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A Dual-Price Demand Theory for Economies under Transition

GUY SHAOJIA LIU and HAIYAN SONG

ABSTRACT *China adopted a dual-price system shortly after the economic reform started in 1978 to liberalise its price control. This led to the coexistence of both plan and market prices for an identical good in the economy. The conventional demand theory developed based on the pure market economies is not useful in explaining consumers' behaviour in the transitional economies such as China in which both plan and market prices are prevalent. This study develops an alternative demand theory for a dual-price (or dual-track) economy and derives the dual-price Slusky equation that identifies a replacement effect of price liberalisation. This demand theory distinguishes itself from the conventional demand theory and explains the ways in which consumers respond to the price liberalisation during the reform period. The new demand theory shows that the gradual approach to reform is superior to the 'Big Bang' approach in terms of reducing the 'corrected inflation' during the transition period. The new theory also suggests that the price elasticity of demand is higher in the dual-track system than that in a full market economy, implying that the price elasticity diminishes over the process of price liberalisation. This theory is tested using the Chinese aggregate consumption data.*

Key words: Dual-Track Demand Theory; Transition Economies; Price Elasticity.

JEL classifications: D11, P21, P22.

1. Introduction

China has adopted a dual-track system to liberalise gradually its centrally controlled prices since early 1980s (for a full survey of China's price reforms, see, for example, Liu, 1994 and Zhang and Yi, 1994). Lau *et al.* (1997, 2000) and Li (1999) argue that the dual-track economy with both plan and market prices could improve efficiency without creating losers in the economy. One of the important characteristics of a dual-track economy is the coexistence of the planned and market supplies at the same time.

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Table 1. Percentage of Controlled Prices over the Period of 1990–98 in China

	Types of prices	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total retail sales	State fixed	29.8	20.9	5.9	4.8	7.2	8.8	6.3	5.5	4.1
	State guided	17.2	10.3	1.1	1.4	2.4	2.4	1.2	2.3	1.2
	Market decided	53.0	68.8	93.0	93.8	90.4	88.8	92.5	93.2	94.7
Total producer goods	State fixed	44.6	36.0	18.7	13.8	14.7	15.6	14.0	13.6	9.6
	State guided	19.0	183	7.5	5.1	5.3	5.3	4.8	4.8	4.4
	Market decided	36.4	45.7	73.8	81.1	80.0	77.9	81.1	81.6	86.0

Source: Yearbook of Price Indicators of China 1999 (p. 577).

The experiences have shown that the shift of planned supply to market supply could either be done abruptly (such as the 'Big Bang' approach adopted by Russia and other eastern European countries) or gradually (such as the gradual approach adopted by China). Table 1 shows that China has gradually liberalised the price control for most industrial and consumer goods over the reform period. Although the time length does not affect the ways in which the consumers adjust their behaviour in response to the reduction in planned supplies of goods, it does, however, affect the speed of the adjustment.

To understand better the demand behaviour in a transition economy, we need to start with the conventional demand function related to a full market economy. Naturally, the legitimacy of the application of the traditional demand theory to a dual-track economy is questionable, as consumers in the dual-track economy are likely to behave differently from those in the market economy (Yu, 1993). Previous studies on the demand issues in the Chinese economy have mainly focused on two aspects. One is to look at whether the consumers in the Chinese economy follow Friedman's permanent income hypothesis (Friedman, 1957) or Hall's life cycle hypothesis (Hall, 1978). Studies in this group include Chow (1985), Portes and Santorum (1987), Qian (1988), Feltenstein *et al.* (1990), Qin (1991) and Song *et al.* (1996). A common concern of these studies is that the economic regime changes may have affected the stable relationship between aggregate consumption and income in China. Studies in the second group examine how the consumers' behaviour is influenced by reform policies (see, for example, Lardy, 1984; Chai, 1992 and Martin, 1991). Martin (1991) extends the linear expenditure system model to characterise the consumption behaviour in China based on the theory of rationing developed by Tobin (1952). One of the basic assumptions of the rationing theory is that a buyer cannot purchase more than his/her ration. This assumption cannot be applied to the dual-track system because of the coexistence of rationing and free-market goods. This feature means that the market equilibrium may exist for commodities outside the plan allocation. It is, therefore, inappropriate to use the rationing theory, which has been widely accepted as a basic theoretical tool for analysing centrally planned economies, to derive the demand function for the dual-track economies.

Among the many published studies on the demand theory for the centrally planned economies, the following three are worth noting. The first is the theory of the black market or the theory of'second economy' (see Ericson, 1984). Michaely (1954) shows that the equilibrium prices in the black market are higher than that in an open market, as transaction costs between buyers and sellers are higher. His analysis suggests that, due to the illegality of the black market and high transaction costs, the demand for black-market goods differs from the demand for open-market goods. The second is the study by Deaton and Muellbauer (1980: 109–14), who used the consumer expenditure minimisation approach to derive the restricted Hicksian demand function. They found that when the rationed and un-rationed demands for a good coincide, the market demand is a function of a vector of prices, utility and the rationed demand. The third study is that of Neary and Roberts (1980) who investigated the effect of changes in the ration level on the demand for other goods. They found that the relaxation of a ration constraint generates both a substitution effect and an income effect, and the demand function derived is an exact analogue of the usual Slutsky equation. This result was obtained from the assumption that there is no effective excess demand for the rationed good on the market. Although these studies may provide a useful referencing point for analysing consumers' behaviour in a dual-track economy, they suffer from obvious methodological constraints due to the absence of price liberalisation in their models.

The aim of this paper is, therefore, to develop a dual-track demand theory that takes the price liberalisation into account and to examine how this demand theory differs from that developed based on a pure market economy. In particular, the study will look at how an individual consumer would change his/her market consumption in response to the reduction in the planned allocation of consumer goods during the transition period. The dual-track demand function and its properties are examined from both theoretical and empirical points of view. The study also looks at whether the demand is more responsive to price changes in a dual-track system than in a full market economy. The result indicates that the difference between the two regimes in terms of the consumer's behaviour diminishes with deepened price reform, and disappears eventually when the transition is completed

The organisation of the rest of the paper is as follows. Section 2 derives the demand function for an individual consumer using both the Marshallian and Hicksian approaches. Section 3 contains a comparative static analysis of changes in rationing quantities and planned prices. A dual-price Slutsky identity is constructed to characterise the effects of price reform on demand. Section 4 develops an aggregate dual-track demand function, which is then empirically tested using the Chinese aggregate consumption data. Section 5 concludes the study.

2. Demand Function for an Individual Consumer

In a transition economy, the demand is determined by conventional factors such as price and income as well as the institutional changes. Among those institutional changes, the price reform (increasing prices for rationed goods, and liberalising part of supply from plan control) plays an important role in the determination of demand for consumer goods and services. Hence, the development of a demand model that takes into account the impacts of price reform should be the focus of the analysis.

In line with the derivation of the traditional demand function, we assume:

- A.1 A consumer's preference ordering over bundles of goods $(q_1, \ldots, q_n)$ can be represented by an ordinal utility function;
- A.2 An individual's utility function is differentiable;
- A.3 A consumer is rational in choosing bundles of goods for preference or utility maximisation;

A.4 A consumer is given a gross nominal income, M, that is *greater* than the money value of all plan entitlements (goods) $\overline{\boldsymbol{q}}$, when it is valued at the plan price $\overline{\boldsymbol{p}}$. That is

$M > \sum \overline{p}_i \overline{q}_i$;

A.5 A consumer's feasible set for choosing a bundle of *market* goods is bounded, closed, convex, and non-empty;

A.6 The plan good and market good are *identical* in terms of specification and quality, but different in terms of distribution. In addition the plan price, $\overline{\boldsymbol{p}}$, is *lower* than or equal to the market price, $\boldsymbol{p}$.

Assumptions A.1–A.3 are typical textbook assumptions. A.4 and A.5 state that there must be money income available for market goods consumption after purchasing the planned entitlements, and an optimal solution exists in choosing a bundle of market goods for utility maximisation. A.6 and A.3 ensure that a rational consumer always purchases plan goods first, and then buys goods for his/her excess consumption from the market. In addition, the resale of plan goods on the market is not allowed.

These assumptions allow us to derive the dual-track demand function based on two approaches: utility maximisation and expenditure minimisation. Different approaches illustrate different properties of the demand function, which are discussed below.

2.1. Utility Maximisation Approach

The consumer's problem is how to choose a bundle of market goods to maximise his/her utility subject to the income available after obtaining plan goods:

$$\max_{q_1^m \cdots q_n^m} U\left(q_1^m + \overline{q}_1, \ldots, q_n^m + \overline{q}_n\right), \quad \text{s.t.} \sum_{i=1} \left(q_i^m p_i + \overline{q}_i \overline{p}_i\right) \leq M. \tag{1}$$

where, q_i^m is the quantity of the ith good purchased from the market at an equilibrium price p_i, $\overline{q}_i$ is the quantity of the ith good distributed by the plan system at price $\overline{p}_i$, and M is the gross income of an individual consumer. The total consumption of the good is $q_i = \overline{q}_i + q_i^m$, and the individual consumes more than his/her planned entitlements.

If $\sum \overline{p}_i\ \overline{q}_i$ is regarded as the total value of the endowment of the goods allocated by the plan, $\overline{M} = (M - \sum \overline{p}_i \overline{q}_i)$ is the consumer's *net or residual income* to spend on the market goods.

In the dual-track economy, the consumer's problem can be more precisely formulated as how to choose the most preferred bundle of goods from the market within the net budget constraint, which is described as:

$$\max_{q_1^m \cdots q_n^m} U(q_1^m + \overline{q}_1, \ldots, q_n^m + \overline{q}_n), \quad \text{s.t.} \sum_{i=1} q_i^m p_i \leq \overline{M}. \tag{2}$$

Applying the Lagrange multiplier technique and taking the first-order conditions with respect to q_i^m gives:

$$\frac{\partial \xi}{\partial q_i^m} = \frac{\partial U}{\partial q_i} - \lambda p_i = 0 \qquad (\text{where, } q_i = q_i^m + \overline{q}_i),$$

$$\frac{\partial \xi}{\partial \lambda} = \overline{M} - \sum_{i=1} p_i q_i^m = \overline{M} - \sum_{i=1} p_i q_i + \sum_{i=1} p_i \overline{q}_i = 0.$$

These $n+1$ unknowns, $\boldsymbol{q}$ and λ, can be solved with $n+1$ conditions. The general solution of the consumer for the ith good is: $q_i = f_i\ (\boldsymbol{p}, \overline{\boldsymbol{q}}, \overline{M})$, or for the market good quantity:

$$q_i^m = v_i(p, \overline{q}, \overline{M}) = v_i(p, \overline{q}, M - \sum \overline{p}_i, \overline{q}_i),$$

which can be rewritten as:

$$q_i^m = d_i(\boldsymbol{p}, \overline{\boldsymbol{p}}, \overline{\boldsymbol{q}}, M).$$

This is the dual-track demand function for the consumer, which is of the Marshallian type. To illustrate its properties, we specify a Cobb–Douglas utility function in a two-goods case as:

$$U = (q_1^m + \overline{q}_1)^{b_1}(q_2^m + \overline{q}_2)^{b_2}. \tag{3}$$

The Lagrange multiplier for the problem is

$$\xi = (q_1^m + \overline{q}_1)^{b_1}(q_2^m + \overline{q}_2)^{b_2} + \lambda(M - p_1 q_1^m - p_2 q_2^m - \overline{p}_1\overline{q}_1 - \overline{p}_1\overline{q}_2)$$

taking the first order condition with respect to q_i^m and manipulating the derivatives gives the solution of q_i^m:

$$q_1^m = \frac{b_1}{p_1(b_1+b_2)}\left[M - \left(\overline{p}_1 + p_1\frac{b_2}{b_1}\right)\overline{q}_1 + (p_2 - \overline{p}_2)\overline{q}_2\right]$$

and this is a special case of Equation (3) and the general form of the equation takes the form of

$$q_i^m = d_i(p_1, p_2, \overline{p}_1, \overline{p}_2, \overline{q}_1, \overline{q}_2, M).$$

This dual-track demand function has the following properties.

(M-1) *If the plan value of the total rationing quotas for the consumer does not change, the dual-track Marshallian demand function for market goods is homogeneous of degree zero in market prices and net income.*

Proof: By definition the net income is

$$\overline{M} = M - \sum \overline{p}_i\overline{q}_i = \left(\sum p_i q_i^m + \sum \overline{p}_i\overline{q}_i\right) - \sum \overline{p}_i\overline{q}_i = \sum p_i q_i^m.$$

We can show that $k\overline{M} = \sum k p_i q_i^m$ when $k > 0$.

Holding $\sum \overline{p}_i\overline{q}_i$ constant, an increase in both the net income $\overline{M}$ and the market prices $\boldsymbol{p}$ by a factor k, $(k > 0)$, leaves the constraint unchanged. Hence,

$$q_i^m(k\boldsymbol{p}, k\overline{M}, \overline{\boldsymbol{q}}) = q_i^m(\boldsymbol{p}, \overline{M}, \overline{\boldsymbol{q}}).$$

(M-2) *The dual-track Marshallian demand for market goods decreases given an increase in plan ration quotas.*

Proof: From Equation (3), $q_i^m = v_i(\boldsymbol{p}, \overline{\boldsymbol{q}}, \overline{M}) = v_i(\boldsymbol{p}, \overline{\boldsymbol{q}}, M - \sum \overline{p}_i\overline{q}_i)$, we can obtain

$$\frac{\partial q_i^m}{\partial \overline{q}_i} = \frac{\partial v_i}{\partial \overline{q}_i} + \frac{\partial v_i}{\partial \overline{M}}(-\overline{p}_i). \tag{4}$$

Since the plan price $\overline{p}_i > 0$, and an increase in the residual income $(\overline{M})$ leads to an increase in the market demand for the good i, it means that

$$\frac{\partial v_i}{\partial \overline{M}_i}(-\overline{p}_i) < 0.$$

Moreover, due to a perfect substitution between the plan and market goods, it suggests that the greater the plan supply of good i, the less market demand for it given the consumer's income. Hence,

$$\frac{\partial v_i}{\partial \overline{q}} < 0,$$

which means

$$\frac{\partial q_i^m}{\partial \overline{q}_i} = \frac{\partial v_i}{\partial \overline{q}_i} + \frac{\partial v_i}{\partial \overline{M}}(-p_i) < 0.$$

2.2. Cost Minimisation Approach

This approach is based on the minimisation of consumer expenditure subject to a reservation utility u^0:

$$\sum_{i=1} \overline{p}_i \overline{q}_i + \underset{q_i^m}{Min} \sum_{i=1} p_i q_i^m \quad \text{s.t. } u(q_1, \ldots, q_n) \geq u^0$$

with

$$q_i = q_i^m + \overline{q}_i, \quad \text{and} \quad 0 < \overline{p}_i \leq p_i^m \tag{5}$$

with

$$q_i = q_i^m + \overline{q}_i, \quad \text{and} \quad 0 < \overline{p}_i \leq p_i^m.$$

This implies that the plan goods are short in supply, and that the consumer has to buy more from the market in order to obtain his reservation utility at the least possible expenditure. The quantity of good i a consumer should buy from the market can be solved by applying the Lagrange technique to Equation (5) and taking the first-order conditions with respect to q_i^m:

$$\frac{\partial \xi}{\partial q_i^m} = p_i - \lambda \frac{\partial u}{\partial q_i} = 0,$$

$$\frac{\partial \xi}{\partial \lambda} = u(\boldsymbol{q}) - u^0 = 0.$$

Solving these $n+1$ unknowns, $\boldsymbol{q^m}$ and λ, yields the total demand for the ith good as:

$$q_i = h_i(\boldsymbol{p}, u^0).$$

The demand for the ith market good is:

$$q_i^m = h_i(\boldsymbol{p}, u^0) - \overline{q}_i. \tag{6}$$

Equation (6) is the Hicksian demand function for the dual-price economy. To illustrate, we specify a Cobb–Douglas utility function for a two-good case as:

$$\underset{q_1^m \ldots q_2^m}{\text{Min}} (\overline{p}_1 \overline{q}_1 + \overline{p}_2 \overline{q}_2 + p_1^m q_1^m + p_2^m q_2^m), \quad \text{s.t. } (q_1^m + \overline{q}_1)^{b_1} (q_2^m + \overline{q}_2)^{b_2} \geq u,$$

taking the first-order condition with respect to q_i^m and manipulating the derivatives, we have

$$q_2 = u^{\frac{1}{(b_1+b_2)}}\left(\frac{b_2 p_1}{b_1 p_2}\right)^{\frac{b_1}{(b_1+b_2)}}, \quad \text{with } q_2 = q_2^m + \bar{q}_2.$$

This is equivalent to:

$$q_2^m = u^{\frac{1}{(b_1+b_2)}}\left(\frac{b_2 p_1}{b_1 p_2}\right)^{\frac{b_1}{(b_1+b_2)}} - \bar{q}_2,$$

which is a specific form of Equation (6) and it can be conveniently written as:

$$q_2^m = h_i(p, u^0) - \bar{q}_2.$$

This Hicksian dual-track demand function has the following property with respect to changes in $\bar{q}_i$:

> *The Hicksian demand in the dual-track economy is decreasing one for one with a rise in the plan quota.*

The implication of this property is that the amount of the *i*th plan good given up must equal the amount of increases in the *i*th market good purchased in order to keep the utility constant.

Having obtained $\boldsymbol{q}^{\boldsymbol{m}^*}$, which is the quantity solution of the market goods with respect to the cost minimisation, we can substitute $\boldsymbol{q}^{\boldsymbol{m}^*}$ back into the cost identity to derive the dual-track expenditure function:

$$M = \sum(p_i q_i^{m^*} + \bar{p}_i \bar{q}_i) = \sum[p_i h_i(p, u^0) - p_i \bar{q}_i + \bar{p}_i \bar{q}_i] = M'(p, u^0) - \sum(p_i - \bar{p}_i)\bar{q}_i. \tag{7}$$

Obviously, if the dual prices are equal (i.e., $p_i = \bar{p}_i$), the expenditure function becomes the familiar textbook expenditure function and possesses all the related properties. But an interesting question is whether or not those properties are still valid for the dual-track economy, and this is examined below.

(E-1) *The dual-track expenditure function is concave in market prices.*

Proof: Choose two market price vectors $\boldsymbol{p}'$ and $\boldsymbol{p}''$, and k such that $0 \leq k \leq 1$. Define $\boldsymbol{p} = k\boldsymbol{p}' + (1-k)\boldsymbol{p}''$. To prove (E-1), we need to prove

$$M'(p, u^0) - \sum(p_i - \bar{p}_i)\bar{q}_i \geq k[M'(\boldsymbol{p}', u^0) - \sum(p_i' - \bar{p}_i)\bar{q}_i] + (1-k)[M'(\boldsymbol{p}'' u^0) - \sum(p_i'' - \bar{p}_i)\bar{q}_i]$$

for given u^0, $\bar{\boldsymbol{p}}$ and $\bar{\boldsymbol{q}}$.

Use $\boldsymbol{q}^{\boldsymbol{m}}$, $\boldsymbol{q}^{\boldsymbol{m}'}$ and $\boldsymbol{q}^{\boldsymbol{m}''}$ to solve the expenditure minimisation problem in choosing the market goods when the price vector is, respectively, $\boldsymbol{p}$, $\boldsymbol{p}'$ and $\boldsymbol{p}''$. By the definition of the dual-track expenditure function, we have:

$$M' = \boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'} + \bar{\boldsymbol{p}}\bar{\boldsymbol{q}} = M'(\boldsymbol{p}', u^0) - \sum(p_i' - \bar{p}_i)\bar{q}_i,$$

$$M'' = \boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''} + \bar{\boldsymbol{p}}\bar{\boldsymbol{q}} = M'(\boldsymbol{p}'', u^0) - \sum(p_i'' - \bar{p}_i)\bar{q}_i,$$

$$M = \boldsymbol{p}\boldsymbol{q}^{\boldsymbol{m}} + \bar{\boldsymbol{p}}\bar{\boldsymbol{q}} = M'(\boldsymbol{p}, u^0) - \sum(p_i - \bar{p}_i)\bar{q}_i.$$

Since $\boldsymbol{q}^{\boldsymbol{m}'}$ and $\boldsymbol{q}^{\boldsymbol{m}''}$ are the solutions to their respective expenditure minimisation problems we must have

$$\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}} \geq \boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'},$$
$$\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}} \geq \boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''}.$$

Multiplying through the first inequality by k and the second by $(1-k)$ yields:

$$k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}} \geq k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'},$$
$$(1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}} \geq (1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''}.$$

From these two inequalities we can also obtain:

$$k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}} + (1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}} \geq k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'} + (1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''},$$
$$(k\boldsymbol{p}' + (1-k)\boldsymbol{p}'')\boldsymbol{q}^{\boldsymbol{m}} \geq k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'} + (1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''}.$$

According to the definition of $\boldsymbol{p}$, we have

$$\boldsymbol{p}\boldsymbol{q}^{\boldsymbol{m}} \geq k\boldsymbol{p}'\boldsymbol{q}^{\boldsymbol{m}'} + (1-k)\boldsymbol{p}''\boldsymbol{q}^{\boldsymbol{m}''}.$$

From the expenditure functions of M', M'' and M above, and $\overline{\boldsymbol{p}}\overline{\boldsymbol{q}} = k\overline{\boldsymbol{p}}\overline{\boldsymbol{q}} + (1-k)\overline{\boldsymbol{p}}\overline{\boldsymbol{q}}$, we arrive at:

$$M'(\boldsymbol{p}, u^0) - \sum(p_i - \overline{p}_i)\overline{q}_i \geq k[M'(\boldsymbol{p}', u^0) - \sum(p_i' - \overline{p}_i)\overline{q}_i]$$
$$+ (1-k)[M'(\boldsymbol{p}'', u^0) - \sum(p_i'' - \overline{p}_i)\overline{q}_i]$$

and the proof is complete.

(E-2) *The dual-track expenditure function is homogeneous of degree one in market prices for a given residual (net) income.*

Proof: By definition the residual income is:

$$\overline{M} = M - \sum \overline{p}_i\overline{q}_i.$$

According to the expenditure function, the total gross income M is

$$M = M'(\boldsymbol{p}, u^0) - \sum(p_i - \overline{p}_i)\overline{q}_i = M'(\boldsymbol{p}, u^0) - \sum p_i\overline{q}_i + \sum \overline{p}_i\overline{q}_i.$$

That is: $M - \sum \overline{p}_i\overline{q}_i = M'(p, u^0) - \sum p_i\overline{q}_i$. Therefore, the residual income is

$$\overline{M} = M'(\boldsymbol{p}, u^0) - \sum p_i\overline{q}_i = \sum p_i q_i - \sum p_i\overline{q}_i$$
$$= \sum p_i q_i^m + \sum p_i\overline{q}_i - \sum p_i\overline{q}_i = \sum p_i q_i^m = \overline{M}(\boldsymbol{p}, \boldsymbol{q}^{\boldsymbol{m}})$$

Obviously, this gives:

$$\overline{M}(k\boldsymbol{p}, \boldsymbol{q}^{\boldsymbol{m}}) = \sum k p_i q_i^m = k\overline{M},$$

where k is a price factor and $k > 0$.

(E-3) *The dual-track expenditure function is linearly decreasing in plan quotas but linearly increasing in plan prices.*

Proof: Taking the first derivatives of Equation (7) with respect to $\overline{q}_i$ and $\overline{p}_i$, respectively, yields:

$$\frac{\partial M}{\partial \overline{q}_i} = -(p_i - \overline{p}_i) \leq 0 \quad \text{when} \quad p_i \geq \overline{p}_i \tag{8}$$

$$\frac{\partial M}{\partial \overline{p}_i} = \overline{q}_i \geq 0. \tag{9}$$

The property (E-3) implies that the more the good is distributed by the plan system the less the consumer's expenditure. Hence a higher plan price will increase the costs for the consumer.

3. A Comparative Static Analysis of the Dual-track Demand Function

This section uses Marshallian and Hicksian demand functions to identify the effects of plan quota and price changes on the demand for market goods. To do this, it is convenient to adopt the duality technique in deriving the Slutsky equation. Varian (1992): 113) proves that the solution based on the utility maximisation is identical to the solution based on the expenditure minimisation. Neary and Roberts (1980) point out that the Hicksian and Marshallian demand functions for rationed goods coincide when the household's total expenditure equals the minimum expenditure needed to reach utility level u^0 given the prices of rationed and un-rationed goods, and rationed quotas. Hence, from Equations (3) and (6), we have:

$$h_i(\boldsymbol{p}, u^0) - \overline{q}_i = d_i(\boldsymbol{p}, \overline{\boldsymbol{q}}, \overline{\boldsymbol{p}}, M) \tag{10}$$

this identity holds when the cost minimisation expenditure equals the income constraint for utility maximisation. Given Equation (7), setting $H_i(\boldsymbol{p}, u^0, \overline{q}_i) = h_i(\boldsymbol{p}, u^0) - \overline{q}_i$ and $\partial H_i / \partial \overline{q}_i = -1$, Equation (10) can be rewritten as:

$$H_i(\boldsymbol{p}, u^0, \overline{q}_i) = d_i[\boldsymbol{p}, \overline{\boldsymbol{q}}, \overline{\boldsymbol{p}}, (M'(\boldsymbol{p}, u^0) - \sum (p_i - \overline{p}_i)\overline{q}_i)] \tag{11}$$

so that

$$\frac{\partial d_i}{\partial \overline{q}_i} = \frac{\partial H_i}{\partial \overline{q}_i} - \frac{\partial d_i}{\partial M}(\overline{p}_i - p_i). \tag{12}$$

This is *the dual-track Slutsky equation*, which takes account of the effect of price reform on the demand for market goods. It shows that the *total effect* of changes in the rationed quota on the market demand. $\partial d_i / \partial \overline{q}_i$ can be decomposed into a *replacement effect*, $\partial H_i / \partial \overline{q}_i = -1$ and an *income effect* $-(\partial d_i / \partial M)(\overline{p}_i - p_i)$. The two effects have opposite signs, since $\partial H_i / \partial \overline{q}_i = -1$ and $\overline{p}_i \leq p_i$ with $\partial d_i / \partial M > 0$ (demand increases with income for normal goods).

$\partial H_i / \partial \overline{q}_i$, the replacement effect, indicates that the marginal change in market demand for good *i* in response to a unit change in the plan ration for the same good is unity. This marginal change is conditional on maintaining the previous bundle just affordable, and thus holding the individual's utility constant. The replacement effect is different from the substitution effect when relative prices change. Assume that the price of good *i* relative to all other goods *j* remains constant, so there is no substitution effect on the demand for all other goods *j*, but there is a cross income effect,[1] when the plan supply of good *i* is changed. With changing plan quantity, the replacement effect measures the switch in consumption between perfectly substitutable plan and market goods. The cross income effect measures the effect of real income losses on the consumer's demand for all other market goods *j*. The negative sign of the replacement effect implies that a reduction in the plan ration always induces the consumer to increase the market consumption of the good in the exact amount of the reduction in the planned allocation.

A direct income effect, $(\partial d_i/\partial M)(\bar{p}_i - p_i)$, reflects the real income loss for the consumer in the shift from the planned good to the market good given that plan prices are less than market prices, $\bar{\boldsymbol{p}} \leq \boldsymbol{p}$. Without compensation, the income reduction will induce a fall in the individual's demand for the good. To sum up, the consumer's demand for market goods will increase to offset the reduction in the planned quantity but not as much as expected by the one-to-one replacement, if the real income losses are not compensated.

If only the plan price is adjusted without changing the plan quantity and nominal income, the consumer would reduce his/her market demand for the good due to his/her real income loss. This point can be illustrated by taking the first derivatives of Equation (11) with respect to $\bar{p}_i$:

$$0 = \frac{\partial d_i}{\partial \bar{p}_i} + \frac{\partial d_i}{\partial M}\bar{q}_i \quad \text{that is} \quad \frac{\partial d_i}{\partial \bar{p}_i} = -\frac{\partial d_i}{\partial M}\bar{q}_i < 0. \tag{13}$$

Equation (13) shows that market demand is decreasing with respect to a one-unit rise in the plan price holding other prices constant.

The dual-track Slutsky equation (12) decomposes a change in market demand into a replacement effect and an income effect in response to the plan ration change. This theoretical prediction of a change in the market demand implies that there would be a fall in the total demand for good *i* during the transition from a planned economy to a market economy when consumers' nominal income remains unchanged. How much this demand would fall is determined by the income effect in the transition. This income effect is affected by a number of factors including the income elasticity of demand, the importance of consumption of the good in the total budget, and the rate of the price change. These determinants can be shown by rewriting Equation (12) as:

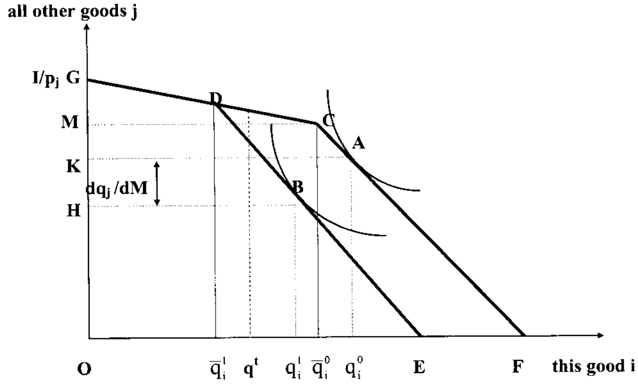
$$\frac{\mathrm{d}q_i}{\mathrm{d}\bar{q}_i} = -1 + \frac{\mathrm{d}q_i}{\mathrm{d}M}(p_i - \bar{p}_i)$$

where dq_i represents the change in the total demand for good *i*, $\partial H_i/\partial \bar{q}_i = -1$, so that

$$\mathrm{d}q_i = -\mathrm{d}\bar{q}_i + \mathrm{d}\bar{q}_i\left(\frac{\mathrm{d}q_i}{\mathrm{d}M}\frac{M}{q_i}\right)\left(\frac{\bar{p}_i q_i}{M}\right)\frac{p_i - \bar{p}_i}{\bar{p}_i} = -\mathrm{d}\bar{q}_i + \mathrm{d}\bar{q}_i E_i^m \alpha_i \frac{p_i - \bar{p}_i}{\bar{p}_i} \tag{14}$$

where E_i^m is the income elasticity of the good *i*, α_i is the proportion of the total consumption of good *i* (valued at the plan price) in the total budget, and $(p_i - \bar{p}_i)/\bar{p}_i$ is the (corrected inflation) rate of change of the price of good *i* in the transition. Geometrically, the replacement and income effects in (14) can be illustrated by Figure 1.

This diagram shows the effects on both demand for good *i*, and demand for other goods *j*, but the effect on the demand for *i* is of primary interest. Since the rationed quantity of good is reduced by $(\bar{q}_i^0 - \bar{q}_i^1)$, the budget line shifts from GCF to GDE, indicating a fall in consumer's real income in the transition because of $p > \bar{p}$. The slope of the budget line in the FC section measures the ratio of the market's



$$I = p_j q_j + \overline{p}_i \overline{q}_i + p_i^m q_i^m \quad \text{where, } q_i = \overline{q}_i + q_i^m$$

Figure 1. The demand curves for a two-good economy under transition.

price of good i to the price of all other goods j, and the slope of the line in GC is the ratio of good i's plan price to the good j's market price. So point M represents the consumption of all other goods j at a price, p_j, after the plan entitlements of $\overline{q}_i^0$ at a given lower plan price $\overline{p}_i$. Point G is the total consumption of all other goods at a price p_j, when the plan supply of good i is zero. Point A represents the optimal bundle of market good i and all other market goods j under the plan supply of $\overline{q}_i^0$. Point B is the new optimal bundle of market good i and all other market goods j under the new plan supply of $\overline{q}_i^1$. The cross income effect on demand for other goods j after a decrease in plan supply of good i by $(\overline{q}_i^0 - \overline{q}_i^1)$ is indicated by KH. The direct income effect on the demand for the market good i is indicated by $(q_i^0 - q_i^1)$. The total change in market demand is the replacement effect $(\overline{q}_i^0 - \overline{q}_i^1)$ less the income effect $(\overline{q}_i^0 - \overline{q}_i^1)$, which means $dq_i = (\overline{q}_i^0 - \overline{q}_i^1) - (q_i^0 - q_i^1) = (q_i^1 - q^t)$ in the diagram.[2] $(q_i^1 - q^t)$ indicates the amount of new added market demand after plan reduction from $\overline{q}_i^0$ to $\overline{q}_i^1$, since the market demand at the plan supply of $\overline{q}_i^0$ is measured by $(q_i^0 - \overline{q}_i^0)$ which is equal to $(q^1 - \overline{q}_i^1)$.

The discussion above shows that a consumption loss is expected in the process of liberalisation from plan to market, to a degree that is dependent on the price change, the importance of the good in the consumer's budget, and the income elasticity. This suggests that, when the differences between market and plan prices are large, a rapid price reform with a macro stabilisation programme to tighten money supply and limit wage incomes will result in a significant fall in both individual consumption and market demand. In particular, this consequence is more serious in a situation where market competition is lacking (Liu, 1997; Liu and Garino 2001). This has been evidenced by reforms in Eastern European countries and the former Soviet Union, which suffered from a considerable output fall with higher inflation in the year of introducing both the 'big bang' price liberalisation and a macro stabilisation programme.

By contrast, China liberalised its price control gradually, which reduced the importance of the plan in a defused manner. Each stage of the price reform was accompanied by raising wages for state employees in compensation for state price rises, or plan ration reductions. This approach gave time to develop the market sector and competition outside the plan system, which avoided sudden rises in market prices, and helped market and plan prices to converge during the liberalisation process. The dual reforms in prices and wages have also ensured that the consumers' real income does not fall too much. This, in turn, avoided a rapid fall in consumption over the transition period.

4. Aggregate Market Demand Function and Market Price Elasticity

4.1. The Theory

Aggregating Equation (3) yields the aggregate demand for market goods

$$Q_i^m = \sum_{n=1}^{h} q_{in}^m = \sum_{n=1}^{h} d_{in}^m(\boldsymbol{p}, \overline{\boldsymbol{p}}, \overline{\boldsymbol{q}}, M), \tag{15}$$

and the total demand is

$$Q_i = Q_i^m + \overline{Q} = \sum_{n=1}^{h} q_{in}^m = \sum_{n=1}^{h} d_{in}^m(\boldsymbol{p}, \overline{\boldsymbol{p}}, \overline{\boldsymbol{q}}, M) + \sum_{n=1}^{h} \overline{q}_{in}. \tag{16}$$

where i denotes the good i, n denotes the nth individual, $n = 1, \ldots, h$ consumers on the market; and $\boldsymbol{p}$ is the vector of market prices which can affect the demand for the ith good.

The market price elasticity for good i in the dual-track economy is:

$$e_i^m = \frac{\partial Q_i^m}{\partial p_i}\frac{p_i}{Q_i^m} = -\sum_{n=1}^{h} \frac{\partial q_{in}^m}{\partial p_i}\frac{p_i}{Q_i^m}\frac{q_{in}^m}{q_{in}^m} = -\sum_{n=1}^{h} e_{in}^m \frac{q_{in}^m}{Q_i^m},$$

where e_i^m is the market price elasticity for the good i; e_{in}^m is the individual price elasticity for good i; the quantity demanded by the nth individual from the market is $q_{in}^m = q_{in} - \overline{q}_{in}$, and the aggregate market demand for good i is $Q_i^m = Q_i - \overline{Q}_i$. Thus, the above equation can be further written as:

$$e_i^m = -\sum_{n=1}^{h} e_{in}^m \frac{q_{in}(1 - \overline{q}_{in}/q_{in})}{Q_i(1 - \overline{Q}_i/Q_i)} = -\frac{\sum_{n=1}^{h} e_{in}^m w_{in}(1 - \overline{s}_{in})}{1 - \overline{S}_i}. \tag{17}$$

In Equation (17), w_{in} is the weight of the nth individual's total consumption of the ith good in the aggregate total consumption; $\overline{s}_{in}$ is the share of plan ration in the individual's total consumption of the good i; $\overline{S}_i$ is the proportion of the aggregate plan allocation in the aggregate total consumption of good i.

Thus, for the dual-track economy, the market price elasticity depends on the sum of the individuals' price elasticities weighted by the shares that consumers have in the aggregate total consumption, and further weighted by the degree of marketisation of the good at both individual and average market levels.

Equation (17) shows that, when $\overline{s}_{in} = \overline{S}_i = 0$ – that is the liberalisation of the ith good from plan control is completed – the price elasticity would be equivalent to the elasticity under the full market economy. When $\overline{s}_{in} = \overline{S}_i = 1$, the ith good is fully rationed by plan and there is no market for the good, so the elasticity does not exist. $0 < \overline{S}_i < 1$ describes a mixed market and plan economy, and the price elasticity is determined not only by the individuals' demand behaviour but also by the progress of marketisation in the economy.

Comparing the market price elasticity under the dual-track economy with the elasticity under a full market economy, we have the following proposition:

Proposition: *The market price elasticity in a dual-track economy is higher than that in a full market economy.*

Proof: For notational simplicity, we ignore i in denoting the ith good, and use n to indicate the nth individual. Then, the consumer's price elasticity in the dual-price economy is defined as:

$$e_n^m = \frac{\Delta q_n^m}{\Delta p}\frac{p}{q_n^m} = \frac{\Delta q_n^m}{\Delta p}\frac{p}{q_n^m}\frac{q_n}{q_n}.$$

Since $q_n = q_n^m + \bar{q}_n$, this implies that $\Delta q_n = \Delta q_n^m + \Delta\bar{q}_n$. If we allow $s_n^m = \frac{q_n^m}{q_n}$, the above equation becomes:

$$e_n^m = \frac{\Delta q_n - \Delta\bar{q}_n}{\Delta p}\frac{p}{q_n}\frac{1}{s_n^m}.$$

We know that $\Delta\bar{q}_n/\Delta p = 0$ as $\bar{q}_n$ is set by plan, and does not respond to changes in the market price. The above equation can now be further written as:

$$e_n^m = \frac{\Delta q_n}{\Delta p}\frac{p}{q_n}\frac{1}{1-\bar{s}_n}, \tag{18}$$

and this is because $s_n^m = 1 - \bar{s}_n = 1 - (\bar{q}_n/q_n) \le 1$.

When the plan supply diminishes to $\bar{s}_n = 0$, the economy is equivalent to a full market system, and the individual's price elasticity becomes:

$$e_n = \frac{\Delta q_n}{\Delta p}\frac{p}{q_n}. \tag{19}$$

From Equations (18) and (19) we have the following relationship:

$$e_n - e_n^m = \frac{\Delta q_n}{\Delta p}\frac{p}{q_n}\left(1 - \frac{1}{1-\bar{s}_n}\right) \le 0 \qquad (\text{since } \bar{s}_n \le 1).$$

Hence

$$e_n \le e_n^m. \tag{20}$$

From the above, we could find that $e_n^m = e_n$ when $\bar{s}_n = 0$ and e_n^m does not exist when $\bar{s}_n = 1$. This indicates that the higher $\bar{s}_n$ (the plan proportion) is, the more elastic is the consumer's demand with respect to the market price.

The above relationship can also be extended to the aggregate market price elasticity. If we denote e as the price elasticity for the full market economy, e^m as the price elasticity for the dual-price economy, and use the relationship established in Equation (17), we then have

$$e - e^m = \sum_{n=1}^{h} e_n w_n - \frac{\sum_{n=1}^{h} e_n^m w_n\left(1 - \frac{\bar{q}_n}{q_n}\right)}{1 - \frac{\bar{Q}}{Q}}.$$

Given $w_n = q_n/Q$ the above equation can be written as:

$$e - e^m = \frac{1}{Q - \overline{Q}}\left(\sum_{n=1} e_n q_n \frac{Q^m}{Q} - \sum e_n^m q_n^m\right).$$

In order to show $e \leq e^m$, we need to substitute Equations (18) and (19), respectively, for e_n^m and e_n into the above equation:

$$\begin{aligned}\left(\sum_{n=1} e_n q_n \frac{Q^m}{Q} - \sum_{n=1} e_n^m q_n^m\right) &= \sum_{n=1}\left(\frac{\Delta q_n}{\Delta p}\frac{p}{q_n}\right) q_n \frac{Q^m}{Q} - \sum_{n=1}\left(\frac{\Delta q_n}{\Delta p}\frac{p}{q_n}\frac{1}{1-\overline{s}_n}\right) q_n^m \\ &= \sum_{n=1}\frac{\Delta q_n}{\Delta p} p\left(\frac{Q^m}{Q}\right) - \sum_{n=1}\frac{\Delta q_n}{\Delta p} p\left(\frac{1}{s_n^m}\frac{q_n^m}{q_n}\right) \\ &= \frac{Q^m}{Q}\left(\sum_{n=1}\frac{\Delta q_n}{\Delta p} p - \sum_{n=1}\frac{\Delta q_n}{\Delta p} p \frac{Q}{Q^m}\right) \leq 0\end{aligned}$$

and this suggests

$$e \leq e^m. \tag{21}$$

In deriving the above relationship we have used: $1 - \overline{s}_n = s_n^m = q_n^m / q_n$ and $(Q^m/Q) \leq 1$.

Since the above proof is based on a constant $\Delta q_n / \Delta p$, its validity is restricted to the linear demand function. Non-linear demand function, e.g., a constant price elasticity at different prices, requires us to show that the marginal change of demand with respect to price is higher in the dual-track economy than in the full market economy, that is

$$\left.\frac{\Delta q_n}{\Delta p}\right|_{\overline{q}>0} > \left.\frac{\Delta q_n}{\Delta p}\right|_{\overline{q}=0}.$$

Proof: From the dual price Hicksian demand function: $H_1(\boldsymbol{p}, u^0, \overline{q}_i) = h_i(\boldsymbol{p}, u^0) - \overline{q}_i$, we can rewrite Equation (11) as:

$$h_i(\boldsymbol{p}, u^0) = d[\boldsymbol{p}, \overline{\boldsymbol{q}}, \overline{\boldsymbol{p}}, [M'(p, u^0) - \sum (p_i - \overline{p}_i)\overline{q}_i]] + \overline{q}_i.$$

Given plan $\overline{q}$ and price $\overline{p}$, differentiating the above with respect to a market price shows how a rational consumer would react to a price change by rearranging his market consumption:

$$\frac{\partial h_i(\boldsymbol{p}, u^0)}{\partial p_i} = \frac{\partial d_i}{\partial p_i} + \frac{\partial d_i}{\partial M}\left[\frac{\partial M'}{\partial p_i} - \overline{q}_i\right].$$

Since the expenditure change, dM', and the market price change, dp_i, are related by:

$$dM' = q_i dp_i,$$

this gives $\frac{\partial M'}{\partial p_i} = q_i$. Substituting this into the above yields:

$$\frac{\partial d_i}{\partial p_i} = \frac{\partial h_i(\boldsymbol{p}, u^0)}{\partial p_i} - \frac{\partial d_i}{\partial M}[q_i - \overline{q}_i] \tag{22}$$

which is the dual-track Slutsky equation with respect to the market prices. The first term is the substitution effect and the second is the income effect. When the plan supply is removed, that is $\bar{q}_i = 0$, then

$$\frac{\partial d_i}{\partial p_i} = \frac{\partial h_i(\boldsymbol{p}, u^0)}{\partial p_i} - \frac{\partial d_i}{\partial M} q_i, \tag{23}$$

which is the conventional Slutsky equation for a full market economy. Subtracting Equation (23) from Equation (22) gives (given $\partial d_i / \partial M > 0$)

$$\left.\frac{\partial d_i}{\partial p_i}\right|_{\bar{q}_i > 0} - \left.\frac{\partial d_i}{\partial p_i}\right|_{\bar{q}_i = 0} = \frac{\partial d_i}{\partial M} \bar{q}_i > 0. \tag{24}$$

Clearly, this indicates that the marginal change of demand with respect to price in the dual-track economy is greater than that in the full market economy, as the income effect is smaller in the former system than in the latter system.

Equation (24) suggests that consumers would behave differently in the two economic regimes. When the consumers' goods are partly allocated by plan, the degree of reliance on the market would not be as strong as that when the goods are fully supplied by the market. Consumers in the dual-track economy also tend to have more spare income; therefore, they would be more sensitive to market price changes when determining their bundles of market goods. The implication of this result is that the industries in the transition economies can raise prices without worrying too much about the revenue falls. So this will be conducive to industries raising prices.

4.2. Empirical Evidence

The dual track demand theory suggests that the demand elasticity of price diminishes over the transition period. Table 2 provides some published price elasticities related to energy products in China. The figures show that the values of the price elasticities of energy products declined during the period of price liberalisation.

A more general test is conducted based on the aggregate consumption data in China over the period 1952–93. There are two reasons why only the data up to 1993 were used in the test. The first reason for choosing this sample period is that the data cover both the plan (1952–77) and dual-track (1978–93) systems. As Table 1 suggested, the proportion of planned supply of goods was reduced to less than 14%

Table 2. Price Elasticity in China's Energy Sector during the Period of Price Liberalisation

	1989	1990	1991	1992	1993
Energy	1.02	0.47	0.55	0.37	0.21
Coal	1.00	0.53	0.33	0.12	0.32
Electricity	1.78	1.63	0.99	0.81	0.70

Source: China Statistical Yearbook 1999, International Energy Agency, and Coal China.

in 1993. The second reason for the use of the data between 1952 and 1993 is that the consistent official data on aggregate consumption were only available up to 1993 and the data were obtained from the Macroeconomic Analysis System (MEAS) compiled by the State Information Centre of China. Although the consumption data after 1993 are available from other sources, they were subject to frequent revisions.

According to previous studies of aggregate consumption in China discussed in the introductory section, the aggregate consumption function is formulated based on Chow (1985), Qin (1991) and Song *et al.* (1996), and it is written as:

$$c_t = \alpha + \beta_1 y_t + \beta_2 c_{t-1} + \beta_3 \Delta p_t + \varepsilon_t, \tag{25}$$

where c, y, Δp are the real aggregate consumption expenditure, real national income available for households and the retail price inflation, respectively. All variables are in natural logarithms. β_3 can be interpreted as the price elasticity of aggregate demand. In Equation (25), the plan price variable is not included due to data unavailability. Aggregate demand, c, includes the consumption of both market goods and plan goods. Since the plan aggregate consumption does not respond to changes in prices, this should not cause any bias in estimating β_3. The OLS estimation of Equation (25) is

$$\begin{aligned} c_t = -0.1137 &+ \underset{(2.1)}{0.1567} y_t + \underset{(2.2)}{0.8642} c_{t-1} - \underset{(10.5)}{0.4339}\Delta p \quad (2.7) \end{aligned}$$

$$\overline{R}^2 = 0.996 \quad \sigma = 0.039 \quad DW = 1.344 \quad M.D. = 4.729$$

$$\chi^2_{\text{auto}} = 3.66\ \chi^2_{\text{white}}(10) = 15.53\ \chi_{\text{reset}}(1) = 4.39^{*} F_{\text{Chow}}(\text{d.f.}) = 5.913^{**}.$$

The above estimates assume that the structure of the model remains constant over time from 1952 to 1993. The $\chi^2(4)$ is the Breusch–Godfrey (Breusch, 1978; Godfrey, 1978) Lagrange multiplier test for serial correlation, $\chi^2_{\text{White}}(10)$ is the White (1980) heteroscedasticity test, the $\chi^2_{\text{reset}}(1)$ is the Ramsey (1969) test for functional form, and the $F_{\text{Chow}}(4,34)$ is the Chow (1960) coefficient stability test. In conducting the Chow coefficient stability test, 1978 is chosen as a structural break point. Although the estimated coefficients (elasticities) have the expected signs and magnitudes, the diagnostic statistics indicate that the model may suffer from a problem of structural instability (time varying coefficients) and this may be related to the economic regime change since 1978. Recursive OLS was then applied to analyse the stability of the estimated price elasticity, and it was found that the price elasticity has changed over time (see Figure 2).

The solid line represents the changes of the price elasticity over the estimation period. Between 1965 and the late 1970s, the price elasticity was quite stable, with an average absolute value of around 0.8. However, after 1978 the value began to drop and this trend was continued to the end of the 1980s. During the dual-track period the mean absolute value of the price elasticity was 0.4, which is much lower than that in the pre-reform period. The diagram also shows that, from the beginning of the 1990s, when the majority of state controlled prices were lifted, the price elasticity was stabilised and this suggests that the price elasticity fell with decreases in the planned supply of goods, and became stable when market supply dominated the economy. This conclusion is consistent with the reported price elasticities of

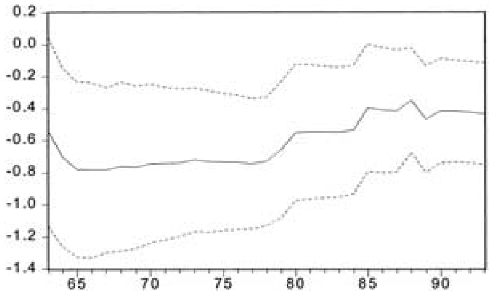


Figure 2. Recursive estimates of the price elasticity and the standard errors.

demand for pork meat (absolute value), which diminished from 1.05 in the period of 1979–85 to 0.6 in the period of 1986–95, and the same was true for the price elasticity of demand for eggs, which dropped from 1.67 to 0.8 during the same period (Deng and Yao, 1998).

Although, to a large extent, this simple empirical test confirms our theoretical conclusion, great efforts are still needed to examine separately the price elasticities for both plan goods and market goods, and this will form the base for further empirical studies.

5. Concluding Remarks

The dual-track demand function derived in this study has three distinctive properties that differ from those of the conventional demand function. The first is that the market demand for a consumer good increases with a decrease in the planned supply of the good; the second is that there exists a positive and concave relationship between the consumer's expenditure and the market price of the good; and the third is that the greater the plan supply, the lower the expenditure if the plan price is lower than the market price of the consumer good. One of the most important features of the demand function for the transition economy is that it identifies a replacement effect of ration change on the market demand for an identical good. The impact of changes in the planned supply on demand can be decomposed into a replacement effect and an income effect by the dual-track Slutsky equation. If the price of the good relative to all other goods remains unchanged with a reduction in plan supply, the substitution effect on the demand for other goods will be absent while the income effects are still in force. The demand for all other goods will fall with decreases in the planned supply of the good and this is because the residual income available for these goods falls. The income effect is the source of the individual consumption loss during the transition of the good from plan supply at a lower price to market supply at a higher price. The size of the effect depends partly on the difference between the plan price and market price of the good, partly on the importance (proportion) of the good in the consumer's budget, and partly on the income elasticity. The price differential, the so called *corrected inflation rate*, can be reduced before the liberalisation by the convergence of the market and plan prices through fostering market competition outside the plan and through increasing plan prices gradually in line with income. This provides a theoretical explanation for the success of China's gradual approach to price reform, and explains the rationale for price adjustment related to plan goods. It also implies that the market competition should be encouraged before a large-scale price liberalisation can be introduced.

The dual-track demand function also suggests that the market demand elasticity for a good is time varying over the transition period. This is because the income effect in the dual-track economy is smaller than that in the full market economy. The significance of this finding is that it differentiates the *transitional* demand theory from the *conventional* demand theory, which opens a new area for further studies both theoretically and empirically.

Notes

1. This point can be shown by rewriting Equation (11) as:

$$H_j(p, u^0, \bar{q}_j) = d_j\left[p, \bar{q}, \bar{p}, \left[M'(p, u^0) - ((p_i - \bar{p}_i)\bar{q}_i + \sum_{j \neq i}(p_j - \bar{p}_j)\bar{q}_j)\right]\right]$$

and taking f.o.c. on the above with respect to $\bar{q}_i$ gives:

$$\frac{\partial d_j}{\partial \bar{q}_i} = \frac{\partial H_j}{\partial \bar{q}_i} + \frac{\partial d_j}{\partial M}(p_i - \bar{p}_i)$$

Since $H_j(\boldsymbol{p}, u^0, \bar{q}_i) = h_j(\boldsymbol{p}, u^0) - \bar{q}_i$, which implies $\partial H_j / \partial \bar{q}_i = 0$, the above equation becomes

$$\frac{\partial d_j}{\partial \bar{q}_i} = \frac{\partial d_j}{\partial M}(p_i - \bar{p}_i) > 0$$

and this shows that the cross effect of a plan reduction on the demand for all other goods is determined by the income effect. The positive sign means an increase in the plan entitlement of good i with the demand for the other goods, because of the more residual income available for the consumption of all other goods after good i, see Figure 1 for an illustration.

2. This can be shown in Figure 1 by setting $\bar{q}_i^0 - \bar{q}_i^1 = q_i^0 - q^t$, which means $\bar{q}_i^1 = \bar{q}_i^0 - q_i^0 + q_i^t$. Substituting $\bar{q}_i^1$ into $\mathrm{d}q_i$ gets: $\mathrm{d}q_i = (\bar{q}_i^0 - \bar{q}_i^1) - (q_{i.}^0 - q_i^1) = \bar{q}_i^0 - \bar{q}_i^0 + q_i^0 - q^t - q_i^0 + q_i^1 = q_i^1 - q^t$.

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