CHAPTER 3: INTERTEMPORAL PRICES

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Topics to be covered

- Study the effect of varying intertemporal prices within the intertemporal approach to the current account.
  - A model without wealth effects.
    - Permanent and temporary trade liberalization.
    - The role of the elasticity of intertemporal substitution.
    - Intertemporal price speculation with durable goods.
  - Lack of credibility.
  - A model with wealth effects.
    - Permanent and temporary trade liberalization.
    - Partial rebates.
  - Distortionary taxation.
  - Terms of trade shocks.

1. Introduction

- In chapter 1 the relative price of consumption was constant over time (i.e. price of consumption across different points in time).
  - As a result, consumers chose a constant path of consumption.
- In practice, temporary government policies (such as changes in taxes, tariffs and monetary policy) or temporary terms of trade shocks could change the intertemporal price of consumption.
  - In these cases, even though they could, consumers will choose not to smooth consumption overtime, because they will find in their advantage to consume more when the good is relatively cheap.

2. The Model

- Small open economy inhabited by a large number of identical, infinitely-lived consumers.
- No uncertainty, perfect foresight.
- ~~Only one~~ Two (non-durable) tradable goods: an exportable (not consumed) and an importable good. (Two goods to analyze trade liberalization. Exportable not consumed to isolate intertemporal from intratemporal effects).
- Small open economy: takes ~~price of tradable good~~ international terms of trade ($p^{imp}/p^{exp} = 1$) as given.
- The economy is endowed with a flow of exportable good (but not importables).
- ~~No~~ government may impose tariffs on the importable goods and returns the proceeds to consumers in a lump-sum way.
- Perfect capital mobility in the sense that consumers can borrow/lend in international capital markets at a constant real interest rate, r.

2.1 Consumer's Problem

Let c_t denote consumption of the importable good. The objective is to

$$\max\ W(c_t) = \int_0^{\infty} u(c_t) e^{-\beta t} dt \qquad (1)$$

with $\beta > 0, \quad u' > 0, \quad u'' < 0, \quad \lim_{c_t \to 0} u'(c_t) = \infty$

Let b_t denote net foreign assets (denominated in terms of the exportable good) held by the representative individual. Let y denote the exogenous constant endowment of the exportable good, τ_t be lump-sum transfers from the government, p_t denote the domestic terms of trade and $(p_t - 1)$ be the tariff. The individual's flow constraint is

$$\dot{b}_t = r b_t + y + \tau_t - p_t c_t \qquad (2)$$

with b_0, r, and y given and the No-Ponzi condition $\lim_{t \to \infty} e^{-rt} b_t \geq 0$.

Consumer's Problem (cont.)

Integrating (2) forward and imposing the NPG condition yields the consumer's intertemporal budget constraint :

$$b_0 + \frac{y}{r} + \int_0^{\infty} \tau_t e^{-rt} dt = \int_0^{\infty} p_t c_t e^{-rt} dt \qquad (3)$$

The representative individual's optimization problem consists in choosing a sequence of consumption $\{c_t\}_{t=0}^{\infty}$ to maximize lifetime utility (1) subject to the intertemporal budget constraint (3) for given paths of τ_t and p_t and given values of b_0, r, and y.

Consumer's Problem (cont.)

$$\max_{\{c_t,\lambda\}_{t=0}^{\infty}} L = \int_0^{\infty} u(c_t)e^{-\beta t}dt + \lambda\left(b_0 + \frac{y}{r} + \int_0^{\infty}\tau_t e^{-rt}dt - \int_0^{\infty} p_t c_t e^{-rt}dt\right)$$

$$\frac{\partial L}{\partial c_t} = u'(c_t)e^{-\beta t} - \lambda p_t e^{-rt} = 0 \quad \Rightarrow \quad u'(c_t)e^{-\beta t} = \lambda p_t e^{-rt}$$

Assuming $\beta = r$: $\qquad u'(c_t) = \lambda p_t \qquad (4)$

Which states that optimal consumption/savings is attained when the marginal utility of consumption, $u'(c_t)$, is equal to the Lagrange multiplier, λ, times the domestic terms of trade p_t.

Hence a preference for consumption smoothing $(u'' < 0)$ coupled with perfect capital markets is not enough to obtain consumption smoothing as p_t might vary over time.

2.2 Government

Assume the government sets the tariff, $(p_t - 1)$, and returns the proceeds to the consumer in the form of a lump-sum transfer:

$$\tau_t = (p_t - 1)c_t \qquad (5)$$

by assuming that proceeds are returned to consumers, we abstract from any possible wealth effects associated with tariffs.

This important assumption will be relaxed ahead in Section 5.

2.3 Equilibrium Conditions

Combining the consumer's flow constraint, given by (2) with the government's, given by (5), we obtain the economy's flow constraint (*i.e.*, the current account):

$$\dot{b}_t = rb_t + y + \underbrace{(p_t - 1)c_t}_{\tau_t} - p_t c_t$$

$$= rb_t + y - c_t \qquad (6)$$

By the same token, combining the consumer's intertemporal constraint, given by (3) and (5), we obtain the economy's intertemporal constraint:

$$b_0 + \frac{y}{r} = \int_0^\infty c_t e^{-rt} dt \qquad (7)$$

Note that the domestic terms of trade, p_t, doesn't enter (6) nor (7).

2.4 Solution of the Model

In a perfect foresight equilibriu m, the time path of the four endogenous variables $(c_t, b_t, \tau_t, \lambda)$ is completely characterized by equations

$$u'(c_t) = \lambda p_t \tag{4}$$

$$\tau_t = (p_t - 1)c_t \tag{5}$$

$$\dot{b}_t = rb_t + y - c_t \tag{6}$$

$$b_0 + \frac{y}{r} = \int_0^{\infty} c_t e^{-rt} dt \tag{7}$$

Solution of the Model (cont.)

In a stationary equilibrium, with $p_t = p^H$ constant, equation (4) tells us that consumption will also be constant over time (at $\bar{c}$).

The resource constraint (7) then determines the level of consumption.

$$\bar{c} = rb_0 + y \quad ; \quad \text{independent of } p_t \qquad (9)$$

Substituting (9) into (5), we obtain the path of transfers

$$\tau_t = \left(p^H - 1\right)\left(rb_0 + y\right) \quad ; \quad \frac{d\tau_t}{dp^H} > 0$$

Solution of the Model (cont.)

By definition the trade balance is given by :

$$TB_t \equiv y - c_t \qquad (8)$$

Substituting $\bar{c}$ from (9) into (8) yields the trade balance path :

$$TB_t = -rb_0 \qquad (10)$$

Now, substituting (10) into (6) we can see that

$$\dot{b}_t = rb_t - rb_0 \quad \Rightarrow \quad b_t = b_0 \quad \forall\, t$$

Hence,

$$CA_t = \dot{b}_t = 0$$

Finally, substituting (9) into (4) we get

$$\lambda = \frac{u'\left(y + rb_0\right)}{p^H}$$

3. Unanticipated Shocks

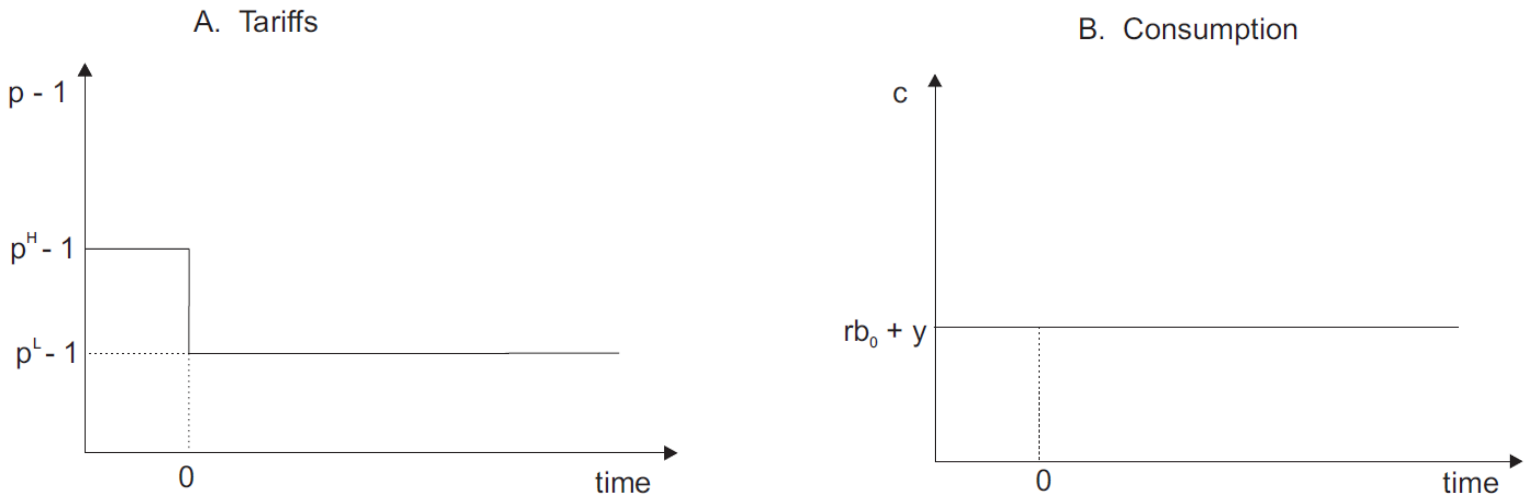
3.1 Permanent fall in tariffs

$$p_t = \begin{cases} p^H & t < 0 \\ p^L & t \geq 0 \end{cases} \qquad p^H > p^L$$

As $\bar{c} = rb_0 + y$ is independent of p, consumption does not change (due to: (i) no intertemporal distortion and (ii) no wealth effect)

Also, TB_t and CA_t remain unchanged and welfare is unaffected.

Permanent Fall in Tariffs (cont.)



3.2 Temporary Fall in Tariffs

From a stationary equilibriu m at $t = 0$, we have an unanticipa ted and temporary fall in tariffs

$$p_t = \begin{cases} p^L & 0 \le t < T \\ \\ p^H & \mathrm{t} \ge T \end{cases} \tag{11}$$

Again, since the shock comes as a surprise, the consumer reoptimize s at $\mathrm{t} = 0$. The first - order condition can be written as :

$$u'(c_t) = \tilde{\lambda} p^L \quad 0 \le t < T \tag{12}$$

$$u'(c_t) = \tilde{\lambda} p^H \qquad \mathrm{t} \ge T \tag{13}$$

where $\tilde{\lambda}$ denotes the new value of the Lagrange multiplier .

Temporary Fall in Tariffs (cont.)

Two key implications follow from (12) and (13):

(1) Consumption will be constant in each subperiod. Formally,

$$c_t = c^1 \quad 0 \le t < T \qquad (14)$$

$$c_t = c^2 \quad t \ge T \qquad (15)$$

(2) Given $u'' < 0$ and $p^L < p^H$, then $c^1 > c^2$. Since consumption is cheaper "today" than "tomorrow", rational consumers choose to consume more today $\Rightarrow$ faced with a lower price for today's consumption, consumers engage in intertemporal consumption substitution.

To see this, in analogy with standard consumer theory, use (14) and (15) in the ratio of (12) over (13):

$$\underbrace{\frac{u'(c^1)}{u'(c^2)}}_{MRS} = \underbrace{\frac{p^L}{p^H}}_{MRT} \qquad (16)$$

Temporary Fall in Tariffs (cont.)

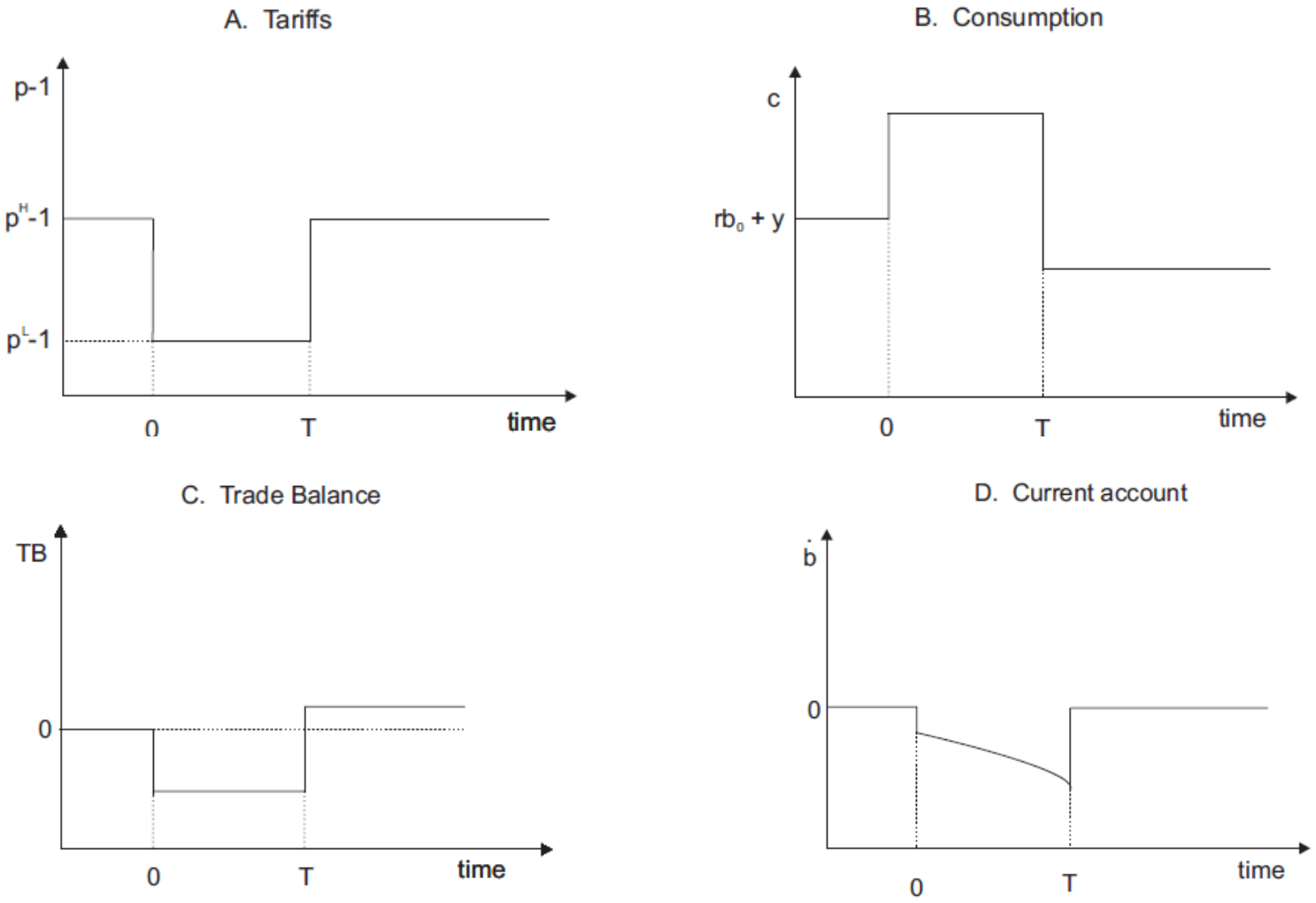
Having solved for the time profile of consumption, we now make use of the resource constraint to solve for the level of consumption. Given $c^1 > c^2$ it follows that $c^1 > \bar{c} > c^2$ as wealth (given by $b_0 + \frac{y}{r}$) has not been altered by the temporary fall in the tariff.

The higher level of consumption between $[0, \mathrm{T})$ leads to a trade worsening. To fix ideas assume $b_0 = 0$ so $TB_0 = 0$ and $CA_0 = rb_0 + TB_0 = 0$, then

$$TB^1 < 0 \qquad CA^1 < 0 \qquad 0 \le t < T$$

$$TB^2 \ge 0 \qquad CA^2 = 0 \qquad t \ge T$$

Temporary Fall Tariffs(cont.)



3.2.2 Welfare Analysis

- How does a temporary liberalization affect consumer's welfare?
  - In this model, due to the non-flat consumption profile, welfare is reduced.
- Why if the economy as a whole can still afford the initial path of consumption?
  - A flat path of consumption will never be chosen by an individual facing a non-flat path of prices $\frac{u'(c^1)}{u'(c^2)} = \frac{p^L}{p^H}$
  - The consumer cannot afford the initial flat path of consumption.

Welfare Analysis (cont.)

We need to show that, given the price distortion, a constant consumption profile, $\bar{c} = rb_0 + y$, is not affordable with the life-time income $b_0 + \frac{y}{r}$.
With the price profile the value of a constant consumption basket is :

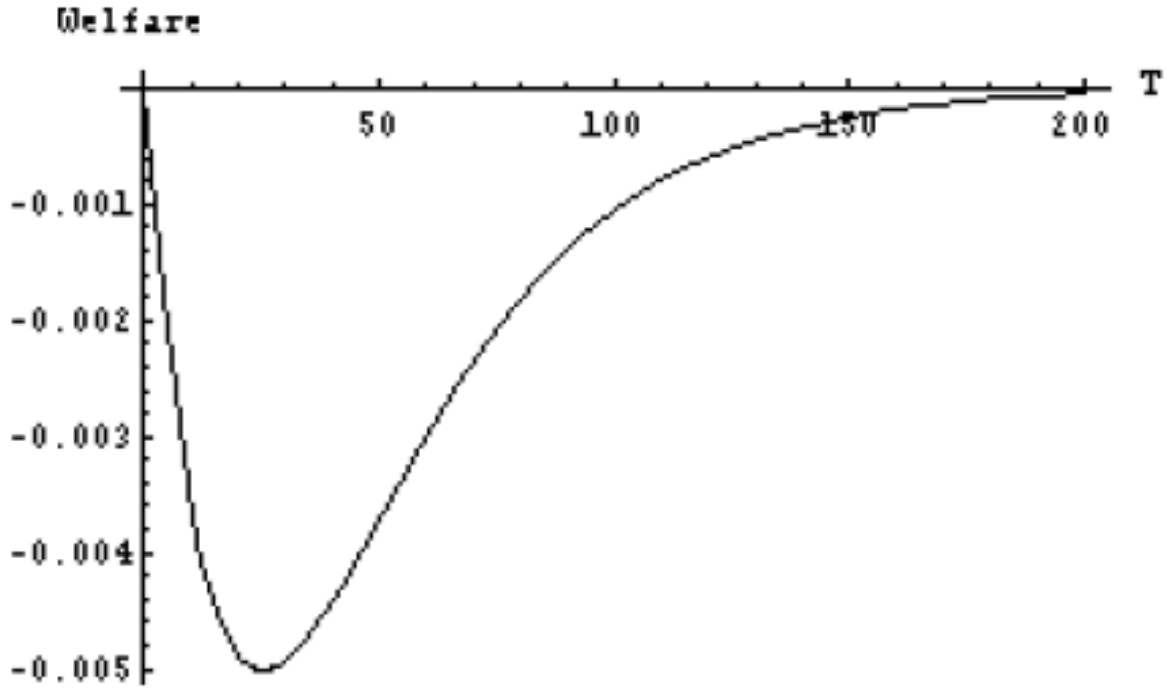
$$\int_0^T p^L \bar{c} e^{-rt} dt + \int_T^\infty p^H \bar{c} e^{-rt} dt = p^L \bar{c} \int_0^T e^{-rt} dt + p^H \bar{c} \int_T^\infty e^{-rt} dt$$

$$= p^L \bar{c} \frac{\left(1 - e^{-rT}\right)}{r} + p^H \bar{c} \frac{e^{-rT}}{r} = \left[\left(p^H - p^L\right) e^{-rT} + p^L\right] \frac{\bar{c}}{r}$$

$$= \left[\left(p^H - p^L\right) e^{-rT} + p^L\right] \left[b_0 + \frac{y}{r}\right] > b_0 + \frac{y}{r} \quad \text{as } p^H > p^L \geq 1 \text{ Q.E.D.}$$

3.2.3 Effect of *T*

- When the liberalization period is shortened, consumption during the liberalization period, c^1, will increase.
- Welfare, as a function of the duration of the liberalization, follows the U-curve shape:



3.2.4 The role of the intertemporal elasticity of substitution (σ)

σ captures the willingne ss to substitute consumption over time in response to a change in intertemporal relative prices.

From the optimality condition $(4): u'(c_t) = \lambda p_t$ we can totally differentiate:

$$u''(c_t)\frac{dc_t}{dt} = p_t \underbrace{\frac{d\lambda}{dt}}_{=0} + \lambda \frac{dp_t}{dt} \quad \Rightarrow \quad \frac{u''(c_t)\frac{dc_t}{dt}}{u'(c_t)} = \frac{\lambda \frac{dp_t}{dt}}{\lambda p_t} \quad \Rightarrow \quad \frac{\frac{dc_t}{dt}}{c_t} = \frac{u'(c_t)}{c_t u''(c_t)} \frac{\frac{dp_t}{dt}}{p_t}$$

with CRRA preferences $u(c) = \frac{c^{1-\frac{1}{\sigma}} - 1}{1-\frac{1}{\sigma}} \quad \Rightarrow \quad \frac{u'(c_t)}{c_t u''(c_t)} = -\sigma \quad \Rightarrow \quad \frac{\frac{\frac{dc_t}{dt}}{c_t}}{\frac{\frac{dp_t}{dt}}{p_t}} = -\sigma \quad (18)$

If $\sigma \to \infty$ demand is perfectly elastic, high substituta bility of consumption

If $\sigma \to 0$ Leontief preferences: low willingne ss to substitute consumption across time, low welfare costs of libralizat ion.

Evidence: Intertemporal Elasticity of Substitution

TABLE 1. Empirical estimates of the intertemporal elasticity of substitution

Countries	Point estimates	Sample and frequency	Type of model	Source
Argentina	0.21 (0.03)	Quarterly 1978:1-1989:2	Transaction costs model	Reinhart and Végh (1995)
	0.15 to 0.19 (0.16) (0.11)	Annual 1960-77	Hall's one good, pure consumption model	Giovannini (1985)
Brazil	-0.17 to 0.01 (0.13) (0.14)	Annual 1967-79	Hall's one good, pure consumption model	Giovannini (1985)
Chile	0.19 (0.10)	Quarterly 1976:2-1989:2	Transaction costs model	Reinhart and Végh (1995)
	1.59 (n.a)	Quarterly 1971:3-1981:4	Money in the utility function model	Arrau (1990)
	0.46 to 0.56 (0.15) (0.26)	Quarterly 1986:1-2002:4	Pure consumption two-good model	Duncan (2003)
Israel	0.15 to 1.32 (n.a) (n.a)	Quarterly 1970:1-1988:3	Money in the utility function model	Eckstein and Leiderman (1991)
Mexico	2.87 (n.a.)	Quarterly 1980:1-1987:4	Money in the utility function model	Arrau (1990)
	0.07 to 0.12 (0.10) (0.12)	Annual 1965-79	Hall's one good, pure consumption model	Giovannini (1985)
Uruguay	0.53 (0.22)	Quarterly 1977:2-1989:3	Transaction costs model	Reinhart and Végh (1995)
Panel of countries*		Annual	Pure consumption two-good	Ostry and Reinhart (1992)
Latin America (4)	0.37 to 0.43 (0.11) (0.14)	1968-87	model	
Asia (5)	0.80 to 0.80 (0.20) (0.24)			
Africa (4)	0.44 to 0.45 (0.18) (0.16)			
Panel of countries*		Annual	Pure consumption two-good	Ostry, Ogaki,
Low Income (31)	0.34 (n.a.)	1968-1992	model. Stone-Geary utility	and Reinhart (1996)
Lower-Middle Income (21)	0.58 (n.a.)		function.	
Upper-Middle Incomec(15)	0.61 (n.a.)			
Panel of 9 South American	0.09	Annual	Hall's one good, pure	Rossi (1988)
Countries	(0.07)	1973-83	consumption model	
	0.09	Annual	With liquidity constraints	Rossi (1988)
	(0.04)	1973-81		

Note: The highest and lowest point estimates are reported. Standard errors are in parenthesis. An "n.a." denotes the standard error was not reported.
*Number of countries in parentheses

3.2.5 Intertemporal Price Speculation

- If there are durable goods, there could be costs to temporarily liberalization even if $\sigma \rightarrow 0$ due to speculative motive.
  - Consumers would want to purchase more durables while they are relatively cheaper.
  - From a social point of view, however, this is suboptimal as durable goods are dominated in return by foreign bonds.

4. Lack of Credibility

- If the government lacks credibility, even an announcement of a permanent trade liberalization will induce the public to behave as if the change is temporary with an increase in consumption and the consequent current account deficit.
  - So the temporary liberalization analyzed above may be interpreted as arising from a situation in which the announcement of a permanent reduction in tariffs was not fully credible.
- Lack of credibility is equivalent to having an intertemporal distortion and is therefore socially costly.
- In theory (if they don't generate distortions) capital controls can be welfare improving in an environment characterized by lack of credibility.

5. Wealth Effects

- Without wealth effects, we concluded that a permanent liberalization would have no effects on welfare, whereas a temporary liberalization would always reduce welfare.
  - These results appear counterintuitive since one would argue that, in practice, there should be some statics gains from trade liberalization, such as higher productivity.
  - Such static gains would increase the economy's wealth and lead to higher welfare.

- To introduce wealth effect, now consider the case where tariff revenues are used by the government to finance socially unproductive public spending.

Wealth Effects (cont.)

In this new set-up, the flow constraint of the consumer is given by

$$\dot{b}_t = r b_t + y + \underbrace{\tau_t}_{=0} - p_t c_t \qquad (19)$$

The corresponding consumer's intertemporal budget constraint is

$$b_0 + \frac{y}{r} + \int_0^{\infty} \underbrace{\tau_t}_{=0} e^{-rt} dt = \int_0^{\infty} p_t c_t e^{-rt} dt \qquad (20)$$

To fix ideas, let preferences be given by the CES $u(c) = \frac{c^{1-\frac{1}{\sigma}} - 1}{1-\frac{1}{\sigma}}$. Then optimality requires:

$$c_t^{-\frac{1}{\sigma}} = \lambda p_t \qquad (21)$$

The government's flow constraint is thus given by

$$g_t = (p_t - 1) c_t \qquad (22)$$

Wealth Effects (cont.)

By definition , the trade balance is given by

$$TB_t \equiv y - c_t - g_t$$

or using (22)

$$TB_t \equiv y - p_t c_t \qquad (23)$$

To obtain the economy's CA_t and resource constraint, combine equation (22) with, respectively (19) and (20) to obtain :

$$\dot{b}_t = rb_t + y - c_t - g_t \qquad (24)$$

and

$$b_0 + \frac{y}{r} = \int_0^{\infty} (c_t + g_t) e^{-rt} dt \qquad (25)$$

So relative to (6) and (7), we now have government absorption.

Wealth Effects (cont.)

In a perfect foresight equilibriu m, the time path of the four endogenous variables (c_t, b_t, g_t, λ) is completely characterized by equations

$$u'(c_t) = \lambda p_t \qquad (4)$$

$$g_t = (p_t - 1)c_t \qquad (22)$$

$$\dot{b}_t = rb_t + y - c_t - g_t \qquad (24)$$

$$b_0 + \frac{y}{r} = \int_0^\infty p_t c_t e^{-rt} dt \qquad (20)$$

Notice that in this case we are using (20) instead of (25) to deal with the endogeneity of g.

Solution of the Model with Wealth Effects

Assume the economy is in a PFEP with $p_t = p^H \ \forall \ t \geq 0.$

From the optimality condition (4), $c_t = \bar{c}$ along the PFEP.

From (20) it follows that

$$\bar{c} = \frac{rb_0 + y}{p^H} \tag{26}$$

Substituting (26) into (22), it follows that

$$\bar{g} = \left(p^H - 1\right)\frac{rb_0 + y}{p^H} \tag{27}$$

While the trade balance, TB_t can be obtained by using $\bar{c}$ of equation (26) on (23)

$$TB_t = y - p^H\left(\frac{rb_0 + y}{p^H}\right) = -rb_0 \tag{28}$$

Finally, from (19) at time 0, we know that $CA_0 = rb_0 + TB_0.$

Hence, from (28), it follows that $CA_0 = 0.$ Hence, $CA_t = 0 \ \forall \ t \geq 0.$

5.1 Permanent Fall in Tariffs with Wealth Effects

Assume that at time 0 there is a permanent reduction in tariffs

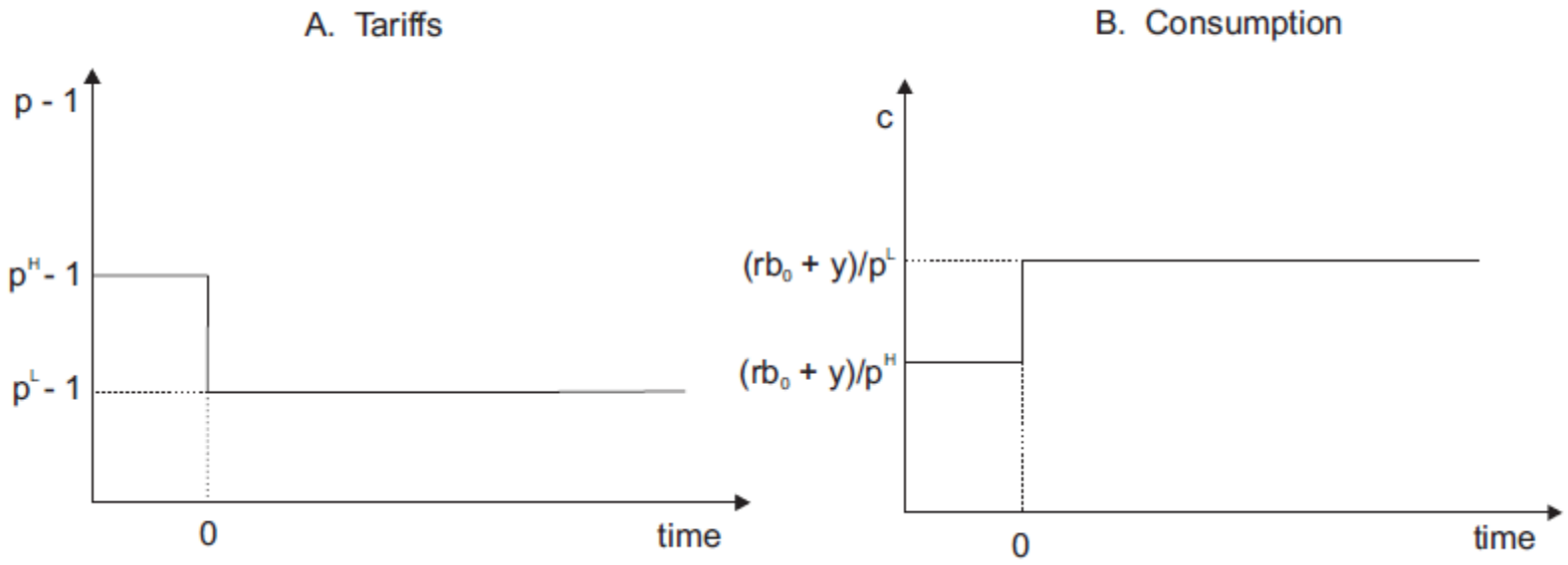
$$p-1=\begin{cases} p^H-1 & t<0 \qquad p^H>p^L \\ \\ p^L-1 & t\geq 0 \end{cases}$$

From (26), as $\bar{c}=\frac{rb_0+y}{p^i}$ consumption increases and with it welfare.

From (27), as $\bar{g}=\left(p^i-1\right)\bar{c}$ and $\frac{d\bar{g}}{dp^i}=\frac{rb_0+y}{\left(p^i\right)^2}>0$, we have $\bar{g}\downarrow$.

Finally, TB_t and CA_t remain unchanged.

Permanent Fall in Tariffs with Wealth Effects (cont.)



❖ In this case, with wealth effects, a trade liberalization implies a higher wealth for the economy as less resources are wasted (thrown away given our assumption of unproductive government expenditure).

5.2 Temporary Fall in Tariffs with Wealth Effects

From a stationary equilibrium at $t = 0$, we have an unanticipated and temporary fall in tariffs

$$p_t = \begin{cases} p^H & 0 > t \\ p^L & 0 \le t < T \\ p^H & t \ge T \end{cases} \quad \Rightarrow \quad c_t = \begin{cases} \bar{c} = \left(\lambda p^H\right)^{-\sigma} & 0 > t \\ c^1 = \left(\tilde{\lambda} p^L\right)^{-\sigma} & 0 \le t < T \\ c^2 = \left(\tilde{\lambda} p^H\right)^{-\sigma} & t \ge T \end{cases} \qquad (29) \quad (30)$$

$\Rightarrow c^1 > c^2$ as consumer takes advantage of cheaper prices.

While the consumption time profile is the same as before $\left(c^1 > c^2\right)$ the level of the new path will be different $\left(c^1 > \bar{c} \begin{matrix} \ge \\ \le \end{matrix} c^2 \right)$.

Temporary Fall in Tariffs with Wealth Effects (cont.)

To determine if $\bar{c} \begin{matrix} \geq \\ \leq \end{matrix} c^2$ rewrite the intertemporal budget constraint (20) as

$$b_0 + \frac{y}{r} = \left(1 - e^{-rT}\right)\frac{p^L c^1}{r} + e^{-rT}\,\frac{p^H c^2}{r} \qquad (31)$$

Then combine (29), (30), and (31) to get $rb_0 + y = \left(1 - e^{-rT}\right)p^L c^1 + e^{-rT}\,p^H c^2$

$$\rightarrow rb_0 + y = \left(1 - e^{-rT}\right)p^L \left[\frac{p^L}{p^H}\right]^{-\sigma} c^2 + e^{-rT}\,p^H c^2$$

$$\rightarrow rb_0 + y = p^H c^2 \left[\left(1 - e^{-rT}\right)\left[\frac{p^L}{p^H}\right]^{1-\sigma} + e^{-rT}\right]$$

$$\rightarrow p^H c^2 = \frac{rb_0 + y}{\left(1 - e^{-rT}\right)\left[\frac{p^L}{p^H}\right]^{1-\sigma} + e^{-rT}}$$

Temporary Fall in Tariffs with Wealth Effects (cont.)

$$\rightarrow p^H c^2 = \frac{rb_0 + y}{\left(1 - e^{-rT}\right)\left[\frac{p^L}{p^H}\right]^{1-\sigma} + e^{-rT}}$$

It follows that

$$p^H c^2 \begin{cases} > rb_0 + y & \sigma < 1 \\ = rb_0 + y & \sigma = 1 \\ < rb_0 + y & \sigma > 1 \end{cases} \Rightarrow \quad c^2 \begin{cases} > \bar{c} \\ = \bar{c} \\ < \bar{c} \end{cases} \qquad (32)$$

In the case of c^1 both substituti on and income effect work in the same direction

while for c^2 they go in opposite directions with $\begin{cases} \text{substituti on} \rightarrow & \downarrow c \\ \text{income} \rightarrow & \uparrow c \end{cases}$

If $\sigma < 1$ weak intertemporal substituti on and $c^2 > \bar{c}$.

Temporary Fall in Tariffs with Wealth Effects (cont.)

What about the trade balance?

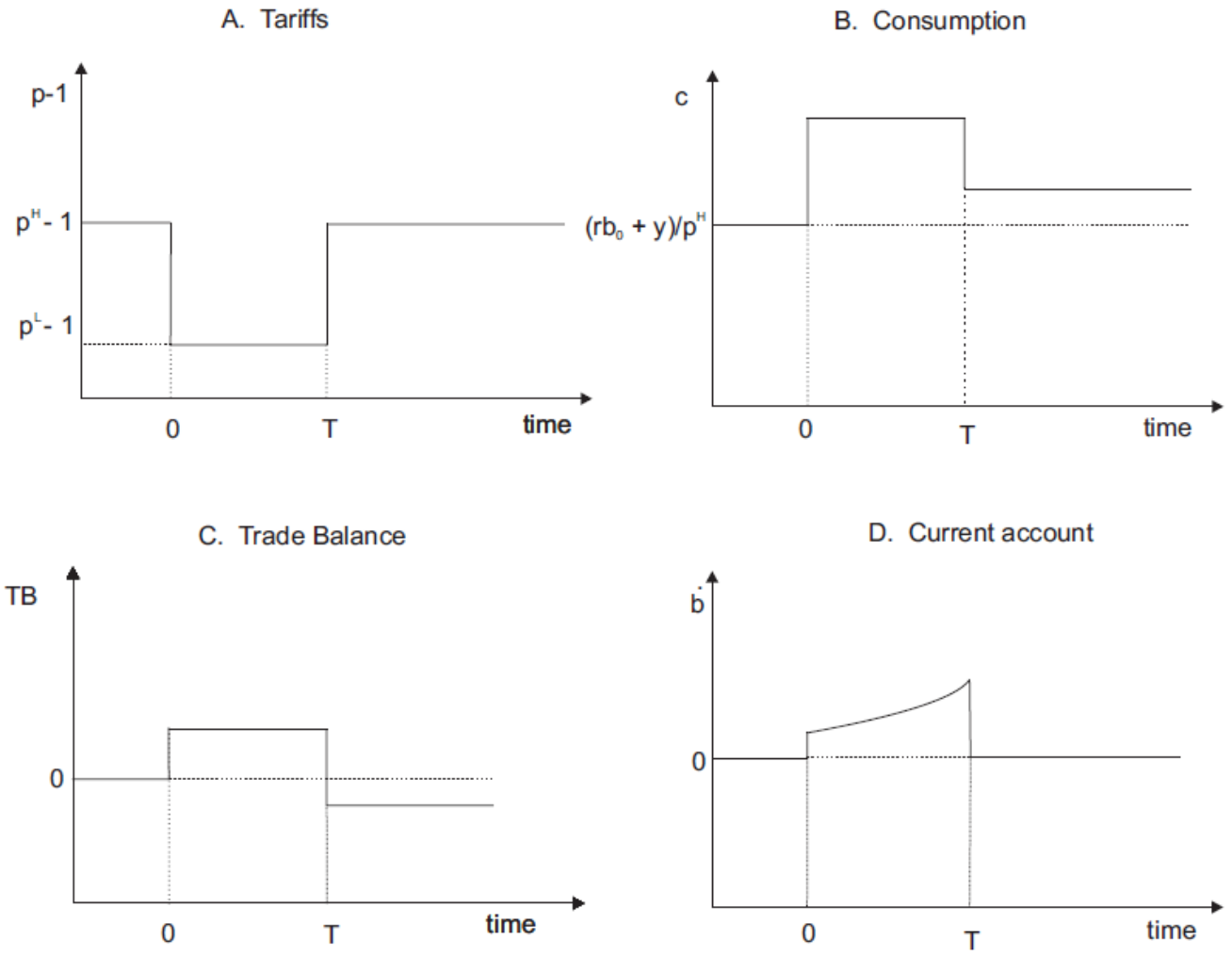
Since the NPV of $p_t c_t$ does not change $\left(b_0 + \frac{y}{r}\right)$, (32) provides all the information needed.

$$\text{If } \sigma = 1 \quad \Rightarrow \quad TB_t = -rb_0 \text{ and } CA_t = 0 \ \forall \ t.$$

$$\text{If } \sigma < 1 \quad \Rightarrow \quad TB_t \begin{cases} > 0 \\ < 0 \end{cases} \quad \text{and} \quad CA_t \begin{cases} > 0 & 0 \le t < T \\ = 0 & t \ge T \end{cases}$$

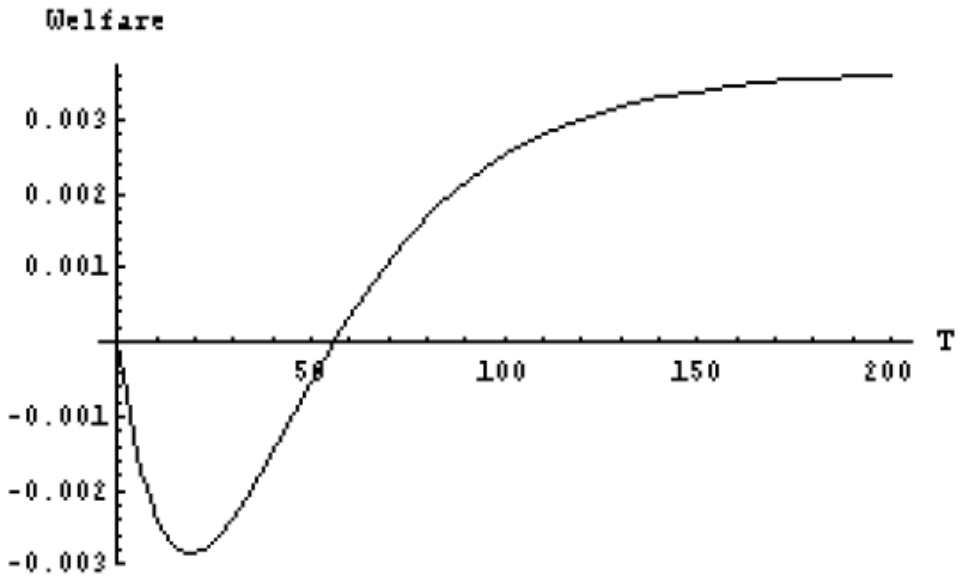
In all cases welfare unambiguously increases given the now larger consumption opportunity set $\rightarrow$ the wealth effect dominates the intertemporal distortion effect. Consumer's welfare is a strictly increasing function of the lenght of the liberalization period, T.

Temporary Fall Tariffs with Wealth Effects (cont.)



5.3 Partial Rebates

Figure 6. Welfare as a function of T
(with wealth effect and partial rebate)



- With full rebate (no wealth effects) a temporary reduction in tariffs always reduces welfare.
- With no rebate (wealth effects) the same policy always leads to higher welfare.
- With improvements in productivity and partial rebate we could get the effect depicted here Where the intertemporal distortion dominates for small T, while the wealth effect is predominant for large T.

Box 2. Do trade liberalizations lead to productivity gains?

- For trade liberalizations to be welfare improving, the wealth effect must dominate the intertemporal distortion.
- Such wealth effects might be the result of increases in productivity brought about by reducing tariffs.
  - Easier access to imported intermediate inputs and more efficient capital goods, leading to productivity gains.
  - A drop in domestic prices, prompting less productive firms to exit the market and if resources are reallocated toward more efficient plants, increasing industry-wide efficiency.
  - More efficient use of inputs, technology diffusion, increase managerial effort, improve capacity utilization, scale efficiency all leading to within-plant productivity gains.
  - Competition reduces market power of domestic producers leading to higher output.

Impact of Trade Liberalization on Productivity

Author	Country/Data	Methodology	Main results
Tybout et al. (1991)	Chile 1974-1979 Industrial census establishment-level data	Maximum likelihood estimation	-Overall, no evidence found of improvements in productive efficiency for the manufacturing sector. -Some evidence of improvements in average efficiency levels and cross-plant efficiency dispersion in industries undergoing relative large reductions in protection. -Adverse macroeconomic shocks might have masked the effects of the trade liberalization.
MacDonald (1994)	United States 1972-1987 3- and 4-digit manufacturing industry data	Instrumental variable approach, fixed effects	-Statistically weak, small and positive association between import shocks and productivity growth. -Import shocks have a large and statistically significant effect on next period productivity in highly concentrated industries.
Tybout and Westbrook (1995)	Mexico 1984-1990 Plant-level panel data	Panel data analysis	-Fall in average costs in most industries and gains in productivity (especially in tradables). Largest fall in average costs in more open sectors. -Minor gains in scale efficiency after liberalization, uncorrelated with increases in import competition. -Productivity gains through movements of individuals plants toward the production frontier, innovation and externalities.
Krishna and Mitra (1998)	India 1986-1993 Firm-level data	Panel data analysis, numerical simulations	-Evidence of increased foreign competition reflected in the drop of price-marginal cost markups in the post liberalization period. -Statistically weak evidence of increases in productivity growth.

Impact of Trade Liberalization on Productivity (cont.)

Author	Country/Data	Methodology	Main results
Hay (2001)	Brazil 1986-1994 Data of large manufacturing firms	Panel data analysis	-Trade liberalization had a negative effect on market shares of domestic producers, as well as it led to a fall in profits. -Growth in productivity, due to recovery from recession, trade liberalization and deregulation of the economy (hard to distinguish among these).
Pavcnik (2002)	Chile 1979-1986 Industrial census Establishment-level data	Panel data analysis	-Evidence of productivity improvements due to trade liberalization. -Exit of less productive plants helps reallocating market shares and resources within the economy, contributing to productivity gains. -Continuing plants in import competing sectors improve their productivity, adjusting to a more trade-open environment (within-plant productivity improvements). -Export-oriented sectors do not experience productivity gains due to trade liberalization.
Fernandes (2007)	Colombia 1977-1991 Annual Colombian manufacturing census plant-level data	Panel data analysis	-Protection had a statistically significant negative effect on TFP, after controlling for plant and industry heterogeneity, RER and cyclical effects. -Impact of tariffs is greater for larger plants and for plants in less competitive industries. -Productivity gains through increases in within-plant imports of intermediate inputs, skill intensity, machinery investments and output reallocations from less to more efficient plants

6. Distortionary Taxation

- We now understand how a temporary trade liberalization creates an intertemporal distortion affecting the household's consumption path.
- Another example of this phenomenon will be present when the government needs to resort to distortionary taxation to finance an exogenously-given level of expenditures.
  - Here we illustrate how a time-varying tax rate will impose an intertemporal distortion, thus leading to a welfare loss over and above the one resulting from the presence of wasteful government spending.

6.1 Consumers

Let c_t denote consumption of the only (non-storable) good. Consumer

$$\max \; W(c_t) = \int_0^{\infty} \ln(c_t) e^{-rt} dt \tag{33}$$

With r denoting the world interest rate on net foreign assets b_t, constant endowment y, and consumption tax θ_t, the individual's flow constraint is

$$\dot{b}_t = r b_t + y - (1+\theta_t) c_t \tag{34}$$

while the intertemporal constraint is

$$b_0 + \frac{y}{r} = \int_0^{\infty} (1+\theta_t) c_t e^{-rt} dt \tag{35}$$

Analogous to (4), the optimal consumption/saving is given by

$$\frac{1}{c_t} = \lambda (1+\theta_t) \tag{36}$$

6.2 Government and 6.3 Equilibrium Conditions

The government spends on tradable goods an exogenous amount g_t, which is financed with the consumption tax to ensure a balanced budget

$$g_t = \theta_t c_t \qquad (37)$$

Substituting (37) into the consumer's flow constraint (34), we obtain the economy's flow constraint (i.e., the current account):

$$\dot{b}_t = r b_t + y - c_t - g_t$$

By definition, the trade balance is

$$TB_t = y - c_t - g_t \qquad (38)$$

and the economy's resource constraint is

$$b_0 + \frac{y}{r} = \int_0^{\infty} (c_t + g_t) e^{-rt} dt \qquad (39)$$

6.4 Initial Stationary Equilibrium

In a stationary equilibriu m, with $g_t = \bar{g}$ constant, (37) $\rightarrow \theta_t c_t$ constant. Further, optimality condition (36) $\rightarrow c_t(1+\theta_t) \rightarrow c_t$ constant. Then from (37) $\rightarrow \theta_t$ constant. Having establishe d that all endogenous variables will be constant over time, we can derive closed - form solutions for consumptio n and the resource constraint :

$$\bar{c} = rb_0 + y - \bar{g} \qquad (40)$$

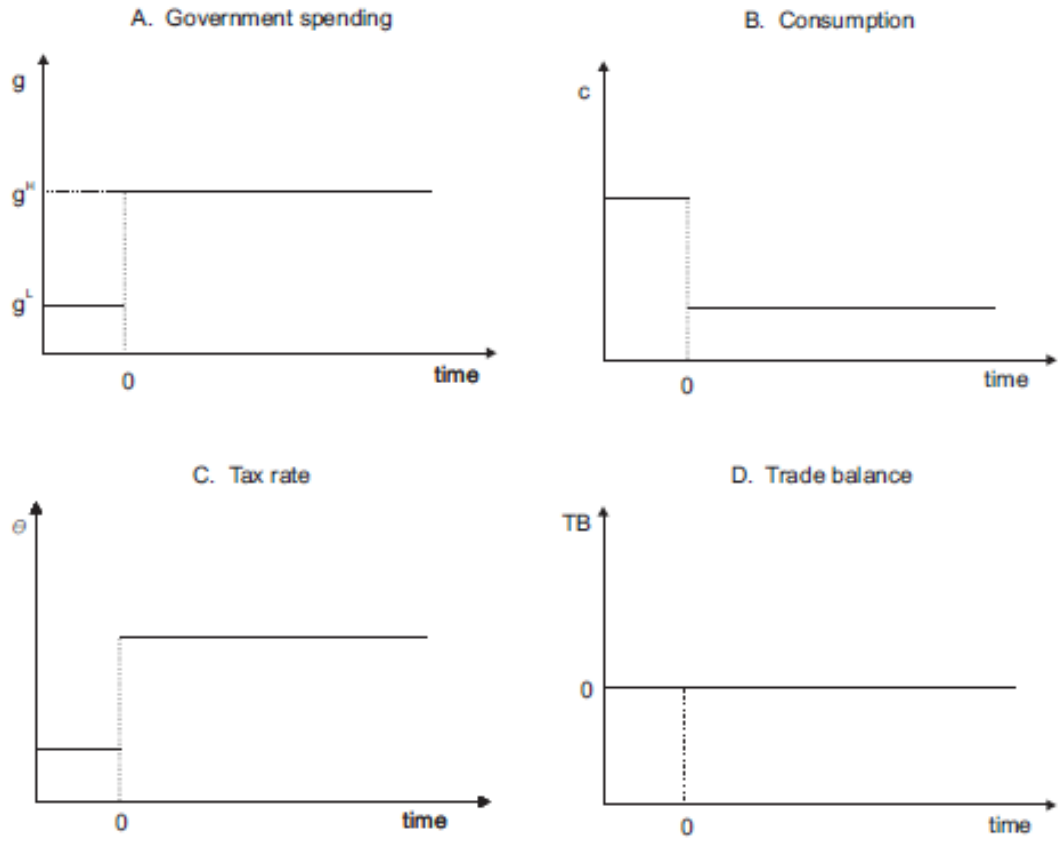
From the government's flow constraint (37), we can derive a reduced - form for the constant value of the tax rate

$$\bar{\theta} = \frac{\bar{g}}{rb_0 + y - \bar{g}} \qquad (41)$$

Substituti ng (40) into (38),

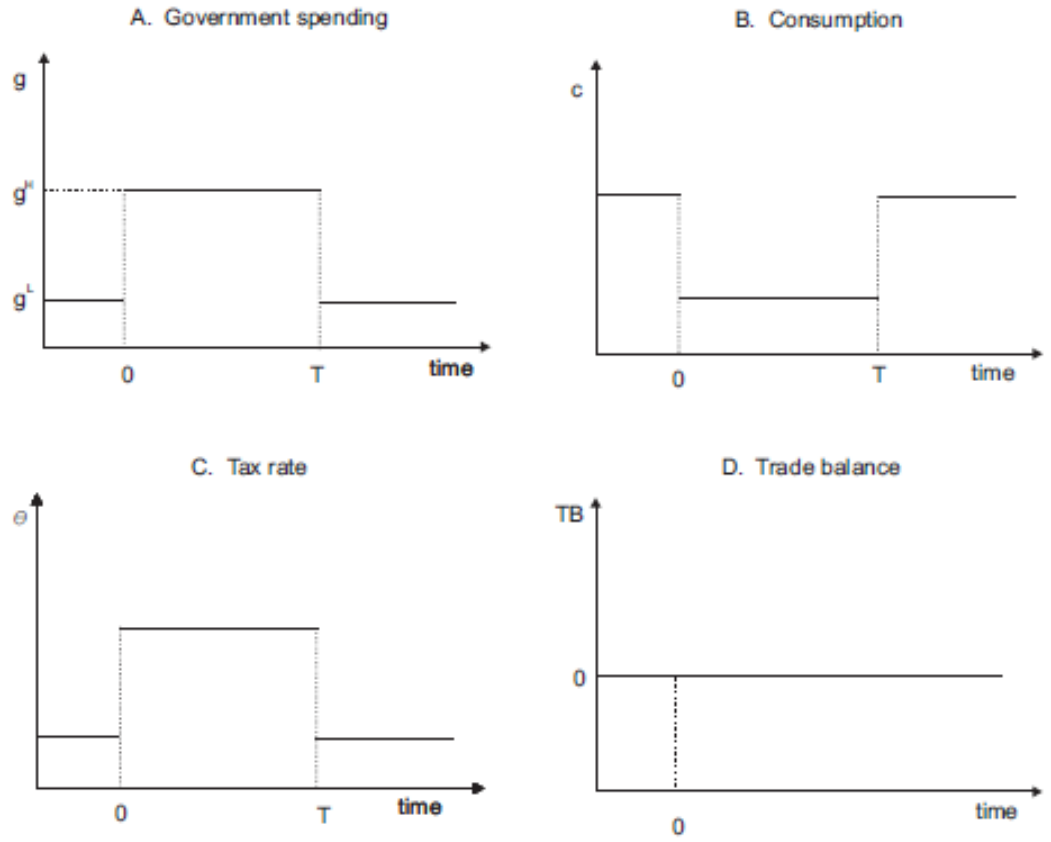
$$TB_t = -rb_0$$

6.5 Permanent increase in government spending



❖ With a permanent increase in *g* there is a permanent reduction in c (eq. 40) and a permanent increase in θ (eq. 41). Since the shock is permanent there is no effect on the trade balance. This increase in *g* has imposed a wealth effect on the economy, but no intertemporal distortion.

6.6 Temporary increase in government spending



❖ With a temporary increase in *g* there is a temporary rise in the tax rate θ. This non-constant path of the price of consumption introduces an intertemporal distortion, for which consumers find optimal to substitute consumption, a suboptimal result. In this case we have negative wealth and substitution effects.

7. Terms of Trade Shock

- Harberger (1950) and Laursen and Metzler (1950) (HLM) effect: a deterioration in a country's terms of trade would result in a fall in savings and consequently in a deterioration of the current account.
  - Rationale: a worsening in the terms of trade would result in lower "real income" because of the smaller purchasing power of exports.
  - Originally developed within a Keynesian framework with a marginal propensity to consume less than one, and where a fall in real income lowers savings and results in a current account deterioration.

Terms of Trade Shock (cont.)

Here, we will study the effects of terms of trade shocks on the CA using the model introduced in section 2 (using CES preferences $u(c)=\begin{cases}\frac{c^{1-\frac{1}{\sigma}}-1}{1-\frac{1}{\sigma}}, \sigma \neq 1 \\ \ln(c), \sigma = 1\end{cases}$ (17)) with two modifications: (i) we abstract from the government (and hence tariffs) and (ii) the international terms of trade are now given by p_t.

In this context, the consumer's flow contraint becomes:

$$\dot{b}_t = rb_t + y - p_t c_t \qquad (43)$$

while the corresponding lifetime budget constraint is given by:

$$b_0 + \frac{y}{r} = \int_0^{\infty} p_t c_t e^{-rt} dt \qquad (44)$$

Optimality condition continues to be given by: $c_t^{-\frac{1}{\sigma}} = \lambda p_t$ (21).

Terms of Trade Shock (cont.)

- Note the resemblance of this model with the one in section 5, in particular (43) and (44) are the same constraints as (19) and (20). We can therefore use the results in that section to discuss the HLM effect.
  - An unanticipated and permanent improvement in the terms of trade (fall in p) results in a higher "permanent income" for consumers because each unit of exportable good is now worth more in terms of importables.
    - Hence, consumption increases *pari passu* with permanent income increasing welfare. There are no changes in the trade balance or the current account.

Terms of Trade Shock (cont.)

- An unanticipated and temporary improvement in the terms of trade leads to
  - higher consumption on impact and welfare improving as it expands the economy's opportunity set.
    - In the more relevant practical case ($\sigma<1$) both the trade balance and the current account improve.
      - Intuitively, expenditure falls between *0* and *T* because of the low intertemporal elasticity of substitution. This is consistent with the HLM effect.
    - However, if $\sigma=1$ the trade balance will not change and for $\sigma>1$ the trade balance will actually worsen on impact.

Terms of Trade Shock (cont.)

- Note that while temporary terms of trade shocks do imply a non-constant path of the relative price of consumption (as before) and hence lead to a non-constant path of consumption, they should not be referred to as an "intertemporal distortion" since they are not policy-induced and hence the economy is still operating at first best equilibrium → a planner would react in the same way as consumer does.
- Bottom line: the HLM effect is consistent with the intertemporal approach to the current account whenever the improvement in the terms of trade is temporary and the intertemporal elasticity of substitution is low.
- The HLM effect vanishes when the improvement in terms of trade is perceived as permanent.

Empirical Studies on the HLM Effect

Author	Dataset	Testing strategy	Results
Bouakez and Kano (2008)	Quarterly data Australia 1972-2001, Canada 1962-2001, and United Kingdom (1971-2001)	Derives an approximate closed-form solution for the present-value representation of the current account that takes into account, in addition to the HLM effect, consumption-smoothing effects of future changes in the interest rate and exchange rate.	Terms of trade shocks do not significantly affect the current account. Extended model is rejected by the data, indicating that terms-of trade shocks are not important in explaining current account movements in Australia and Canada. For United Kingdom, model is not rejected but improvement is marginal.
Kent and Cashin (2003)	128 countries 1960-1999	Consumption-smoothing effect on savings and the investment effect work in opposite directions – the greater the persistence of a terms of trade shock, the more the investment effect will dominate the saving effect.	Persistence of terms of trade shocks varies across countries. The current account response is positively (negatively) related to unanticipated changes in the terms of trade for countries with predominantly temporary (permanent) terms of trade shocks.

Empirical Studies on the HLM Effect (cont.)

Author	Dataset	Testing strategy	Results
Otto (2003)	15 small OECD and 40 developing countries 1960-1999	Uses a structural vector autoregression (SVAR) model to summarize the first and second moments of the data. Empirical evidence of a HLM effect is obtained from the SVAR model by examining the estimated response function for the trade balance following a terms of trade shock.	Strong evidence in favor of the HLM effect. The immediate effect of a positive shock to the terms of trade is an improvement in the balance of trade. On average, terms of trade shocks are marginally more important in explaining fluctuations in the trade balance for developing countries than for developed countries.
Cashin and McDermott (2002)	5 OECD countries 1970-1997	By comparing two commodity-exporting countries with relative small nontradables sectors with three major industrial countries, study examines how important terms of trade shocks are in affecting current account balance.	Terms of trade shocks found to be highly persistent. However, they do not have any impact on the current account balance of countries with large nontradable sector. Only for those countries with relatively small nontradable sectors (Australia and New Zealand), is there evidence in support of the HLM effect.

❖ Empirical evidence of HLM effect is somewhat mixed, but it is consistent with the idea that HLM is more likely to be present in economies with small non-tradable sectors (this model with non-tradable goods can be thought of as an extreme case) and face predominantly temporary shocks

Terms of Trade Shock (cont.)

- Key assumption: assets are denominated in terms of exportables.
  - If assets were denominated in terms of importables, then a temporary improvement in the terms of trade would always lead to a current account surplus.
    - Intuition: if you save in terms of importables, the relevant relative price for consumption decisions is this one.
  - In this context, terms of trade shocks act exactly like the endowment shock in the basic model of chapter 1.
    - Hence, an unanticipated and temporary fall in p_t (i.e., a temporary improvement in the terms of trade) leads to a current account surplus for consumption-smoothing purposes.

8. Final Remarks

- This chapter has analyzed the implications of intertemporal fluctuations in relative prices on consumption and the current account.
- Fluctuations in relative prices may be due to market forces (e.g. terms of trade) or policy measures (e.g. temporary tariffs or tax rates).
  - In the latter case, we refer to them as intertemporal distortions because they induce consumers to choose a non-socially optimal path of consumption.
- Conceptually, this chapter has introduces two key effects in intertemporal models: intertemporal substitution effects and wealth effects.