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DEFLATION IN CHINA

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Summary :

This article investigates the causes of the deflation which occurs in China since 1998. The analysis is based on a theoretical model which addresses supply shocks as well as demand shocks and on the estimation of a reduced equation of consumer prices variations for the period 1986-2002, the results of which corroborate the theoretical assumptions. The main conclusion is that the slowing down of inflation and the fall of prices are chiefly explained by China economic policy. Moreover and contrary to the current opinion we show that deflation is partly due to the deceleration of productivity growth.

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1. Introduction

Deflation was not uncommon in the 19th century, as well as in the early 1930s. In contrast over the four last decades the policy makers have been more worried about inflation than deflation. However there has been recently an increasing concern about deflation in both industrial and developing countries.

Deflation may be defined as "a sustained decline in an aggregate measure of prices such as the consumer price index or the GDP deflator" (FMI 2003). However as the consumer price index is subject to a variety of biases, it is likely that a rise of this index of one per cent reflects in fact price stability or even declining prices. Over the last five years the proportion of countries where annual inflation is less than one per cent shows a sharp increase (FMI 2003). The phenomenon was particularly striking in Asian countries, chiefly in Japan, Taiwan and Hong-Kong, as well as in Mainland China. Germany and Switzerland have also experienced some short periods of declining prices.

Most often deflation is accompanied by a decrease in production. China is a striking exception. Since the beginning of its transition towards a market economy, Chinese economy has been characterized by a fast growth (about 9% by year on average) and a moderate inflation. However there were two episodes of accelerated inflation in 1988 and in 1994 when the annual rise of the consumer price index was over 25%. In contrast in the last five years China has known two episodes of deflation. The consumer prices began to fall in the early 1998 and this lasted until the end of 1999. Deflation reappeared during late 2001 and lasted until the end 2002, with a peak in April 2002 at 1,3 % (12 months change). Moreover the rate of variation of prices was less than one per cent almost permanently from December 1997 until now. Simultaneously the pace of activity continued to be strong with a GDP annual growth of 7,4 % from 1998 to 2002 (see figure 1).

Insert here figure 1 : Inflation, deflation and growth

Deflation may reflect a great variety of factors. Declining prices are likely to go with falling demand. But when the decline is associated with an increase in output, it is likely that some supply shocks are leading to deflation. In the case of China, many factors have been suggested by the literature on the subject. Although public spending has been growing by 20 per cent a year since 1998 and that the monetary policy has been accommodative with several decreases in the interest rates, several authors have underlined the constraints which prevent the state banks from lending to the private sector which would suffer from a kind of "credit crunch" (Fan 1999, Yu 1999). Other authors bring up supply side factors. In this respect the impact of productivity gains as well as the fixity of the exchange rate are particularly controversial. Jubak (2002) and the Task Force of the FMI (2003) think that the large progress in labour productivity pushes prices down. But the drawback of this explanation is that it implies that Balassa-Samuelson effect is not working. Conversely, it is possible that inefficient state enterprises subject to a soft-budget constraint (as the state banks continue to lend to them even if their production is no longer profitable) have accumulated large unsold goods stocks, and finally were obliged to sell them cut-price. Brandt and Zhu (2001) suggest that the nominal anchorage of the Yuan to the dollar, in a context of low world inflation and trade liberalization, explains the fall of tradable goods prices. It is also likely that the fixity of the exchange rate heightens expectations of long-term monetary stability.

The aim of this paper is to investigate the causes of deflation in China[1]. The interest of this research is both theoretical and political. The case of China would allow to understand the roots and mechanisms of deflation in transition economies. On the other hand the macroeconomic situation of China will have a more and more important impact on world economy in the next years. Chinese deflationary impulses can be transmitted to other countries. Indeed the share of China's trade in both world trade and Asian intra-regional trade is rapidly increasing. For the moment it appears that only prices in Taiwan and Hong Kong are really affected by the decline of prices in Mainland China, this owing to their strong links (FMI 2003). Nonetheless it is useful to understand the mechanisms of deflation in China in order to anticipate the

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[1] In a previous paper we have investigated the causes of inflation until 1998 (Guérineau and Guillaumont, 2003). The model presented here is significantly different from the previous one, so that it allows us to explain inflation as well as deflation.

behaviour of Chinese authorities in the field of fiscal, monetary, trade and exchange rate policies.

The analysis will be based on a theoretical model of the consumer price index variations. In order to address the merging of demand and supply shocks, the model is based on the traditional distinction between internationally tradable and non tradable goods. These goods are not subject to the same kind of shocks. Prices of tradable goods are principally influenced by external shocks such as variations in international commodity prices and in exchange rates. Prices of the non tradable goods depend on the equilibrium between domestic demand and supply. On the demand side our model takes into account monetary policy change and the stocking behaviour of the enterprises. On the supply side, it allows us to address the opposite impact that productivity gains in tradable and non tradable sectors exert on domestic prices. Productivity gains in tradable sector are inflationary while the others are deflationary. We suppose that the effect of productivity growth in the tradable sector is dominant so that, contrary to the current opinion, deflation is explained by the slowing down of productivity growth during the recent years. Our model also gives a crucial role to prices expectations, assuming an asymmetry between rising and declining price anticipations.

The paper is organized as follows. In part 2, we present our theoretical model of inflation and deflation. In part 3 we present our empirical results, based on the estimation of a reduced equation of quarterly consumer prices variations, over 1986-2002. These results largely corroborate the theoretical hypotheses set out in part 2. They allow us to compute the relative contribution of the identified explanatory factors to the deflation.

2. A theoretical model of inflation and deflation

Our model is based on the distinction – usual in the macroeconomic analysis of developing and transition economies – between prices of tradable goods and prices of non tradable goods. The non tradable goods sector includes not only the services, but also protected agriculture and the manufactured consumer goods of low quality (not easily exported) that are produced either by state owned enterprises or the informal sector. The price of tradable goods is assumed to be exogenous while the price of non tradable goods depends on the equilibrium of the supply and demand in

the domestic market. We suppose that three main categories of factors determine the conditions of this equilibrium: macroeconomic policy, labour productivity and price expectations.

2.1 A two-goods model

The consumer price index P is defined as a geometric average of price indices of each type of good. The variation of this index (p), which may be a rate of inflation or deflation, is then an arithmetic average of the price variation observed for non tradable goods (p_{NT}) and tradable goods (p_T), where the weight of each type of good is its share in the consumer basket (a and $1-a$):

$$p = a.p_{NT} + (1-a).p_T \tag{1}$$

We may consider that China is price-taker on the world market for the major part of its international trade. In these circumstances, as far as there are no restrictions on external trade, the price of tradable goods depends on two factors: first the world price of tradable goods and second the price of foreign currencies measured in national currency units. Therefore the price of tradable goods is subject to two kinds of shocks. The first one is the exchange rate policy of China (which determines the price of the dollar in Yuans) and the second one is linked to external factors: international fluctuations of commodity prices and variations of the exchange rates (in terms of dollar) of China trade partners. Actually, due to quantitative restrictions (quotas and licences, but also import planning), prices of many imports were almost disconnected from international prices until 1993. Import planning was banished in 1994, and other quantitative restrictions decreased significantly between 1992 and 1994, thus we can expect that the impact of these factors on the prices of tradable goods was lower before 1994.

With the increase of Chinese trade in the world trade, it is likely that China has gained some international market power so that the price of certain exported goods will be an increasing function of the level of the external demand. The rate of variation of the price of tradable goods is then[2]:

$$p_T = (b_1 - b_2.d_1).(p_T^* + gNEER) + b_3.gWD \tag{2}$$

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[2] In this model, all coefficients are defined so that they are positive.

where ($\boldsymbol{p}_T^*$) is the rate of variation of the world price of tradable goods, ($gNEER$) is the rate of variation of Chinese nominal effective exchange rate[3] (the sum of which may be called imported inflation), (d_1) is a dummy variable equal to 1 over the period 1986-1993, when trade restrictions were drastic, and gWD is the rate of variation of world demand.

The variation of the price of non tradable goods ($\boldsymbol{p}_{NT}$) is given by equilibrium conditions of the domestic market and by the control of prices still carried out before 1996.

We assume that demand of non tradable goods, measured at constant prices, is an increasing function of the relative price between tradable goods and non tradable goods, of the real aggregate demand and of the expected prices of goods relatively to present ones. On the other hand supply of non tradable goods is supposed to be a decreasing function of the relative price of tradable versus non tradable goods and of the real unit cost of labour, *i.e.* the real wages and the labour marginal productivity in the non tradable sector. Finally as the transition towards a market economy was carried out with gradual steps in China, many non tradable good prices remained fixed by the state between 1985 and 1995. The price control produced a gap between demand and supply of non tradable goods. The rationing (r) may be defined as the fraction of supply that should be produced to match the demand so that (1+r) is the ratio of demand to supply.

From these relationships, we can derive the following structural model (in terms of rates of variation):

$$gY_{NT}^D - \boldsymbol{p}_{NT} = \boldsymbol{g}_1.(\boldsymbol{p}_T - \boldsymbol{p}_{NT}) + \boldsymbol{g}_2.(gY - \boldsymbol{p}) + \boldsymbol{g}_3.\boldsymbol{p}^a \qquad (3)$$

$$gY_{NT}^S - \boldsymbol{p}_{NT} = -\boldsymbol{d}_1.(\boldsymbol{p}_T - \boldsymbol{p}_{NT}) - \boldsymbol{d}_2.(gW_{NT} - \boldsymbol{p}_{NT} - gLMP_{NT}) \qquad (4)$$

$$gY_{NT}^D = gY_{NT}^S + g(1+r) \qquad (5)$$

where gY_{NT}^D and gY_{NT}^S are the rate of variation of, respectively, the nominal demand and supply of non tradable goods, gY is the rate of variation of the nominal aggregate demand $\boldsymbol{p}^a$ is the anticipated rate of inflation (or deflation)[4], gW_{NT} is the

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rate of variation of the average nominal wage, $gLMP_{NT}$ is the rate of variation of the labour marginal productivity in the non tradable sectorINCORPORER and $g(1+r)$ is the rate of variation of the rationing indicator $(1+r)$.

From equations (3) to (5) we derive a first reduced equation of the rate of variation of non tradable goods, which depends on (p_T) - itself given by equation (2) - gY, $g(1+r)$, gW_{NT}, $gLMP_{NT}$ and p^a:

$$p_{NT} = \frac{(g_1 - g_2.(1-a) + d_1).p_T + g_2.gY - g(1+r) + d_2.gW_{NT} - d_2.gLMP_{NT} + g_3.p^a}{g_1 + g_2.a + d_1 + d_2} \quad (6)$$

2.2 Macroeconomic policy and aggregate demand

In the Chinese context, we can assume that monetary policy is the main factor explaining global demand growth (gY) (Brandt et Zhu, 2000) Indeed, money supply - essentially used to finance state owned enterprises - is also the main source of financing for the budget deficit.

Furthermore it seems that, during the first stage of the transition of China towards a market economy, the credit policy was biased in favour of losing state-owned enterprises. As far as bank credit allows these enterprises to accumulate inventories of goods that they can't sell at a price high enough to cover the production costs, it induces an unfair increase of demand and prevent prices from falling. When from 1994-95 the credit allocation became less accommodating with losing enterprises, these have been obliged to sell their excess stocks at cut price, what conversely may have pushed prices down. Actually the inventories variation has known a steep positive trend from 1984 to 1995 and then has declined until 2000, according to *Chinese National Accounts*. So the rate of variation of the aggregate demand may be expressed as follows:

$$gY = l_1.MP + l_2.dVEI \quad (7)$$

where (MP) is an indicator of the monetary stance, and where dVEI represents the first difference of the variation in excess inventories, which is not induced by GDP growth but is allowed by the credit selectivity in favour of state-owned enterprises.

Simultaneously a price control may have prevented the non tradable goods market equilibrium. The rate of variation of rationing g(1+r) is linked to the price reform. More precisely, it is a decreasing function of price liberalization (LIB):

$$g(1+r) = -\boldsymbol{r}.LIB \tag{8}$$

Therefore, we may assume a price jump in 1988 and 1994, when price liberalization was accelerated.

2.3. A dualistic model of nominal wages : the role of productivity

We consider that labour productivity growth may have an opposite impact on prices according to the sector where it occurs. The determination of nominal wages is based on an oversimplified dualistic model of the labour market. Due to the progressive transition of China towards a market economy, the labour market remains segmented. Here we suppose that there are two segments in the labour market corresponding respectively to the traditional sector of production and the modern one, with no real mobility between them. Moreover we assume that unemployment concentrates in the traditional sector while in the modern dynamic sector the labour demand tends to be rationed by the supply. The modern sector encompasses almost the whole tradable sector and only a part of the non tradable one. Indeed if many workers in the banking, insurance, transport or engineering services may use their skills in the new industry (tradable sector), the workers in the other parts of non tradable sector, *i.e.* the protected agriculture, the old public manufactured sector and the administrative, social, retail trade and informal sectors, are not easily hired in the modern tradable sector, through lack of appropriate qualifications or due to administrative constraints.

In the modern non tradable sector we assume that wages are determined according to a Balassa–Samuelson effect[5]. The basic hypothesis of this effect is that "internal mobility of labour will tend to equalize the wages of comparable labour within each economy" (Balassa 1964 p.586). As prices in the tradable sector are determined by exogenous factors (equation 2), the rate of growth of wages in this sector is equal to the sum of the productivity growth and the rate of variation of tradable good prices. The rate of growth of wages in the non tradable modern sector is the same as in the tradable sector:[6]

$$gW_{NT,1} = gLMP_T + \boldsymbol{p}_T \tag{9}$$

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[5] S. Guillaumont Jeanneney and P. Hua (2002) have showed that the Balassa–Samuelson effect is working in China at least since the early 1990 when the transition towards a market economy was largely realized.
[6] Thanks to productivity gains, the average wage will rise, which doesn't imply that the minimum wage (remunerating the least skilled workers) will rise. The rise of the average wage is compatible with a

On the other hand in the traditional non tradable sector, the nominal wage is determined as in a closed economy. According to an augmented Phillips curve, the rate of variation of the nominal wages may be supposed an increasing function of the rate of expected inflation and a decreasing function of unemployment. Indeed there is no reason to believe that Chinese people are more subject to monetary illusion than other people so that inflation or deflation expectations are introduced in our wage equation.[7] In China there are no reliable data about unemployment so that we shall not be able to test the impact of unemployment on inflation. To overcome the lack of data, we assume here that, in the short run, unemployment depends negatively on aggregate demand. Therefore the rate of variation of the nominal wage in the traditional part of the labour market is determined as follows:

$$gW_{NT,2} = j_1 . p^a + j_2 . gY \tag{10}$$

Combining equations (9) and (10), the reduced form of the equation of the average nominal wage in the non tradable sector is then the following :

$$gW_{NT} = h . (LMP_T + p_T) + (1 - h) . (j_1 . p^a + j_2 . gY) \tag{11}$$

where h is the share of workers belonging to the modern non tradable sector .

In short, productivity gains in the tradable sector have a positive effect on the prices of non tradable goods, by inducing an increase in wages (equation 6), while productivity gains in the non tradable sector have a negative effect in reducing the unitary cost of labour (equation 4). For the econometric estimation of our model, the productivity growth can not be shared between the two sectors. As in the Balassa-Samuelson model we suppose that the productivity growth is much faster in the tradable sector than in the non tradable one and that the share of the modern non tradable sector is high. Therefore we expect a positive effect of the global productivity growth on the variation of prices.

2.4 Price expectations

In a context of rational expectations, we assume that the anticipated rate of inflation or deflation is driven not only by the level of past inflation, but also by the exchange rate policy which seems to be the clearest signal of their behaviour that the Chinese authorities give to the economic agents. Indeed in China, the Central Bank is

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sluggish minimum wage rate as the dispersion of wages is increasing ; it seems to have been the case in China.

supervised by the government. The credit policy is determined as a non cooperative game between the central authority and provincial authorities (provincial governments and provincial branches of the central bank). The latter try essentially to speed economic growth of their province, while the responsibility of the fight against inflation is left to the Central Bank (Boyreau-Debray 2000, 2001, Brandt and Zhu 2001). Since exchange rate policy is determined by the central authority, the exchange strategy observed by economic agents give them a good indicator of the government trade-off policy between price stability and economic growth. In other words, since the central bank can't build its credibility on its independence or on its reputation (as it is the case in other transition economies where the need of economic reforms is deep, Sachs 1996), the choice of a fixed exchange rate is a way to overcome the lack of credibility of monetary policy.

Since 1994, the Yuan has actually been pegged to the US dollar and the exchange rate policy corresponds to a perfect anchorage strategy. On the other hand, before 1994 two exchange rates (an official and a swap rate), both controlled by the authorities, were applied to commercial operations, the swap rate becoming progressively the main one. From 1985 to 1994 these rates were devalued several times. However the nominal depreciation does not always prevent a real appreciation of the currency. So we may consider that sometimes during this period exchange rate policy was a partial anchorage strategy. In our econometric estimation we shall measure the anchorage level, as it may be perceived by the economic agents, by a synthetic indicator previously defined for Poland by Guérineau and Guillaumont Jeanneney (2002).

This indicator works as follows. If the exchange rate is fixed, the "anchorage indicator" (AI) is equal to one. If there is some devaluation and no real appreciation, it is equal to zero. If there is some devaluation and a real appreciation, (AI) takes a value between zero and one and indicates a partial anchorage. In this case the monetary authorities have partly given up monetary stability for competitiveness. Finally, when the growth of exports and external reserves is dramatic, economic agents may anticipate a lower devaluation or even - in the case of a fixed exchange rate - a nominal appreciation. The credibility of the anchorage is then strengthened. Therefore, we build a second indicator adjusted for credibility: we multiply the

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[7] See Howell (1997) and Guillaumont Jeanneney and Hua (2001)

"gross" indicator by the rate of variation of exports so that this adjusted indicator may be higher than one [8].

Therefore the rate of the anticipated variation of prices is a function of their past variation and of the level of anchorage.[9] Moreover we expect that the impact of past inflation on the current variation of prices is not the same as the impact of past deflation, since the deflation may be perceived as an exceptional episode, so:

$$p^a = (m + m_2.d_2).p_{-1} + m_3.AI \tag{12}$$

where AI is the indicator of anchorage and d_2 a dummy equal to one during the deflation episodes.

In our model the fixity of the exchange rate of the Yuan in terms of dollars contributes to a low inflation or to deflation because it has a direct effect on the price of tradable goods and because it dampens inflation expectations.

Figure 2 represents the main relationships of our model.

Insert here Figure 2: Main relationships of the inflation (or deflation) model

2.5 An estimating equation of inflation or deflation

Substituting equations (2), (6), (7) (8), (11) and (12) in equation (1) gives the reduced form of our inflation equation:

$$p = \frac{[(a.(g_1 + g_2.(1-a) + d_1 + d_2.h) + (1-a)].[(b_1 + b_2.d_2).(p_T^* + gNEER) + b_3.(gWD)]}{g_1 + g_2.a + d_1 + d_2}$$

$$+ \frac{a.l_1.(g_2 + d_2.(1-h).j_2).(MP) + a.l_2.(g_2 + d_2.(1-h).j_2).(dVEI) + a.r.(LIB) - a.d_2.h.(LMP_T)}{g_1 + g_2.a + d_1 + d_2}$$

$$+ \frac{a.d_2.(LMP_T) + a.(d_2.(1-h).j_1 + g_3).(m_1 + m_2.d_2).(p_{-1}) + a.(d_2.(1-h).j_1 + g_3).(m_3).(p_{-1})}{g_1 + g_2.a + d_1 + d_2}$$

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[8] In studies dedicated to industrial economies, the credibility associated with the exchange rate stability is often measured by the interest rate premium between the national economy and foreign countries (see for instance Bleaney and Mizen, 1997). This measure is not relevant in China where interest rates remain determined by the state and where there are many controls over international capital flows.

[9] In countries where inflation is very high, as for instance in Poland in the early nineties (cf Guérineau et Guillaumont Jeanneney, 2002), it is likely that the anchorage of the domestic currency on a foreign one may reduce the inertia of inflation. We have checked that this assumption does not hold in China.

Therefore in our estimation the overall inflation is a function of the following variables: the variation of foreign prices and of the nominal effective exchange rate of China, the variation in the world demand, the monetary policy (global and selective) and the liberalization of domestic rices, the past variation of prices and the level of anchorage by the exchange rate, and the overall growth of labour productivity, as we have no data on the productivity growth in each sector[10]:

$$\boldsymbol{p} = \boldsymbol{y}_0 + (\boldsymbol{y}_1 - \boldsymbol{y}_2.d_1).(\boldsymbol{p}_T^* + gNEER) + \boldsymbol{y}_3.(gWD) + \boldsymbol{y}_4.(MP) + \boldsymbol{y}_5.d(VEI) + \boldsymbol{y}_6.(LIB) + \boldsymbol{y}_7.(LMP)$$

$$+ (\boldsymbol{y}_8 - \boldsymbol{y}_9.d_2).(\boldsymbol{p}_{-1}) - \boldsymbol{y}_{10}.(AI) \qquad (14)$$

where the signs behind each coefficient indicates its expected impact on inflation.

In equation (14) most variables are foreign ones or are depending on China economic policy. So we can test the different explanations of the Chinese deflation given in the literature that we have recalled in the introduction: external shocks, credit policy, productivity growth and exchange rate fixity.

3 Econometric estimation of the model

We have four main objectives: (1) determining if there are one or two distinct models explaining inflation and deflation ; (2) assessing the relevance of the "wide" definition of deflation mentioned in section 1 (*i.e.* when the rate of variation of prices is below 1%) ; (3) testing the impact of the two anchorage indicators, adjusted or not for credibility ; (4) and finally identifying the reasons of the switch from inflation to deflation for the last five years.

We first present the data, then the econometric method of estimation, results which corroborates our theoretical model, and finally we can evaluate the relative importance of the main factors explaining the slowing down of inflation or the deflation.

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[10] This substitution implies a linear relationship between the growth of productivity in the tradable sector and in the non tradable sector. The coefficient of the productivity growth is equal to $\dfrac{\boldsymbol{a}.\boldsymbol{d}_2.(\boldsymbol{h} - \boldsymbol{q})}{(\boldsymbol{g}_1 + \boldsymbol{g}_2.\boldsymbol{a} + \boldsymbol{d}_1 + \boldsymbol{d}_2).(\boldsymbol{q}.\boldsymbol{a} + (1 - \boldsymbol{a}))}$, where $\boldsymbol{q} = gLMP_{NT}/gLMP_T$. This coefficient will be positive if the share of the modern sector for non tradable goods is greater than $\boldsymbol{q}$.

3.1 Data

We will estimate equation (14) using quarterly data during the period 1986 (4th quarter) –2002 (3rd quarter). This equation is simple enough to fit to the available quarterly data. Sources of data are given in appendix 1. All the quarterly rates of variation are computed on the previous one.

Inflation (or deflation) is defined as the rate of variation of the consumer price index, and past inflation (or deflation) corresponds to the variation of prices of the previous quarter. Since we assumed an asymmetric impact of past inflation and of past deflation on price expectations, we build a dummy variable (DEF1), equal to 1 during the two episodes of price decrease (4th quarter of 1997 – 4th quarter of 1999, then 1st quarter of 2001 – 3rd quarter of 2002). A second dummy variable (DEF2) corresponds to the wider definition of deflation, *i.e.* when the annual rate of variation of prices is below 1% (4th quarter of 1996 – 3rd quarter of 2002).

Imported inflation is proxied by the average rate of variation of the consumer price index in the main trade partners of China, converted in Yuans. Indeed, the Chinese unit values of imports and exports, which would have been better proxies of the price of foreign tradable goods, are not available on a quarterly basis for the whole period of our estimation. Of course foreign consumer price indices include also the prices of non tradable goods, but these indices are the only ones available for the whole sample of China trade partners. In order to test the impact of the trade liberalisation carried out in 1993, this proxy of imported inflation goods is introduced a second time, multiplied by a dummy variable equal to 1 until the second quarter of 1993. World demand is measured by the rate of variation of world imports (in dollars). World imports are defined at constant prices since the index of world imports in current dollars is divided by the world index of imports unit value in dollars.

Monetary policy is measured by the seignoriage indicator suggested by Brandt et Zhu (2000), *i.e.* the ratio of the variation of the monetary base to past GDP. This indicator allows us to take into account the monetisation phenomenon experienced by the Chinese economy during its transition towards a market economy[11]. To take into account the bias of the credit policy towards losing state-owned enterprises, which is

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[11] Let $MP = \dfrac{\Delta B}{Y_{(-1)}} = \dfrac{\Delta B}{B} . \dfrac{B}{Y_{(-1)}}$, where B is monetary base. We assume here that the ratio B/Y (which increased from 11% in 1987-89 to 17% in 1996-98) is essentially explained by structural factors. Inflation expectations may have an impact on this ratio, but several studies dedicated to money demand in China don't support this view (Boyreau-Debray, 2001).

supposed to have induce an unfair movement in inventories, we have computed a variation in excess inventories (VEI), defined as the variation in inventories not induced by GDP growth, namely:

$VEI = dI - k.dGDP$

where *dI* is the variation in inventories and *k* is supposed to be equal to 0,55 which is the minimum value of the ratio of inventories to the GDP in our sample[12]. Then we introduce the first difference of the variation in excess inventories (*dVEI*) into the regression[13].

Price liberalization is proxied by a dummy variable equal to 1 when the decrease of the share of fixed prices in the basket of the consumer price index is equal or greater than five percentage points (*i.e.* in 1988 and 1994). The dummy variable is put in the third quarter of each year, since this choice maximises the significance of the coefficient associated with this variable[14].

The rate of variation of the labour marginal productivity is proxied by the rate of variation of the ratio of the GDP to total employment[15][16]. Moreover, as mentioned earlier, we can't measure productivity growth separately in each sector (tradable and non tradable). However we have tested if an involuntary increase in inventories (*i.e.* a positive variation in excess inventories), working as a signal of bad management and therefore acting as an incentive to improve efficiency in the following quarters, notably in the non tradable sector, may have pushed prices down.

The "anchorage indicator" (AI) is measured as the ratio of two elements: first the absolute value of the rate of variation of the real exchange rate of the dollar in terms of Yuans (gRER$_\$$) during the last four quarters and second the sum of this same rate and the rate of variation of the nominal exchange rate (gNER$_\$$)(both in absolute value):

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[12] Since quarterly data on the variation in inventories is not available, we have calculated these variations as follows: (1) computing a "gross" quarterly variation in inventories by allocating one fourth of the annual variation to each quarter ; (2) smoothing this side-stepping series by computing a centred moving average on five quarters.

[13] As the variation in excess inventories (VEI) are sometimes negative , we don't introduce into the regression the rate of variation of VEI but its first difference.

[14] We don't know precisely the quarter when the control removal occurs.

[15] If we assume that the production elasticity with respect to labour is constant (which is an usual assumption) the rate of variation of labour marginal productivity and labour average productivity are equal.

[16] Since there is no reliable quarterly data of total employment, we used annual data and interpolated quarterly data of total employment by assuming that the seasonality component of total employment is the same as the total urban employment given in the *China Monthly statistics*.

$$AI_1 = \frac{\left|gRER_\$\right|}{\left|gRER_\$\right| + \left|gNER_\$\right|} \quad {}^{17}$$

The "anchorage indicator" adjusted for credibility is "weighted" by the ratio of current exports to exports of the previous quarter, *i.e.* one plus the rate of variation of exports (gEXP):

$$AI_2 = \frac{\left|gRER_\$\right|}{\left|gRER_\$\right| + \left|gNER_\$\right|} \cdot (1 + gEXP)$$

3.2 Econometric tests

Unit root analysis has been carried out with Dickey-Fuller, Phillips-Perron and Elliot-Rothenberg – Stock tests. At the 5% level, all variables may be considered as stationary[18] (cf. appendix 2), thus we can estimate inflation equation with standard procedures.

The Bera-Jarque tests performed on the four equations do not reject the null hypothesis of normality of residuals. Breusch-Godfrey tests reject the null hypothesis of absence of autocorrelation. This autocorrelation is corrected by a Cochrane-Orcutt procedure. Heteroskedasticity is tested and corrected by White's procedure.

A common issue of any macroeconomic equation estimation is that we might suspect right-hand-side variables to be endogenous. However most variables of our estimation represent external shocks, policy indicators and lagged variables. Hausman exogeneity tests have been carried out on each explanatory variable (except dummy variables) to test this hypothesis. For each exogeneity test, an over-identification test is performed following Sargan's procedure (Baltagi, 1998). The null hypothesis of exogeneity is not rejected for all variables. Instrumental relationships, exogeneity and over-identification tests are presented in appendix 3.

To know if the same model is relevant during inflation and deflation periods, we test the stability of coefficients between the two periods. A dummy variable corresponding to the deflation period (DEF1) is successively associated with each coefficient and added in equation (1). The null hypothesis of stability is not rejected for each of the coefficients tested (see appendix 4)[19].

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[17] A nominal appreciation is measured as a nominal stability and a real depreciation as a real stability. For a complete explanation of the indicator see Guérineau and Jeanneney Guillaumont, 2002.

[18] See Guérineau et Guillaumont Jeanneney (2002) for a discussion on the stationarity of Chinese inflation.

[19] Remind however that we have supposed a different coefficient of past variations of price when there is inflation or deflation.

3.3 Estimation results

The results of our estimations are given in table 1. Column 1 to 4 allow us to test the impact of the two definitions of deflation (compare columns 1 and 2, or columns 3 and 4), and of the two measures of the anchorage policy (compare columns 1 and 3, or columns 2 and 4). The remaining variables are the same in the four estimations. In 5 we test the lagged deflationary effect of a variation in excess inventories (acting as an incentive to efficiency), while capturing the direct inflationary impact of an increase in the variation in excess inventories as in columns (1) to (4) [20]

These results of the five estimations largely corroborate the theoretical assumptions presented in the previous section. About one fourth of the growth of the price of foreign goods passes on overall inflation, but this impact was considerably lower before the trade liberalization of 1993 (6%)[21]. World demand exerts a positive and significant impact on Chinese inflation, with a lag of two quarters. Macroeconomic policy has also a significant effect, through positive impact of the growth of seignoriage and the sporadic inflationary effect of the reduction of price control in 1988 and 1994. Finally, the impact of the selective credit policy, captured by the first difference of the variation in excess inventories, appears to be significantly positive as expected, but of small size.

Insert here table 1 Table 1: Estimation of Chinese inflation (1986-2002)

As we expected, the overall impact of productivity growth is positive, thus the inflationary impact of productivity growth in the tradable sector (through the wage applied in the "modern" sector) is higher than the deflationary impact of productivity growth in the non tradable sector (through the price of non tradable goods). Of course, the availability of the data on productivity in each sector would improve the estimation of these effects. When we introduce the lagged variation of excess inventories, assumed to be an incentive to productivity growth in the non tradable

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[20] As we assume that the lag is longer for an incentive effect than for a direct effect on demand, we introduce different lags for the two variables relative to inventories and so we avoid the collinearity between them.

[21] Nevertheless, a Wald test performed on the restriction $y_1 + y_2 = 0$ shows that this impact is significantly different from 0 before 1993.

sector (column 5), the impact on inflation is as expected negative while the coefficient associated to the productivity growth is slightly higher.

The only difference between inflation and deflation models is the impact of the past price variation on the current price variation. Whereas inflation inertia is strong, deflation inertia seems to be null[22]. It is not surprising that we observe only short episodes of deflation, since there is no mechanism which extends deflation when the initial causes of this deflation no longer exist. As soon as economic conditions are modified, deflation may end. At the opposite, inflation inertia contributes to the occurrence of long periods of continuous inflation. Moreover, this absence of deflation inertia seems to occur as soon as annual inflation is below 1%, since the coefficient associated with past inflation multiplied by the deflation dummy is strongly significant.

At last, the nominal anchor policy (measured either by the gross or adjusted anchorage indicator) contributes to the decrease of inflation or to deflation. Since the indicator adjusted according to the speed of exports growth has a significant impact while it is superior to 1 in 1996-97, 1999 and 2002, we may think that in these periods many economic agents expected a nominal appreciation of the Yuan.

3.4 The relative importance of the factors explaining deflation

In this last section, we will try to identify the reasons of the switch from inflation to deflation. So we will compute the average contribution to the rate of variation of prices of each explanatory variable respectively during inflation and deflation periods (according to the regression (5)). As we use the wide definition of deflation, these two periods are 1986:4 to 1996:3 and 1996:4 to 2002:3. This average contribution is the product of the estimated coefficient of each variable by its average value. For the sake of readability, the quarterly rates of variation of prices are converted in annual rates of variation.

The average annual rate of variation of the prices was 12,2% during the inflation period and it was almost null (-0,04%) during the deflation period. Figure 3 represents the difference between the impact of each factor on the variation of prices in the two periods and allows to explain the removal of inflation. The most striking

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[22] Indeed, a Wald test performed on the restriction $y_7 + y_8 = 0$ shows that deflation inertia is not significantly different from 0.

fact in this graph is the weight of past inflation in this explanation (more than a half of the overall gap). Indeed inflation inertia largely contributes to the average rise of prices during the inflation period. This contribution to the gap would have even been higher if there was a deflation inertia (since the average fall of prices would have been stronger). Nevertheless, if inflation inertia explains the length of inflation episodes – thus the high level of average inflation during these phases – it's not an initial cause of inflation. The change in the price dynamics comes from the various factors related to external shocks, economic policies and productivity growth.

The Chinese economy experienced three kinds of external shocks: world inflation, fluctuations of world demand and the exchange rate policies of its foreign trade partners. Each of these three items contributes to the slowing down of inflation in the second period, as the world inflation and the world expansion have decreased and China's trade partners on average have depreciated their currency vis-à-vis the dollar. Their joint contribution is equal to 0,75%, *i.e.* about 14% of the gap between the variation of the prices of the two periods which is not explained by the inflation inertia.

Insert here figure 3: The contribution of each the factors explaining the variation of prices upon the removal of inflation.

The tightening of the control of money supply and the stronger budgetary constraint imposed to state-owned enterprises, the price liberalisation and the exchange rate policy also exerted a deflationary impact during the second period. Indeed, money growth has been slower, excess inventories have been sold and price liberalisation was completed. Moreover, since 1994, the Chinese authorities ceased to devalue their currency. The fixity of the Yuan vis-à-vis the dollar combined two effects on the slowing down of inflation, through the price of tradable goods and through price expectations. The latter effect has been probably strengthened by the credibility of the peg, or even by the anticipation of a revaluation of the Yuan. The overall impact of the economic policy is equal to 3,42%, i.e. about 63% of the gap previously defined. Nevertheless, the contribution of the selective credit policy (captured by the first difference of the variation in excess inventories) is almost null, since the coefficient associated with this variable is very small.

At last, since productivity growth decelerated in the second half of the nineties, its contribution to the slowing of inflation is 1,26%, *i.e.* about 23% of the gap.[23].

Conclusion

The aim of this paper was to investigate the causes of deflation in China. The estimation of a model explaining the rate of variation of prices allows us to draw several conclusions. (1) The determination of the variation of prices is slightly different between inflation and deflation periods, since deflation inertia is null while inflation inertia is strong. Nevertheless, this difference contributes dramatically to the gap between the average rate of variation of prices during inflation and deflation periods (2) This removal of inertia seems to exist as soon as the annual rate of variation of prices is below 1%, which validates the "wide" definition of deflation in China. (3) The nominal anchor policy contributed to the slowing down of inflation and the credibility of the peg with the dollar has strengthened this impact (may be through the anticipation of a revaluation of the Yuan). (4) The slowing down of inflation is due more to economic policy than to external shocks. Nevertheless, the reduction of excess inventories plays a small part in the deflation. Finally, the deflationary impact of productivity comes from the deceleration of productivity growth, and not from its acceleration.

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[23] The contribution of the variation in excess inventories (assumed to be an incentive to improve productivity) is almost null, since the average value of this variable is not significantly different between inflation and deflation periods. Indeed, the fall in excess inventories begins in 1995, while the deflation period begins only in 1997, so that the average value of the variation of excess inventories is not significantly higher during the inflation period.

<u>Consumer price index</u>

FMI*, International Financial Statistics.*

Rate of variation (over 12 months) of the consumer price index.

Fry M. J., 1995. « Estimating money demand for monetary control in China : A review of some technical issues raised by the research department of the People's Bank of China », *International Finance Group Working Paper*, The University of Birmingham, n° 02, 31p.

We used the Fry's methodology to build a series of the level of the consumer price index.

<u>Price liberalisation</u>

World Bank, 1995. *Country Study, China : Macroeconomic stability in a decentralized economy*, p210.

Rate of variation of fixed and free prices.

State Statistical Bureau, several years, *Price Yearbook of China*.

Shares of fixed, guided and free prices in the consumer price index.

<u>Gross domestic product</u>

National Bureau of Statistics, *China Monthly Statistics*, several months and years (1998:01 – 2000:01)

Research and Statistics Department of the People's Bank of China, 1998, *The People's Bank of China Quarterly Statistical Bulletin* (1996:1 – 1997:4).

State Information Centre, (1985:2 – 1995:4).

In 1993 and 1994, we have corrected the seasonality of the series –which seemed to be aberrant – according the seasonality observed in 1992 and 1995

<u>Inflation of the tradable goods</u>

FMI, *International Financial Statistics*

Nominal effective exchange rate.

<u>Anchorage indicators</u>

World Bank, 1994. *Country study, China : Foreign Trade Reform*, p35**.**

Swap exchange rate (Yuans/dollar).

FMI, *International Financial Statistics.*

Official exchange rate (Yuans/dollar, period average) ; Consumer price indexes of trade partners of China ; exports (value in dollars).

Author's calculations.

<u>Employment</u>

State Statistical Bureau, several years, *China Statistical Yearbook* and *China Monthly Statistics*.

Total number of employed persons ; total number of persons employed in urban areas.

<u>Inventories</u>

State Statistical Bureau, several years, *China Statistical Yearbook*

<u>Other series :</u>

FMI, *International Financial Statistics.*

Monetary base ; Domestic credit ; External reserves ; Imports (value) ;Official exchange rate (China) ; World imports (in dollars) ; World index of import unit values in dollars.

Appendix 2: Unit root tests

For each variable, Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are implemented. If the existence of a unit root cannot be rejected at the 10% level for both tests, Elliott, Rothenberg and Stock (ERS) procedure is carried out to determine the status of this variable (Elliott et al. 1996). This latter test consists of two steps: (i) estimating the deterministic component of the test (intercept and possibly a trend); (ii) performing an ADF test on the series without its deterministic component.

Variables	ADF	PP	ERS		Status
			Estimates of intercept and trend [a]	ERS Statistic (calculated)	
Inflation	-3.40* (4,c,t)	-4.10*** (4,c)			I(0)
Rate of variation of tradable goods	-4.04** (2,c,t)	-7.34*** (3,c,t)			I(0)
Rate of variation of world imports in dollars	-6.97*** (0,c)	-7.02*** (0,c)			I(0)
Ratio (variation of the monetary base) to GDP	-4.14*** (1,c)	-7.90*** (3,c)			I(0)
Rate of variation of labour productivity	-2.65* (3,c)	-11.6*** (0,c)			I(0)
Variation in excess inventories	-4,02*** (2,c)	-9,98*** (1,c)			I(0)
First difference of the variation in excess inventories	-12,44*** (2)	-44,8*** (3)			I(0)
Anchorage indicator	-3.48** (4,c,t)	-2.75 (3,c)	0.305948 [0.012978]	-3.26*** (4)	I(0)
Anchorage indicator (adjusted)	-3.20* (4,c,t)	-2.97 (3,c,t)	0.299236 [-0.013388]	-3.30*** (4)	I(0)

Statistics are t-ratios associated with the alternative hypothesis of stationarity. * implies that the null hypothesis is rejected at the 10% level, ** at the 5% level and *** at the 1% level. The shape of each test (lags, inclusion of an intercept and a trend in ADF and PP tests) is given in parentheses. When a trend is introduced in the ERS test, the estimate of the trend coefficient is given in brackets. The shape of the ERS test (with or without trend) is chosen according to the trend significance in the usual ADF test.

Appendix 3: Exogeneity and over-identification tests

	Equation (1)	
	Over-identification	Exogeneity
Inflation of tradable goods	97%	95%
World demand (-2)	99%	31%
Seignoriage	95%	99%
Productivity growth (-1)	99%	96%
Past inflation	99%	92%
First difference of the variation in excess inventories (-1)	99%	99%
Variation in excess inventories (-3)	99%	72%
Anchorage indicator	99%	79%

p-values of the alternative hypotheses of over-identification and endogeneity respectively.

Instrumental relationships
(t-ratios in parenthesis)

$(p^* + \text{gNEER}) = 0.04 - 0.04*\text{AI}(-1) + 0.46*\text{gWD}(-1)$
$\qquad\qquad\quad$ (3.46) (-2.80) $\qquad$ (2.02)

$\text{gWD}(-2) = 0.006 + 0.70*\text{gUSA}(-1) + 0.63*\text{gUSA}(-2) + 0.31*\text{gJAP}(-3)$
$\qquad\quad$ (1.57) (2.00) $\qquad\quad$ (1.78) $\qquad\qquad$ (1.78)

$\text{Seign} = -0.001 + 0.009*\text{gOER} + 0.056*\text{gCRED} + 0.0003*\text{Trend} - 4.4.10^{-5}*\text{Trend}^2$
$\qquad\quad$ (0.30) (2.64) $\qquad\quad$ (2.93) $\qquad\qquad$ (2.59) $\qquad\qquad$ (-2.96)

$\text{d(VEI)}(-1) = -0,18 - 0,55*\text{d(VEI)}(-2) + 5,3*\text{gLMP}(-2)$
$\qquad\qquad\quad$ (-2.46) (-5.41) $\qquad\quad$ (3.74)

$\text{gLMP}(-1) = 0.011 - 0.28*\text{gLMP}(-2) + 0.41*\text{gCRED}(-1) + 0.05*\text{VEI}(-4)$
$\qquad\qquad$ (0.98) (-2.56) $\qquad\qquad$ (2.27) $\qquad\qquad$ (3.64)

$\text{AI} = 0.01 + 0.86*\text{AI}(-1) + 3.20*p_{-1} + 0.15*\text{dRI}$
$\quad$ (0.17) (12.6) $\qquad$ (1.95) $\qquad$ (2.84)

$\text{VEI}(-3) = 0,0576 + 0,3*\text{VEI}(-5) + 2,89\text{gX}(-4)$
$\qquad\qquad$ (0.96) (3.07) $\qquad$ (3.01)

p_{-1} = Estimated inflation equation (lagged)

where : $(\text{gNEER} + p^*)$: Inflation of tradable goods.
$\qquad\quad$ **AI** : Anchorage indicator
$\qquad\quad$ **gWD** : Rate of variation of world demand (world imports at constant prices)
$\qquad\quad$ **gUSA** : Growth rate of the GDP of United States.
$\qquad\quad$ **gJAP** : Growth rate of the GDP of Japan.
$\qquad\quad$ **Seign** : Variation of the ratio (monetary base to past GDP).
$\qquad\quad$ **gOER** : Rate of variation of the official exchange rate
$\qquad\quad$ **gCRED** : Rate of variation of domestic credit.
$\qquad\quad$ **gLMP** : Rate of variation of the labour productivity (ratio GDP to total employment)
$\qquad\quad$ **VEI** : Variation in excess inventories
$\qquad\quad$ **d(VEI)** : First difference of the variation in excess inventories
$\qquad\quad$ p_{-1} : Lagged inflation
$\qquad\quad$ **dRI** : Variation of the ratio (external reserves to imports).

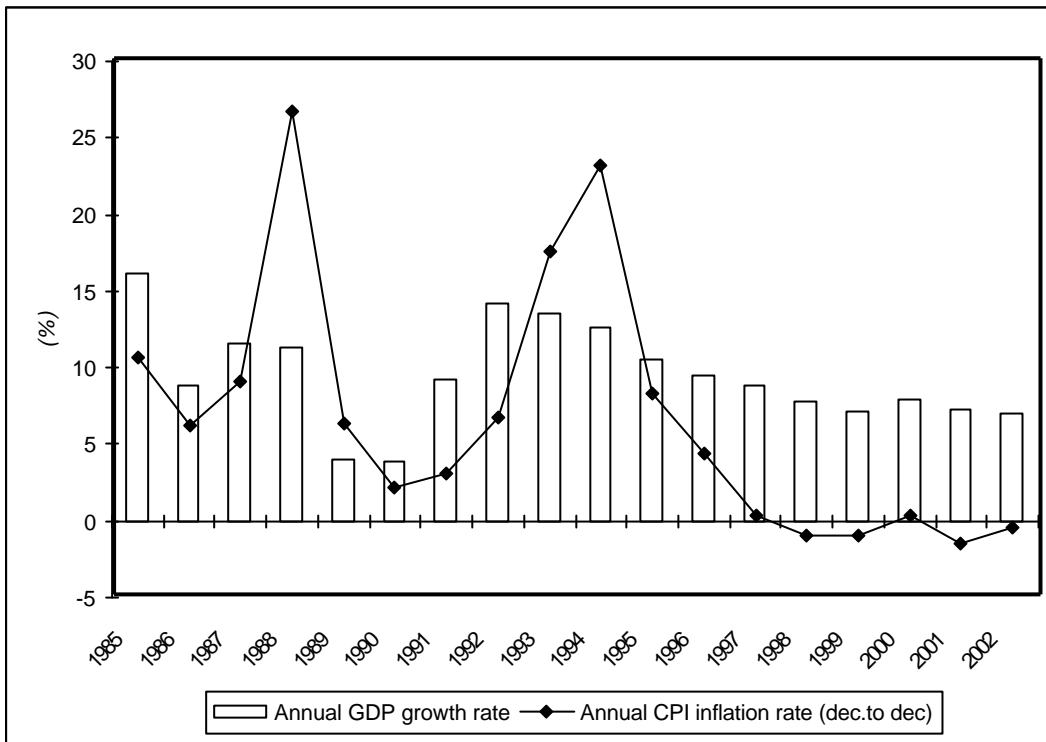| **Explanatory Variables** (abbreviation used in the theoretical model)						
Intercept	0.0003 (91%)	0.002 (50%)	0.001 (69%)	0.001 (62%)	0.002 (57%)	0.001 (98%)
Tradable goods inflation $(p_T^* + gNEER)$	0.27 (1%)	0.31 (2%)	0.28 (1%)	0.27 (1%)	0.27 (1%)	0.27 (1%)
Tradable goods inflation *dummy (1986-1993q2) $(p_T^* + gNEER)$ *DUM8693	-0.20 (2%)	-0.25 (5%)	-0.22 (1%)	-0.21 (2%)	-0.21 (2%)	-0.20 (2%)
Monetary policy (MP)	0.63 (2%)	0.51 (2%)	0.51 (3%)	0.54 (3%)	0.53 (2%)	0.65 (2%)
Price liberalisation (LIB)	0.031 (1%)	0.032 (1%)	0.031 (1%)	0.032 (1%)	0.032 (1%)	0.031 (1%)
World demand (-2) (WD)	0.16 (4%)	0.13 (7%)	0.15 (4%)	0.15 (12%)	0.13 (10%)	0.16 (3%)
Past inflation (p_{-1})	0.61 (1%)	0.59 (1%)	0.60 (1%)	0.59 (1%)	0.58 (1%)	0.61 (1%)
Productivity gains (-1) LMP(-1)	0.060 (1%)	0.062 (1%)	0.062 (1%)	0.059 (1%)	0.069 (1%)	0.062 (1%)
Nominal anchor policy indicator (adjusted for credibility) AI	-0.008 (1%)	-0.008 (1%)	-0.008 (1%)	-0.008 (1%)	-0.008 (1%)	-0.008 (1%)
Dummy deflation DEF	0.002 (35%)					
Tradable goods inflation *dummy_deflation (MP)*DEF		-0.008 (52%)				
Monetary Policy*dummy_deflation (MP)*DEF			0.27 (42%)			
World demand*dummy_deflation (gWD)*DEF				-0.31 (77%)		
Productivity gains *dummy_deflation (gWD)*DEF					-0.56 (20%)	
Nominal anchor policy *dummy_deflation (AI)*DEF						0.002 (35%)
Adjusted R^2	80.6 %	80.5 %	80.4 %	80.4%	80.6 %	80.6 %

p-values in parenthesis.

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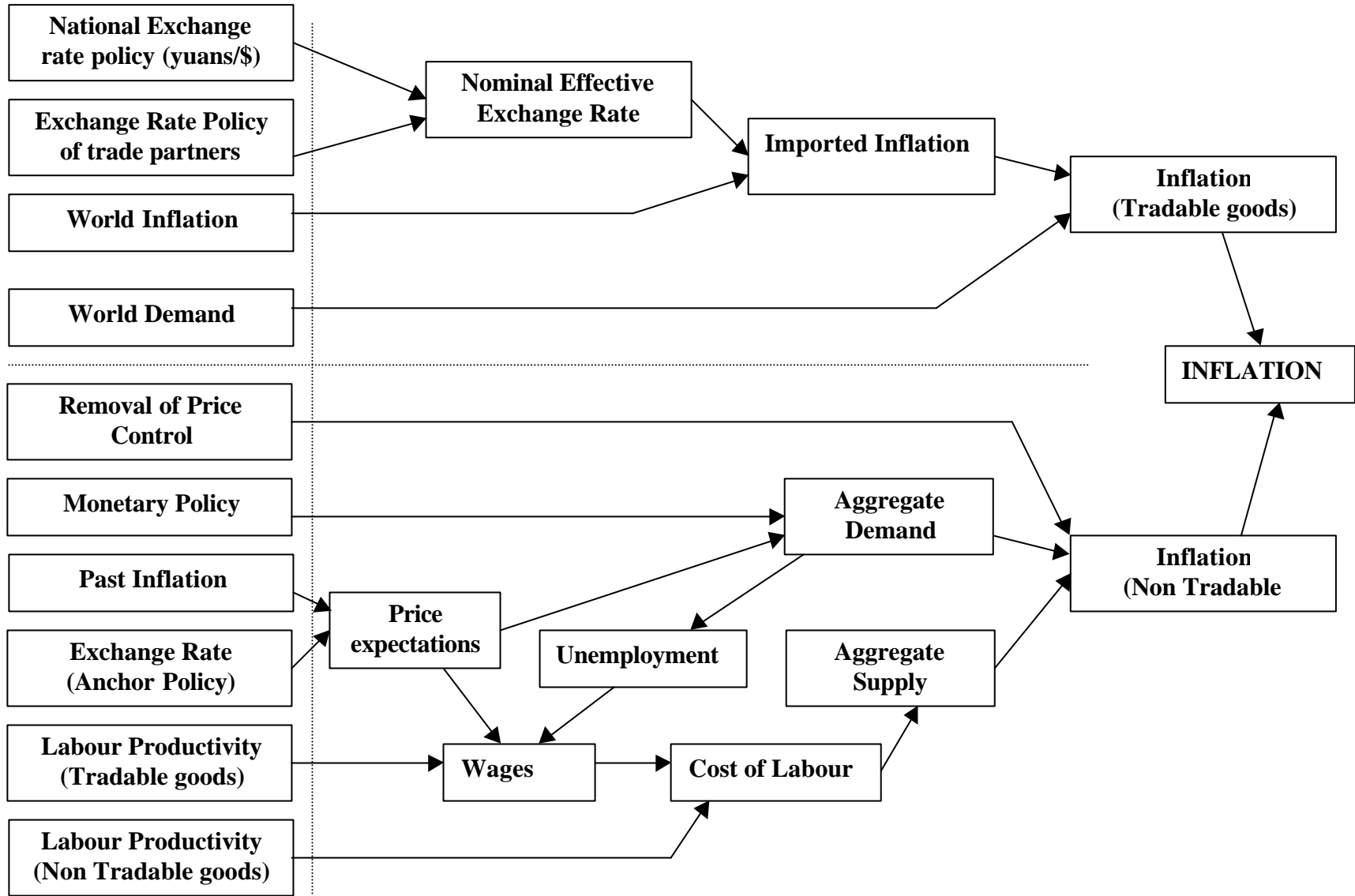## *Figure 1 : Inflation, deflation and growth*

Table 1: Estimation of Chinese inflation (1986-2002)

Explanatory variables (abbreviation used in the theoretical model)	(1)	(2)	(3)	(4)	(5)
Intercept	0.001 (86%)	0.001 (99%)	0.001 (94%)	0.001 (93%)	0.001 (96%)
Tradable goods inflation ($p_T^* + gNEER$)	0.25 (1%)	0.24 (1%)	0.23 (1%)	0.22 (1%)	0.23 (1%)
Tradable goods inflation *dummy (1986-1993q2) ($p_T^* + gNEER$) *DUM8693)	-0.18 (5%)	-0.18 (5%)	-0.17 (7%)	-0.16 (7%)	-0.16 (5%)
World demand (-2) (WD(-2))	0.16 (3%)	0.16 (3%)	0.17 (2%)	0.17 (2%)	0.18 (2%)
Monetary stance (seignoriage) (MP)	0.59 (1%)	0.55 (2%)	0.55 (2%)	0.51 (3%)	0.61 (1%)
Credit allocation (first difference of the variation in excess inventories) (dVEI)	0.004 (3%)	0.005 (2%)	0.004 (2%)	0.005 (1%)	0.005 (1%
Price liberalisation (-2) (LIB)	0.031 (1%)	0.031 (1%)	0.031 (1%)	0.031 (1%)	0.030 (1%)
Productivity gains (-1) (LMP(-1))	0.088 (1%)	0.092 (1%)	0.088 (1%)	0.092 (1%)	0.106 (1%)
Past inflation (p_{-1})	0.59 (1%)	0.59 (1%)	0.59 (1%)	0.58 (1%)	0.58 (1%)
Past inflation*dummy_deflation (p_{-1} *DUM_DEF1)	-0.59 (3%)	-0.63 (1%)			-0.78 (1%)
Past inflation*dummy_deflation (p_{-1} *DUM_DEF2)			-0.46 (2%)	-0.48 (1%)	
Nominal anchor policy indicator (adjusted for credibility) (AI)	-0.007 (2%)		-0.007 (2%)		
Nominal anchor policy indicator (gross) (AI)		-0.008 (1%)		-0.007 (2%)	-0.007 (7%)
Variation of excess inventories (VEI(-3))					-0.005 (3%)
Autoregressive term (AR(1))	-0.56 (1%)	-0.54 (1%)	-0.55 (1%)	-0.53 (1%)	-0.54 (1%)
Bera-Jarque Normality test	37%	28%	23%	16%	40.0%
Adjusted R^2	81.5 %	81.6%	81.5 %	81.6%	82.2%

p-values in parenthesis.

Figure 2: Main relationships of the inflation (or deflation) model

National Exchange rate policy (yuans/$)

Exchange Rate Policy of trade partners

World Inflation

World Demand

Nominal Effective Exchange Rate

Imported Inflation

Inflation (Tradable goods)

INFLATION

Removal of Price Control

Monetary Policy

Past Inflation

Exchange Rate (Anchor Policy)

Labour Productivity (Tradable goods)

Labour Productivity (Non Tradable goods)

Price expectations

Aggregate Demand

Unemployment

Aggregate Supply

Inflation (Non Tradable

Wages

Cost of Labour

Figure 3: The contribution of each the factors explaining the variation of prices upon the removal of inflation

Total (12,2%) = reduction of inflation

National ER policy (0,8%)

Nominal anchor policy (1,4%)

Price liberalisation (0,6%)

Monetary policy (0,6%)

Productivity growth (1,3%)

World inflation (0,2%)

Foreign ER (0,1%)

World demand (0,4%)

Past inflation (6,8%)