feel that the cost of living was low. Those who depended on wages for a living found that their wages did not increase as rapidly as the prices of things they had to buy with depreciated paper currency. Those whose income was based on the sale of products were also dissatisfied at receiving payment in depreciated currency."

These remarks confirm the presence of undervaluation though the author did not quite understand the phenomena. Note also, that even in modern high inflations, wages are usually lagging behind the increase of the price level.

Another remark by *Li* (pp. 287sq.) also refers to undervaluation. It shows at the same time that officials tried to maintain the old official parities:

"The merchants calculated the prices in terms of hard currency and invariably felt that the commodity prices were too low; the officials calculated in terms of paper notes, and invariably felt that prices were too high. Hence commodity prices became a matter of contention between officials and merchants".

V. Conclusions

We have seen that the qualitative characteristics of a complete inflationary cycle are present in the historical developments from 1375 to 1448/1488 during the Chinese Ming dynasty. Though the empirical evidence is scanty, especially for the first and third phases, they seem to be in agreement and thus to support the model presented in *Bernholz* (1989) and sketched in Section 2 above: the whole process was clearly driven by printing paper money to cover the budget deficit. It also appears that in the first years after 1375, parity to copper coins could be maintained with the help of a limited convertibility for tax payments. Otherwise the outflow of copper coins to foreign countries (phases one and three) and the hoarding of them (phase three) could not be well explained. Moreover, the scarcity of copper coins mentioned (*Liao* 1941, p. 204) could not be explained, for it is well-known since *Hume* (1742; see also *Bernholz* 1992a) that an excess demand for a commodity money in one country will be solved by importing the respective commodity, here copper. And it is noteworthy in this respect that copper coins were available together with silver again in 1448 (*Li* 1956, p. 289).

Since the monetary authorities of the Ming regime obviously held no reserves to secure convertibility, phase two could not take place in the Chinese experience of that time. Also, phase three widely overlapped with phase four, because in the huge Chinese empire fines and penalties could not be adequately enforced, given the underdeveloped information and transportation systems of the period. But the government certainly did everything it could to prevent by harsh fines and penalties for violators and their families as well as for the withholding of information on them, and by rewards to informers, to maintain the parity and later to prevent the substitution of paper money by the precious metals and by copper coins as a consequence of inflation. Note also that these media of exchange were suddenly again available, presumably from dishoarding and importing them, as to be expected for phase four.

All government measures to prevent this substitution of the bad paper money by good commodity money were of no avail, again in correspondence with the model. Finally, the undervaluation characteristic of most inflations during phase four was also present during the inflationary episode of the Ming dynasty.

Some of our conclusions may be daring given the scarcity of quantitative empirical evidence. But we are rather confident that they are true in view of the fact that the qualitative evidence adduced for the Ming dynasty corresponds to the qualitative characteristics of the many historical cases of inflation from the 18th century to the present. But then the experience of the Ming inflation 600 years ago provides additional evidence for the robustness of the theory.

In writing the present article, we had also to reckon with the fact that historians of China unacquainted and thus not applying the above or similar hypotheses, may have missed some of the facts which could be important to support or to reject them. It would be gratifying if this paper would draw the attention of historians to such hypotheses and help direct their research to some of the relevant questions.

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Summary

Paper Money Inflation, Prices, Gresham's Law and Exchange Rates in Ming China

In the present article the Ming paper money inflation of 1368 - 1448 is analyzed with the intention to test whether the theory of a complete inflationary cycle is applicable not only to Western historical cases but also to this much earlier and

culturally different historical episode. A complete inflationary cycle begins with the introduction of paper money to finance a budget deficit and its use by the public besides specie. It later drives the specie out of circulation (Gresham's law). After that inflation begins and accelerates. Specie money returns and substitutes the paper money, which finally vanishes from circulation. It is shown that these and other qualitative characteristics were present during the Ming inflation.

Zusammenfassung

Papiergeldinflation, Preise, das Gresham-Gesetz und Wechselkurse im China der Mingzeit

In diesem Artikel wird die Papiergeldinflation der Mingzeit (1368 - 1448) mit der Absicht analysiert festzustellen, ob die Theorie eines kompletten Inflationskreislaufts lediglich auf in der westlichen Geschichte aufgetretene Fälle zutrifft oder auch auf viel weiter zurückliegende Zeiträume in anderen Kulturen. Ein kompletter Inflationskreislauf beginnt mit der Einführung von Papiergeld zur Finanzierung eines Haushaltsdefizits und mit der allgemeinen Verwendung dieses Papiergelds als Zahlungsmittel neben dem Münzgeld. Ab einem späteren Zeitpunkt verdrängt das Papiergeld das Münzgeld (das Gresham-Gesetz). Danach beginnt die Inflation und nimmt an Geschwindigkeit zu. Das Münzgeld kehrt zurück und ersetzt das Papiergeld, das schließlich ganz aus dem Umlauf verschwindet. Es wird nachgewiesen, daß diese und andere qualitative Merkmale auch in der Inflation der Mingzeit festzustellen waren.

Résumé

Inflation de la monnaie fiduciaire, prix, loi de Gresham et taux de change en Chine au temps de Ming

L'auteur analyse dans cet article l'inflation de la monnaie-papier de Ming de 1368 - 1448 afin de tester si la théorie d'un cycle inflationniste complet est applicable aussi, outre aux cas occidentaux historiques, à des périodes historiques beaucoup plus reculées et culturellement différentes. Au début d'un cycle complet inflationniste, on émet de la monnaie-papier pour financer un déficit budgétaire et celle-ci est utilisée par le public en plus de la monnaie métallique. Puis, celle-ci est chassée de la circulation (loi de Gresham). Après cela, l'inflation commence et s'accélère. La monnaie métallique revient et se substitue à la monnaie-papier qui disparaît finalement de la circulation. L'auteur montre ici que ces caractéristiques ainsi que d'autres caractéristiques qualitatives étaient présentes lors de l'inflation au temps de Ming.