

The Effects of Reform of the Chinese Dual-Track Price System

John Bennett, Huw Dixon, Helen Hu

February 25, 2008

Abstract

We focus on the experience of gradual price liberation in China. A model of household demand and market supply is built, with two commodities, one of which is under dual-track price system control. The consumer price index (CPI) is defined as the weighted average of the plan-track price and the market price. We find that transitional policy change, i.e., convergence from the plan system towards a full market regime, can cause the market price and the CPI to change in opposite directions.

Key words: dual track price, fully market liberalization, market equilibrium price, welfare.

1 Introduction

In centrally planned economies (CPEs), such as China prior to 1978, most prices were set by the government alongside quantity targets. When the need for reform was accepted, there arose the question of how to move the economy from a planning system towards a market-oriented system. In China, economic reformers took the view that the best way was to keep the existing planned economy, but gradually to build up a free market system alongside it. This was the essence of the Dual Track idea, which was initiated by reform of the price system, through Dual Track Pricing (DTP). This gradualist approach to economic reform, which was partly due to the unwillingness of China's political leaders at the time to take big risks, was to be rolled out gradually across regions and over a long period, with time for trial and error. Beginning with the agricultural sector, DTP became a central part of economic reform in the 1980s, soon being applied to the industrial sector, and in the 1990s it was extended to various markets, being used, for example, for bank interest rates, foreign currency exchange rates, and housing.¹

Among the first analyses of DTP in the Western literature were those of Byrd (1987) and Sicular (1988), who examine the economic background from which the two-tier system was born and how the two mechanisms of resource allocation co-

¹The government still subsidizes the cost of accommodation for the employees of state-owned firms. In the extended family the young generation may be buying housing at the market price, but their parents may be employed by state-owned firms and enjoy the 'plan track' subsidy. An intergenerational household may thus be buying housing at both plan-track and market prices.

existed in China.² A stylized model of the Chinese economy, with DTP applied to agricultural products, was formulated by Bennett and Dixon (1996). In their model, if the government holds down the dual-track price, i.e., if it restricts the price at which coupons can be used to buy the plan-track quantity of agricultural goods, general economic performance is harmed. The income effect of the lower coupon price results in an increase in nominal demand by households, causing the market price of food to rise. The money wage therefore adjusts upward in free market industries, so that both the quantity of exports and output cross the economy fall. Gao et al. (1996) applied Chinese urban food demand data to a DTP model and show that government subsidization of food for urban households led to an increase in market demand, so that the market prices of staple foods were pushed up. Similarly, Liew (1993) showed empirically that government price controls on industrial products increased costs of production, so that removal of these controls would have reduced production cost and increase real national income, as well as diminishing the scope for corruption. Li, et al. (2000) developed a micro-model of the partial privatization of Chinese industries, and demonstrate empirically that the decentralization of government control was an essential factor in the rapid growth of private industry in China.

The analysis that we undertake is complementary to that of Lau et al. (1997,

²On the dual track programme overall (not just prices) in the Chinese industrial sector as a whole, see Wu and Zhao (1987) and Lau (1997).

2000) who have examined the effects of shifting from central planning to DTP. In Lau et al. (2000), they explored in detail for a single good the ideas developed at a general equilibrium level in their 1997 paper, and showed that the introduction of a market track, alongside a plan track in which price and quantities are fixed, yields a Pareto gain.³ Our paper, however, focuses on the transition from DTP toward a market economy. We develop a household demand model in the presence of dual tracks, with allowance for endogenous determination of supply, and we use this model to examine the effects of reducing the role of the plan track. To incorporate the resale of plan-track quantities into the model, we assume that there are two different types of household: permanent residents, who benefit from the plan-track subsidy, and the floating and rural populations, all of whose purchases are at the market price. Under fairly mild assumptions relaxation of DTP leads to a fall in welfare for the former and a rise in welfare for the latter.⁴

We also analyze the effects of the relaxation of DTP for a good on its average price, which is a weighted sum of the plan-track and the market price. Although this is the price that enters the calculation the CPI and inflation, it is the marginal price that a household faces that is primarily what matters for its behaviour, and so

³The ‘quantities’ are plural here because there may be many users or suppliers of the good. A recent paper by Che and Facchini (2007) shows that when the plan-track is not fully enforced introduction of the dual track may be detrimental to some agents.

⁴A related welfare discussion is found in Sah and Srinivasan (1988). They define government intervention as a lump-sum procurement of DTP goods (agricultural products), which has no effect on the market price. The effect of government policy on the welfare of rural households is directly through this ‘tax.’

when we interpret inflation data, changes in the average price will be less important if they result from changes in the plan-track price and quantity. Indeed, since the role of the plan track is primarily one of redistribution, the inflation resulting from its reform does not necessarily lead to an increase in the market price. We show that the effect on demand of a market price change is smaller under DTP, than under a full market pricing, and that the effect on the market price of a good of relaxing DTP depends on the properties of the good (i.e. on the elasticities of demand and supply), implying that government should be aware that a single policy change could result in significantly different effects on the prices of different goods.

The approach that we develop can be applied to any situation in which the market is mixed with price regulation. This applies, in particular, to economies that are still ‘socialist,’ or have not progressed far in the transition from socialism. For example, Cuba has operated a ‘segmented’ market system for many years that is similar to DTP, and in time of crisis it has increased the plan track element to try and protect the standard of living of the poor (Togores and Garcia, 2004). The DTP model may also be seen as a natural way of modelling black markets associated with rationing, and it may be adapted to any situation in which the market is mixed with price regulation, including reform of the electricity market, reform of the national health system, and any reform involving the market price

becoming different from the social cost.

The rest of the paper is organized as follows. The basic model with a homogeneous household is introduced in Section 2. The weighted average price is introduced into the basic model in Section 3. We also examine the marginal effects on average price resulting from changes in policy variables in this section. The model is extended to cover two types of households when a resale market exists in Section 4. A simple welfare analysis for both models is given in Section 5. Section 6 concludes, while proofs and graphs are given in the appendix.

2 A Representative Household Model

Consider an economy with two representative commodities, X and Y . The representative household's consumption of X and Y are denoted by x and y , respectively. We shall assume that commodity X is subject to DTP, while commodity Y is the *numéraire* (this can be viewed as leisure or as a composite commodity). The (relative) market price of X is denoted by p , while the market price of Y is unity. The household has an endowment of Y , which, for simplicity, we normalize to unity. In the absence of DTP the household would face the standard

utility-maximization problem,

$$\begin{aligned} & \max_{x,y} U(x, y) \\ & \text{subject to } px + y \leq 1. \end{aligned}$$

Marshallian demand can be expressed as a function of marginal unit price and full income, m . Here, m is simply the endowment of Y , and so the Marshallian demand function for X would be $x(p, 1)$.

With DTP, however, the household can purchase X on the ‘plan track’ up to the quantity \bar{x} at unit price \bar{p} . Any quantity above \bar{x} has to be purchased on the ‘market track’ (i.e., on the free market) at unit price p , where $p > \bar{p}$. Because we are considering a single representative household in this section, the issue of whether it is possible for a household to trade the quantities bought on the plan track (or, equivalently, the ‘coupons’ entitling purchase on the plan-track) does not arise. The household’s problem is to solve

$$\begin{aligned} & \max_{x,y} U(x, y) \\ & \text{subject to } \bar{p}x + y \leq 1 \quad \text{when } x \leq \bar{x}; \\ & \quad \quad \quad px + y \leq 1 + (p - \bar{p})\bar{x} \quad \text{when } x > \bar{x}. \end{aligned} \tag{1}$$

Here, if $x \leq \bar{x}$, the marginal (and intra-marginal) price facing the household is \bar{p} ,

while full income is the same as in the absence of DTP. However, if $x > \bar{x}$ the marginal price facing the household is the market price p . Since \bar{x} intra-marginal units are obtained at the price \bar{p} , full income must be adjusted to allow for the implicit subsidy $(p - \bar{p})\bar{x}$ that purchase at this lower price involves (see Dixon 1987; Bennett and Dixon 1996). Hence, $m = 1 + (p - \bar{p})\bar{x}$, and the Marshallian demand function becomes

$$\begin{aligned} x &= x(\bar{p}, 1) && \text{when } x \leq \bar{x}; \\ x &= x[p, 1 + (p - \bar{p})\bar{x}] && \text{when } x > \bar{x}. \end{aligned} \tag{2}$$

The arguments of the Marshallian demand function are the parameters of the budget constraint, which is depicted in Figure 1. In the absence of DTP the household begins with an income of one unit of Y and can trade from $(0, 1)$ along the line of slope $-p$. With DTP the household begins at the same place on the y -axis, but can trade along the line of slope $-\bar{p}$ from $x = \bar{x}$, i.e., up to point $(\bar{x}, 1 - \bar{p}\bar{x})$, which is denoted by A in the figure. If the household purchases in this range its budget constraint is fully represented by the intercept $y = 1$ and the slope $-\bar{p}$. From \bar{x} to $B(0, \bar{x} + \frac{1 - \bar{p}\bar{x}}{p})$ on the horizontal axis, it can only purchase additional units of X by trading along the line of slope $-p$. The same points could be reached if, instead of facing DTP, it faced the price p for all units and had an endowment

of Y equal to $1 + (p - \bar{p})\bar{x}$, as shown by point $C(0, 1 + (p - \bar{p})\bar{x})$. Combining the segments for $x \leq \bar{x}$ and $x > \bar{x}$, the entire budget constraint is represented by the kinked thick line.

Fig 1 about here.

From (2), given that $p > \bar{p}$, a change in the free market price p has no effect on x if $x \leq \bar{x}$; but if $x > \bar{x}$,

$$\frac{dx}{dp} = x_p + \bar{x}x_m.$$

Assuming that $x_p < 0$ and $x_m > 0$,⁵ the sign of dx/dp is unclear from this equation.

However, denoting the compensated Slutsky term by S , we have

$$x_p = S - xx_m. \tag{3}$$

Eliminating x_p , we therefore obtain

$$\frac{dx}{dp} = S - (x - \bar{x})x_m < 0. \tag{4}$$

Since $S < 0$, we have that $dx/dp < 0$. The presence of the DTP quantity \bar{x} in (4) makes the income effect of a market price change smaller, since it only applies to the market-track portion of consumption. It also implies that the effect on demand

⁵Throughout, a subscript is used to denote the partial derivative with respect to the variable subscripted.

of a market price change is smaller under DTP than under a full market regime.

2.1 The Supply Function

Under DTP, some output is supplied at the plan-track price, but we assume that total supply will be determined by the marginal price p , i.e., by the market price.

The supply function (in per household terms) is assumed non-decreasing in p ; that is, the elasticity of supply with respect to p , ϵ_p^s , is non-negative:

$$x^s = x^s(p); \quad \epsilon_p^s = \frac{1}{x^s} p x_p^s \geq 0. \quad (5)$$

For simplicity, we shall assume throughout that the plan-track quantity is no greater than the profit-maximizing supply at the plan-track price:

$$\bar{x} \leq x^s(\bar{p}).$$

The plan-track price for suppliers is assumed equal to the plan-track price for consumers. Thus, compared to the market economy, the DTP system operates as a tax on suppliers, transferring to consumers a portion of profit. If we denote the profit function corresponding to (5) as $\pi(p)$, then total profit under DTP is

$$\Pi = \pi(p) - (p - \bar{p})\bar{x}.$$

3 The CPI

In this section we explore how changes in plan-track parameters affect the *weighted average* P of the plan-track and market prices for the representative DTP good X , where⁶

$$P \equiv \frac{\bar{x}}{x}\bar{p} + \frac{x - \bar{x}}{x}p. \quad (6)$$

Since X is representative of the basket of DTP goods, we shall refer to P interchangeably, as the consumer price index (CPI) or the average price, according to context.

The condition for market clearing is

$$x[p, 1 + (p - \bar{p})\bar{x}] = x^s(p). \quad (7)$$

This is depicted in Figure 2, where U is an indifference curve and the equilibrium occurs at E . Here, P is represented by (minus) the slope of the line connecting E with the endowment point on the y -axis. This is the ratio, when consuming x , of the amount of Y forgone to the quantity x . Given that $x^s > \bar{x}$, we have that

⁶Here, we use a linear function for the weighted average price P , but other formulae, such as Cobb–Douglas, could be used. The important thing is that P should depend on both the plan-track and the free-market prices.

$$p > P > \bar{p}.^{7,8}$$

Fig 2 about here.

To analyze the role of DTP in price liberalization, we first consider the effects of changes in \bar{p} and \bar{x} on the free market price and the CPI.

Proposition 1 *In a representative household model, an increase in the plan-track price and a decrease in the plan-track quantity each reduce the market price, i.e.,*

$$\frac{dp}{d\bar{p}} < 0 < \frac{dp}{d\bar{x}}.$$

An increase in the plan-track price \bar{p} cuts the implicit subsidy $(p - \bar{p})\bar{x}$ given to the household, thereby reducing its full income. Consequently, its demand for X falls, negatively affecting the market price p . The market equilibrium shifts along the supply curve. If this has a positive slope the quantity supplied is reduced, so that the overall fall in p is dampened.⁹ A decrease in the plan-track quantity \bar{x} reduces the implicit subsidy, with effects that are qualitatively the same as just

⁷In this section, we assume that market resale is not an option to the household, so we ignore the case of $x < \bar{x}$.

⁸*Helen: I have problems with this note. I think it can only be used if we can say clearly and for sure that the Chinese government did raise the plan-track price.* In China, a high inflation rate was officially recognized in the late 1980s, when the government attempt to liberalize price control as lag of interest rate reform. The Chinese government re-instituted tight controls on the allocation mechanism in the austerity program of 1986 and 1988, reducing government expenditure and freezing some long-term capital investments. However, the controls were relaxed later to allow the growth of the non-state sectors (Lin 2004). In line with our analysis, inflation of the average price could have been due to an increase of plan-track price, which, as it is not a free market signal, is less damaging than an increase of the market price. The high inflation happened in Chinese transitional period should be an inevitable consequence of the incomplete economic reform approach.

⁹A similar result is obtained by Sah and Srinivasan (1988).

described. The indication to the policy maker is that the market equilibrium price falls when the government steadily shifts the DTP system to a competitive market regime.

According to (6), the direct effect on the CPI, P , of an increase in the plan-track price \bar{p} is positive. However, since $dp/d\bar{p} < 0$, there is also a negative indirect effect on the CPI through the induced change in the market price. Let ϵ_p denote price elasticity of demand and ϵ_m the income elasticity of demand. We assume normality of the DTP commodity X , so that $\epsilon_p < 0$ and by $\epsilon_m > 0$. Our next proposition states that the transitional policy associated with DTP inflates the CPI.

Proposition 2 *If the DTP goods X is normal and its supply is non-decreasing in price p , transitional policy inflates the CPI, i.e., $\frac{dP}{d\bar{p}} > 0 > \frac{dP}{dx}$.*

We therefore have a paradoxical situation: when the government raises the controlled price, the CPI is pushed up but the market equilibrium price is reduced.

We illustrate the above proposition of a higher level of \bar{p} , with \bar{x} constant, in Figure 3, in which the supply of X^s is also fixed (we assume that $\bar{p} < p$ throughout). As in Figure 2, the household is at equilibrium point E initially. When \bar{p} is raised the plan-track segment of the budget line, the downward-sloping line from point B $(0, 1)$, rotates clockwise about point C. Assuming momentarily that p is unchanged, the budget line becomes BCD, the sharpness of the kink having been reduced. The

household consumes at point F on CD, which, given that X is normal, is to the left of E. As there is now an excess supply of X , its market price p falls; i.e., the right-hand portion of the budget line rotates anti-clockwise around point C. Given that the quantity of X supplied is unchanged, the rotation occurs until the quantity of X demanded is at its original level. The new solution is at point G. Recall that the average price of X in the original situation was minus the slope of BE. Thus, it has changed to minus the slope of BG, and therefore the CPI has increased.¹⁰

Fig 3 about here.

Also for a given supply of X , Figure 4 illustrates the effect of a lower level of \bar{x} , with \bar{p} constant. When \bar{x} is reduced from \bar{x}_0 to \bar{x}_1 , the kink in the budget line shifts from point A to H, the budget line having shifted to the left of the segment $x > \bar{x}$. For an unchanged level of p , household demand would shift from point E to J. As we assume the supply does not change, there is now an excess supply of X , so that the change on p is dampened in a similar way to above. The new equilibrium is at K. Since E must be above K, the average price line BE lies above BK: i.e., the CPI has increased.

Fig 4 about here.

¹⁰The discussion of the diagram here does not cover what happens if the supply of X changes. The same comment applies to Figure 5.

Our analysis indicates that if the plan-track price of a good is raised, the price observed in the market will fall, but that the CPI rises. In a fuller model, however, the role of commodity Y might be specified further. Suppose that Y is leisure time for the urban household and that leisure is normal. A rise in \bar{p} results in a fall in the quantity of leisure consumed; i.e., there is an increase in the quantity of urban labour supplied. If the supply of manufactures therefore rises, this will have an offsetting, negative, effect on the price level for the economy as a whole. A reduction in \bar{x} has similar effects.

4 Resale Market

We now drop the assumption that households are homogeneous, for we can then allow for the possibility of resale. For simplicity, we assume that there are no effective legal restrictions or other frictions on resale. Commodity X therefore exchanges in the resale market at price p . Rather than allowing a continuum of types, we focus on a case of particular relevance to the Chinese economy. There are two types of household in the model, which we index by the superscripts 1 and 2. The proportion α of the urban population is assumed to work in state sector (type-1 households), while the proportion $1 - \alpha$ comprises non-state employment in urban areas (type-2 households). The employees in state sectors are allocated

a plan-track ration \bar{x} , while the floating population is allocated no ration at all.¹¹

We also allow for a difference in the endowments of Y held by the two types.

The representative type-1 household faces the problem

$$\begin{aligned} & \max_{x^1, y^1} U(x^1, y^1) \\ \text{subject to } & px^1 + y^1 \leq \bar{y}^1 + (p - \bar{p})\bar{x} \equiv m^1 \end{aligned} \quad (8)$$

where \bar{y}^1 is its endowment of Y . Unlike in (1), the budget line is not kinked. Because resale is possible, household 1 can be thought of as always selling its entire plan-track allocation to gain the implicit subsidy $(p - \bar{p})\bar{x}$, and then buying the amount it wishes to consume. The implicit subsidy is a component of its full income m^1 .

The problem for the representative type-2 household is

$$\begin{aligned} & \max_{x^2, y^2} U(x^2, y^2) \\ \text{subject to } & px^2 + y^2 \leq \bar{y}^2 \equiv m^2. \end{aligned} \quad (9)$$

Because a type-2 household does not receive a plan-track allocation of X , its full income m^2 is simply its endowment \bar{y}^2 .

¹¹Brooks and Tao (2003) show that the percent of urban employment in state units, which we represent by α in this paper, was 67.0, 73.0, 76.4 and 43.9, in 1980, 1990, 1995, and 2000 respectively.

The solutions to (8) and (9) yield the Marshallian demand functions

$$\begin{aligned}x^1 &= x[p, \bar{y}^1 + (p - \bar{p})\bar{x}] \\x^2 &= x(p, \bar{y}^2).\end{aligned}$$

Total demand for X is

$$x = \alpha x^1 + (1 - \alpha)x^2.$$

Corresponding to (4), we have

$$\begin{aligned}\frac{dx^1}{dp} &= x_p^1 + x_m^1 \bar{x} = S^1 - (x^1 - \bar{x})x_m^1; \\ \frac{dx^2}{dp} &= x_p^2.\end{aligned}\tag{10}$$

Although $dx^2/dp < 0$, dx^1/dp may take either sign. Without the possibility of resale, as discussed above, the household can only gain the implicit income when it consumes more than its government subsidy. With resale, the type-1 household gains an implicit income, even though it consumes less than the government subsidy \bar{x} . Eq. (10) shows that when the consumption x^1 of DTP goods for a type-1 household is smaller than the plan-track quantity \bar{x} , dx^1/dp is only negative if the compensated demand change is numerically greater than the income effect, and vice versa. However, when the consumption of DTP goods is greater than the plan-track quantity for a type-1 household, dx^1/dp is always negative. In Figure 5

we demonstrate how an increase in market price can increase the consumption of X by a type-1 household. As \bar{x} and \bar{p} are fixed, an increase in market price raises the implicit income of the type-1 household. This is depicted as the clockwise rotation around point A of the budget line from BC to LN. The tangency of an indifference curve with the new budget line occurs at N, which is the new equilibrium for the type-1 household. In this case the increase in p causes the type-1 household to consume more (moving from E to M).¹²

Fig 5 about here.

4.1 Reform with Resale

The market-clearance condition is now

$$\alpha x^1[p, \bar{y}^1 + (p - \bar{p})\bar{x}] + (1 - \alpha)x^2(p, \bar{y}^2) = x^s. \quad (11)$$

¹²Figure 5 represents the case in which the household consumption of the DTP good is less than the plan-track quantity allocation. When, instead, it consumes more than this allocation, starting at a point on AC, the price change causes it to shift to a point on AN. *I think this is what you were saying, but is it true? After the change, couldn't the equilibrium be a tangency on LA, with the indifference curve coming down and cutting AC twice, to the left and right of the original equilibrium on AC? If so, that would mean that the price increase causes the household to move from below A to above it.*

Differentiating (11) and combining the Slutsky equation (3) for each type of household yields

$$\frac{dp}{d\bar{p}} = \frac{\alpha\bar{x}x_m^1}{\alpha[S^1 - x_m^1(x^1 - \bar{x})] + (1 - \alpha)(S^2 - x^2x_m^2) - x_p^s}; \quad (12)$$

$$\frac{dp}{d\bar{x}} = \frac{-\alpha(p - \bar{p})x_m^1}{\alpha[S^1 - x_m^1(x^1 - \bar{x})] + (1 - \alpha)(S^2 - x^2x_m^2) - x_p^s}. \quad (13)$$

Eqs. (12) and (13) cannot be signed unconditionally because when resale is allowed, $S^1 - x_m^1(x^1 - \bar{x}) \gtrless 0$. Nevertheless, substituting (11) into (12) and (13), the denominator, which we denote by Δ , is transformed to

$$\Delta = \alpha S^1 + (1 - \alpha)S^2 - x_m^1(x^s - \alpha\bar{x}) - (1 - \alpha)x^2(x_m^2 - x_m^1) - x_p^s. \quad (14)$$

If $x_m^1 \leq x_m^2$ and $x^s - \alpha\bar{x} \geq 0$ both hold, then, given that $S^1 < 0$ and $S^2 < 0$, we have $\Delta < 0$.

Since both types of household face the same market price p , the condition $x_m^1 \leq x_m^2$ holds for many common specifications of preferences. Thus homothetic and quasi-homothetic preferences with linear Engel curves have $x_m^1 = x_m^2$. Furthermore, most DTP commodities were necessities - for example, clothes, cooking oil and sugar. To the households employed in non-state sector without the direct allocation from the plan-track, those light-industrial products are relative luxuries. Therefore, $x_m^1 < x_m^2$ is a reasonable assumption, reflecting a concave Engel curve.

$\alpha\bar{x}$ is the total ration allocated by the central planning system, which is part of the total supply of X . Thus, the conditions $x_m^1 \leq x_m^2$ and $x^s - \alpha\bar{x} \geq 0$ are sufficient for Proposition 3.

Proposition 3 *Assume that $x_m^1 \leq x_m^2$ and $x^s - \alpha\bar{x} \geq 0$. With resale, transitional reform policy reduces the market price, i.e. $\frac{dp}{d\bar{p}} < 0 < \frac{dp}{d\bar{x}}$.*

This implies that the effect of transitional policy change on market equilibrium price is similar, with or without the opportunity for resale of the rationed quantity.

The next question is, what do we mean by the CPI now? In effect, each type of household faces a different average price, since the mix of market and plan-track differs. The type-1 household pays the average price $\left(\frac{x^1 - \bar{x}}{x^1}\right)p + \frac{\bar{x}}{x^1}\bar{p}$, while the type-2 household pays the market price p . Since the type-1 household buys the proportion $\frac{x^1}{x}$ of the total goods supply, where x denotes total demand for good X , while the type-2 household buys the proportion $\frac{x^2}{x}$, the CPI across all purchases can be written,

$$P = \alpha \frac{x^1}{x} \left[\left(\frac{x^1 - \bar{x}}{x^1} \right) p + \frac{\bar{x}}{x^1} \bar{p} \right] + (1 - \alpha) \frac{x^2}{x} p \quad (15)$$

where $\frac{\bar{x}}{x}$ is the ratio of goods allocated through the plan-track to total supply, which is multiplied by the proportion of the population that is officially covered by the plan-track system to obtain the proportion $\alpha \frac{\bar{x}}{x}$ of DTP goods. Given (11),

(15) simplifies to,

$$P = p - \alpha \frac{\bar{x}}{x^1} (p - \bar{p}). \quad (16)$$

When the resale market is available and if the type-1 household would trade his DTP goods for obtaining the implicit income, then the two types of household face the same CPI. However, when the resale is not possible or if the type-1 would never trade, CPI for the type-1 household is $P(p, \bar{p})$ whilst it for type-2 household is only market price. As the CPI represents the living cost of household, the type-1 household's living cost is lower than the type-2 household's under the second scenario. This also implies when the trading happens between two types of household, the living cost of the type-1 household increases. 16 indicates that the CPI is also related to the urban proportion covered under plan-track system, e.g., α .

Proposition 4 *Assume that $x_m^1 \leq x_m^2$, $x^s - \alpha \bar{x} \geq 0$, and X is normal, i.e., $x_p^1 < 0$. With resale, transitional reform policy increases the CPI, i.e., $\frac{dP}{d\bar{p}} > 0 > \frac{dP}{d\bar{x}}$.*

We conclude that with or without the possibility of resale, transitional policy changes conditionally deflate the market price while inflates the CPI of DTP goods in this framework.

5 Household Welfare

We have seen how a change in the plan-track price affects the market equilibrium and CPI. The CPI is the price that should be used for calculating the various price indices in the economy, and hence the rate of inflation. However, as argued in Bennett and Dixon (1995, 1996), if we are interested in household behaviour the most relevant price is the *marginal price*, which under DTP is the market price p . Furthermore, using the indirect utility function, it plays an important role in measuring household welfare.

First, consider the case treated in Section 2, of homogeneous households and therefore no resale possibility. Corresponding to $U(x, y)$, given that $x > \bar{x}$, the indirect utility function for the representative household is

$$v = v[p, 1 + (p - \bar{p})\bar{x}]. \quad (17)$$

Proposition 5 *When resale is not possible, transitional policy changes deflate the welfare of the representative household (the type-1), i.e., $\frac{dv}{d\bar{p}} < 0 < \frac{dv}{d\bar{x}}$.*

Thus, household indirect utility is reduced by the reforms of raising \bar{p} and lowering \bar{x} , despite the increase that may occur in the average price. However, this result would not necessarily arise if we were also to consider the general equilibrium ramifications. Reform will increase the profits of the SOEs: the change in profits of

the SOEs is exactly equivalent to the change in the implicit subsidy $(p-\bar{p})\bar{x}$ induced by the reforms. Since the DTP is in effect a lump-sum transfer from the producer to the consumer, reform merely serves to redistribute away from the consumer to the producer. In this case, a household covered by the DTP system would be a loser from the full liberalization of prices. However, in a capitalist economy the profits of the firm find their way into the household's budget constraint and so such reforms would not reduce welfare. From our view, when the resale possibility is not available or not complete to all markets, it is endogenous to converge low plan-track price to the higher market price, since it brings damage to all consumers. The only benefit is the state own enterprises, which is a similar case of Big-Bang reforming approach.

With the two types of household and resale, the indirect utility functions are

$$v^1 = v[p, \bar{y}^1 + (p - \bar{p})\bar{x}];$$

$$v^2 = v(p, \bar{y}^2).$$

When resale is possible, there are two circumstances of trading between two types household. Case 1, if we assume that the state employed household does not sell units of its plan-track allocation only to replace them by units bought on the free market, it is implicit that the resale happens only when the demand for X by the type-1 household is less than its allocation by the plan-track system: that is,

$x^1 \leq \bar{x}$. Case 2, the type-1 household is willing to realize its implicit income by selling the DTP goods allocated via the plan-track system, though it then has buy more back from the free market to satisfy its demand, that is $x^1 > \bar{x}$. However, the following proposition holds in both cases.

Proposition 6 *When resale is possible, transitional policy changes deflates the welfare of a type-1 household, i.e., $\frac{dv^1}{dp} < 0 < \frac{dv^1}{d\bar{x}}$, but inflates the welfare of a type-2 household, i.e., $\frac{dv^2}{dp} > 0 > \frac{dv^2}{d\bar{x}}$.*

This indicates when the economy transforms from the transitional period to the full market economy, in terms of welfare, the households employed in non-state sector are better off while the ones working in state-sector worsen off. This is a striking comparison to the Lau et.al papers (1997.2000) and Liew(1993), in which there are no losers from Chinese reforms. Compare to our model, they keep the lump-sum transform from the supplier to the consumer no change in the reform, which ensure the household who were covered in central planned economy have no decrease of income. Even more, an fixed amount of lump-sum transform implies an increase of plan-track price has a positive impact on the market equilibrium price, which causes an increase of type-2 household's welfare. Therefore, no loser is in reform under their framework. In a sense, here we complete the analysis by allowing the market value transform from the supplier to the consumer varying , when DTP converges to a full market economy. As the excessive demand caused by the

liberalization of plan-track system has negative impact on the market equilibrium price as proved in Proposition 1 and 3. Thus, the type-2 household's welfare is better off. But type-1 household's welfare is worsen off since the implicit income decreases by the rising of plan-track price. Therefore, in our framework, there is no Pareto improvement: there are winners and losers in the reform.

6 Conclusion

In this paper we have formulated a rigorous microeconomics model of the DTP system using standard consumer theory. We then used this model to analyze the reform process. We have identified three different price indices for DTP goods: the plan-track price, the free-market price and the weighted average price (CPI). We have considered how the market price and the CPI change when plan-track policy variables are adjusted during the reform process. Corresponding to Chinese experience, economic reform aims to weaken the power of the central plan with regard to both price control and quotas.

We conclude the effect of reform is to reduce the free market price but it can lead to an increase in the CPI. With resale, matters are less clear-cut, because we now have two different types of household: employed by state-owned enterprises, who benefit from the plan-track subsidy, and employed by the non-stated owned enterprises (such as collective and private enterprises), all of whose purchases are

at the market price. Under fairly mild assumptions (e.g. linear Engel curves) the reform leads to a fall in household welfare. When resale of controlled goods is possible, the household employed in state-owned enterprises lose welfare while the ones employed in non-state owned enterprises gains. With the experience of Chinese transitional economic reform, the plan track was segmented from the market completely at the beginning of the transforming from a central economy to a market economy. The plan power was still dominant in the whole economy and the adjustment of plan-track price did hardly any impact on market performance. However, we theoretically demonstrate the scenario in the later economic reform stage, when the share of market economy becomes competitive with the plan system. Under such circumstance, we have to integrate two economic regime for examining any economic change. Therefore, any change of plan-track would have impact on the market equilibrium, through an endogenously market determined supply. A message of this paper is that we need to be careful in interpreting price or inflation data in transitional economies because the measured CPI does not always reflect the ‘true’ prices in a partly planned economy. Within the transitional economic reform, the original socialist economy winners would lose their privileges and become losers in the market competition. Whilst we have developed the partial equilibrium framework for understanding DTP, an extension would be to embed it in a simple general equilibrium framework. This would involve modelling

firms (both SOE and private) and the government.

7 Appendix 1: Proofs

Proposition 1

From (7), $(x_p + x_m \bar{x})dp - x_m \bar{x}d\bar{p} + x_m(p - \bar{p})d\bar{x} = x_p^s dp$. Hence, using (3) to eliminate x_p , we have

$$\frac{dp}{d\bar{p}} = \frac{x_m \bar{x}}{S - (x - \bar{x})x_m - x_p^s} < 0; \quad (18)$$

$$\frac{dp}{d\bar{x}} = \frac{-(p - \bar{p})x_m}{S - (x - \bar{x})x_m - x_p^s} > 0. \quad (19)$$

Proposition 2

Differentiating (6) w.r.t. \bar{p} , we then obtain¹³

$$\frac{dP}{d\bar{p}} = \frac{dp}{d\bar{p}} + \left(1 - \frac{dp}{d\bar{p}}\right) \frac{\bar{x}}{x} + (p - \bar{p}) \frac{\bar{x}}{(x)^2} x_p \frac{dp}{d\bar{p}}. \quad (20)$$

By assumption,

$$\epsilon_p = \frac{p}{x} \frac{dx}{dp} < 0, \quad (21)$$

$$\epsilon_p^s = \frac{p}{x^s} \frac{dx^s}{dp} > 0. \quad (22)$$

¹³We use the bracket with superscript 2 to define the square function, e.g., $(x)^2$ in the proof, while the only superscript 2 represents the variables for the type-2 household.

Substituting (21) into (20) gives

$$\frac{dP}{d\bar{p}} = \frac{\bar{x}}{x} + \left(\frac{x - \bar{x}}{x} + \frac{p - \bar{p}\bar{x}}{p} \epsilon_p \right) \frac{dp}{d\bar{p}}.$$

Substituting for $\frac{dp}{d\bar{p}}$ from (18) and using $x = x^s$ gives

$$\frac{dP}{d\bar{p}} = \frac{\bar{x}}{x} \frac{1}{S - (x - \bar{x})x_m - x_p^s} \left[S - \frac{x}{p} (\epsilon_p^s - \frac{(p - \bar{p})\bar{x}}{m} \epsilon_m \epsilon_p) \right] > 0. \quad (23)$$

Differentiating (6) w.r.t. \bar{x} , we obtain

$$\begin{aligned} \frac{dP}{d\bar{x}} &= \frac{dp}{d\bar{x}} - \frac{\bar{x}}{x} \frac{dp}{d\bar{x}} + \frac{1}{x} (\bar{p} - p) + (p - \bar{p}) \frac{\bar{x}}{(x)^2} x_p \frac{dp}{d\bar{x}} \\ &= \left(\frac{x - \bar{x}}{x} + \frac{p - \bar{p}\bar{x}}{p} \epsilon_p \right) \frac{dp}{d\bar{x}} - \frac{1}{x} (p - \bar{p}). \end{aligned}$$

Substituting for $\frac{dp}{d\bar{x}}$ from (19) and using $x = x^s$, we obtain

$$\frac{dP}{d\bar{x}} = -\frac{p - \bar{p}}{x} \frac{1}{S - (x - \bar{x})x_m - x_p^s} \left[S - \frac{x}{p} (\epsilon_p^s - \frac{(p - \bar{p})\bar{x}}{m} \epsilon_m \epsilon_p) \right] < 0. \quad (24)$$

Proposition 4

Differentiating (??) w.r.t. \bar{p} yields

$$\frac{dP}{d\bar{p}} = \alpha \frac{\bar{x}}{x^1} + \left[\alpha \frac{\bar{x}}{x^1} \frac{p - \bar{p}}{p} \epsilon_p^1 + (1 - \alpha \frac{\bar{x}}{x^1}) \right] \frac{dp}{d\bar{p}}. \quad (25)$$

$$\frac{dP}{d\bar{x}} = -\frac{\alpha}{x^1} (p - \bar{p}) + \left[\alpha \frac{\bar{x}}{x^1} \frac{p - \bar{p}}{p} \epsilon_p^1 + (1 - \alpha \frac{\bar{x}}{x^1}) \right] \frac{dp}{d\bar{x}}. \quad (26)$$

Substituting for $\frac{dp}{d\bar{p}}$ from (12) and using $x = x^s > x^1$, we obtain

$$\frac{dP}{d\bar{p}} = \frac{\alpha \frac{\bar{x}}{x^1} [\alpha S^1 + (1 - \alpha) S^2 - (1 - \alpha) x^2 x_m^2 - x_p^s - \alpha x_m^1 (x^s - x^1)]}{\alpha [S^1 - x_m^1 (x^1 - \bar{x})] + (1 - \alpha) (S^2 - x^2 x_m^2) - x_p^s} > 0.$$

Similar, substituting for $\frac{dp}{d\bar{x}}$ from (13), we have

$$\frac{dP}{d\bar{x}} = \frac{-\alpha \frac{(p - \bar{p})}{x^1} [\alpha S^1 + (1 - \alpha) S^2 - (1 - \alpha) x^2 x_m^2 - x_p^s - \alpha x_m^1 (x^s - x^1)]}{\alpha [S^1 - x_m^1 (x^1 - \bar{x})] + (1 - \alpha) (S^2 - x^2 x_m^2) - x_p^s} < 0.$$

Proposition 5

Differentiating (17),

$$\frac{dv}{d\bar{p}} = v_p \frac{dp}{d\bar{p}} + v_m \left(\frac{dp}{d\bar{p}} - 1 \right) \bar{x}.$$

Using Roy's identity, this becomes

$$\frac{dv}{d\bar{p}} = -v_m \left[\frac{dp}{d\bar{p}} (x - \bar{x}) + \bar{x} \right].$$

Hence, substituting for $\frac{dp}{d\bar{p}}$ from (??), we have

$$\frac{dv}{d\bar{p}} = -v_m \bar{x} \left[\frac{S - x_p^s}{S - (x - \bar{x})x_m - x_p^s} \right] < 0.$$

Similarly, assuming $p > \bar{p}$ and $v_m > 0$, it is found that

$$\frac{dv}{d\bar{x}} = v_m \left[-\frac{dp}{d\bar{x}}(x - \bar{x}) + (p - \bar{p}) \right] = v_m(p - \bar{p}) \left[\frac{S - x_p^s}{S - (x - \bar{x})x_m - x_p^s} \right] > 0.$$

Proposition 6

Case 1: $x^1 - \bar{x} \leq 0$.

For a type-1 household

$$\frac{dv^1}{d\bar{p}} = v_p^1 \frac{dp}{d\bar{p}} + v_m^1 \left(\frac{dp}{d\bar{p}} - 1 \right) \bar{x}.$$

Using Roy's identity, this becomes

$$\frac{dv^1}{d\bar{p}} = -v_m^1 \left[\frac{dp}{d\bar{p}}(x^1 - \bar{x}) + \bar{x} \right].$$

Hence, substituting for $\frac{dp}{d\bar{p}}$ from (12), we have

$$\frac{dv^1}{d\bar{p}} = -v_m^1 \bar{x} \left[\frac{\alpha x_m^1 (x^1 - \bar{x})}{\Delta} + 1 \right].$$

We have seen in the text that if $x_m^1 < x_m^2$, then $\Delta < 0$. Using this with the assumption in case 1, that $x^1 - \bar{x} \leq 0$, it is seen here that $\frac{dv^1}{d\bar{p}} < 0$.

Similarly,

$$\frac{dv^1}{d\bar{x}} = v_m^1 (p - \bar{p}) \left[\bar{x} + \frac{\alpha(x^1 - \bar{x})x_m^1}{\Delta} \right]$$

and so $\frac{dv^1}{d\bar{x}} > 0$.

Likewise, for a type-2 household, as Proposition 3 holds, that is $\frac{dp}{d\bar{p}} < 0 < \frac{dp}{d\bar{x}}$,

$$\frac{dv^2}{d\bar{p}} = -v_m^2 x^2 \frac{dp}{d\bar{p}} > 0; \quad \frac{dv^2}{d\bar{x}} = -v_m^2 x^2 \frac{dp}{d\bar{x}} < 0.$$

Case 2: $x^1 - x > 0$.

When $x^1 - x > 0$, we have $-1 < \frac{\alpha x_m^1 (x^1 - \bar{x})}{\Delta} < 0$, as $\alpha x_m^1 (x^1 - \bar{x}) < |\Delta|$. Then,

$$\frac{dv^1}{d\bar{p}} = -v_m^1 \bar{x} \left[\frac{\alpha x_m^1 (x^1 - \bar{x})}{\Delta} + 1 \right] < 0$$

Similarly,

$$\frac{dv^1}{d\bar{x}} = v_m^1 (p - \bar{p}) \left[\bar{x} + \frac{\alpha(x^1 - \bar{x})x_m^1}{\Delta} \right] > 0.$$

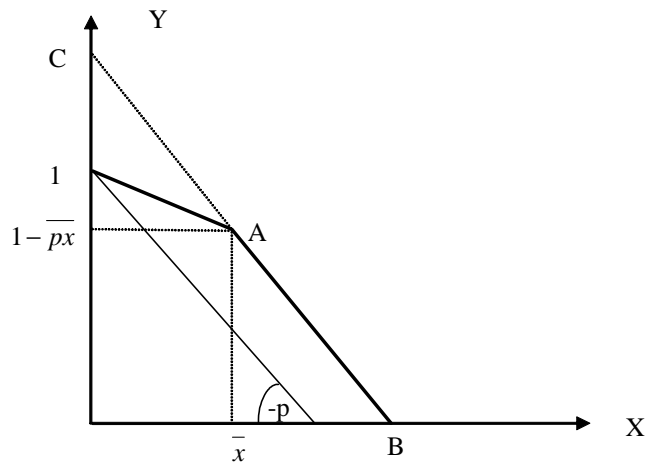


Figure 1: The Budget Constraint Under DTP System

8 Appendix 2: Figures

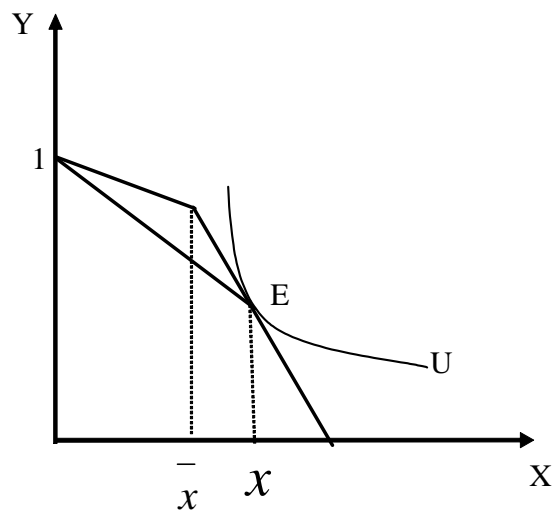


Figure 2: The Average Price of DTP Goods

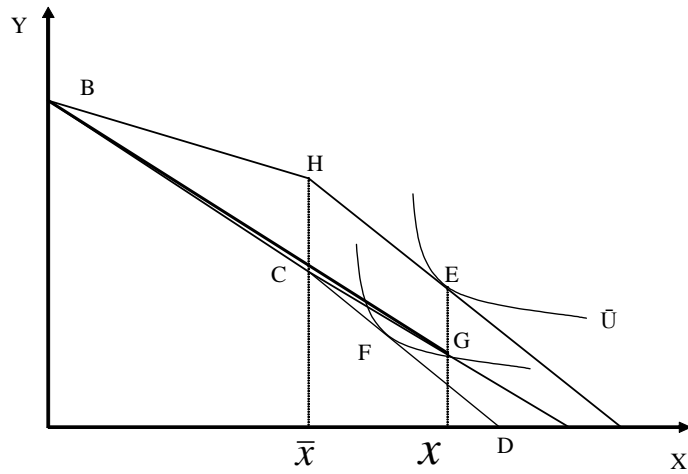


Figure 3: An Increase of Plan-Track Price Inflates CPI of DTP Goods

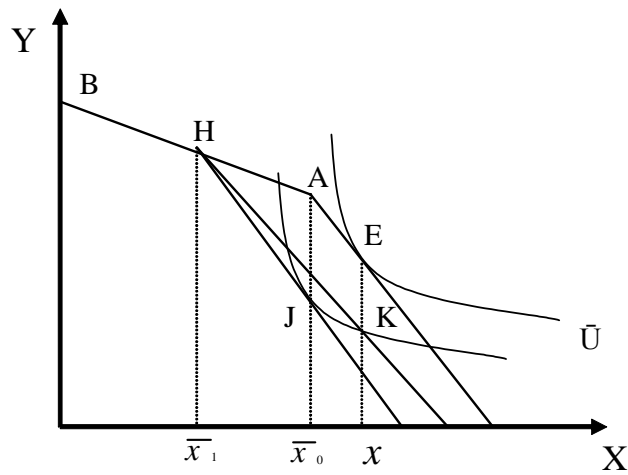


Figure 4: An Decrease of the Plan-Track Quantity Inflates CPI of the DTP Goods

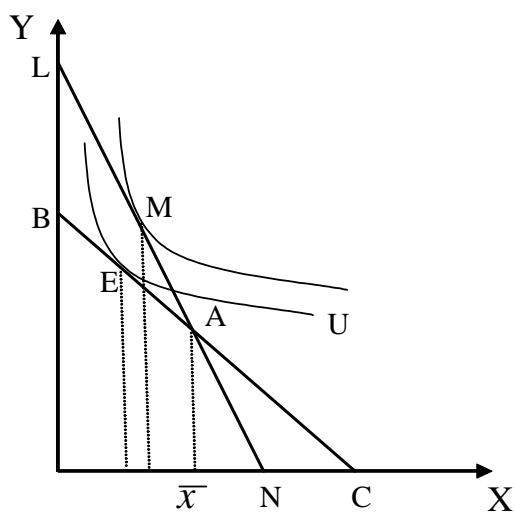


Figure 5: An Increase Market Price Inflates the Type-1 Household's Demand of DTP Goods

References

- [1] Byrd, W. A. (1987). "The Impact of the Two-Tier Plan/Market System in Chinese Industry", *Journal of Comparative Economics* 11, 295–308.
- [2] Bennett, J. and Dixon, H.D.(1995). "Macroeconomic equilibrium and reform in a transitional economy", *European Economic Review* 39, p.1465-1485.
- [3] Bennett, J. and Dixon, H.D.(1996). "A macrotheoretic model of the Chinese economy", *Journal of Comparative Economics* 22, p.277-294.
- [4] Brooks, R. and Tao, R. (2003). "China's Labour Market Performance and

Challenges”, IMF working paper, WP/03/210.

- [5] Che, J. and Facchini, G. (2007). “Dual track liberalization: with and without losers”, *Journal of Public Economics* 91, 2291-2306.
- [6] Dixon, H. D. (1987). “The general theory of household and market contingent demand”, *The Manchester School of Economics and Social Studies* 45, 287–304.
- [7] Gao, X. M., Wailes, Eric J. and Cramer, Gail L. (1996). “Partial rationing and Chinese urban household food demand analysis”, *Journal of Comparative Economics* 22, 43–62.
- [8] Lau, L. J., Qian, Y. Y. and Roland, G. (1997). “Pareto-improving economic reforms through dual-track liberalization”, *Economics Letters* 55, 285–292.
- [9] Lau, L. J., Qian, Y. Y. and Roland, G. (2000). “Reform without losers: an interpretation of China’s dual-track approach to transition”, *Journal of Political Economy*, vol. 108, no.1.
- [10] Li, S., Li, S. and Zhang, W. Y. (2000). “The road to capitalism: competition and institutional change in China”, *Journal of Comparative Economics* 28, 269–292.
- [11] Liew, L. (1993). “Rent-seeking and the two-track price system in China”, *Public Choice* 77, 359-375, 1993.

- [12] Lin, J. Y. (2004). “Lessons of China’s Transition from a Planned Economy to a Market Economy”, Leon Kozminski Academy of Entrepreneurship and Management (WSPiZ) and TIGER Distinguished Lectures Series n.16, Warsaw, 17 December, 2004.
- [13] Sah, R. K. and Srinivasan, T. N. (1988). “Distributional consequences of rural food levy and subsidized urban rations”, *European Economic Review* 32, 141–159.
- [14] Sicular, T. (1988). “Plan and market in China’s agricultural commerce”, *Journal of Political Economy* 92, 283–307.
- [15] Togores, V. and Garcia, A. (2004). “Consumption, markets, and monetary duality in Cuba”, in J. Dominguez, O.E. Perez Villanueva, and L. Barberia, eds., *The Cuban Economy at the Start of the Twenty-First Century*, Cambridge, Mass.: Harvard University Press, 245-295.
- [16] Wu, J. L. and Zhao, R.W.(1987). “The dual pricing system in China’s industry”, *Journal of Comparative Economics* 11, 309–318.