Inflation in Hong Kong, SAR: In search of a transmission mechanism

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and

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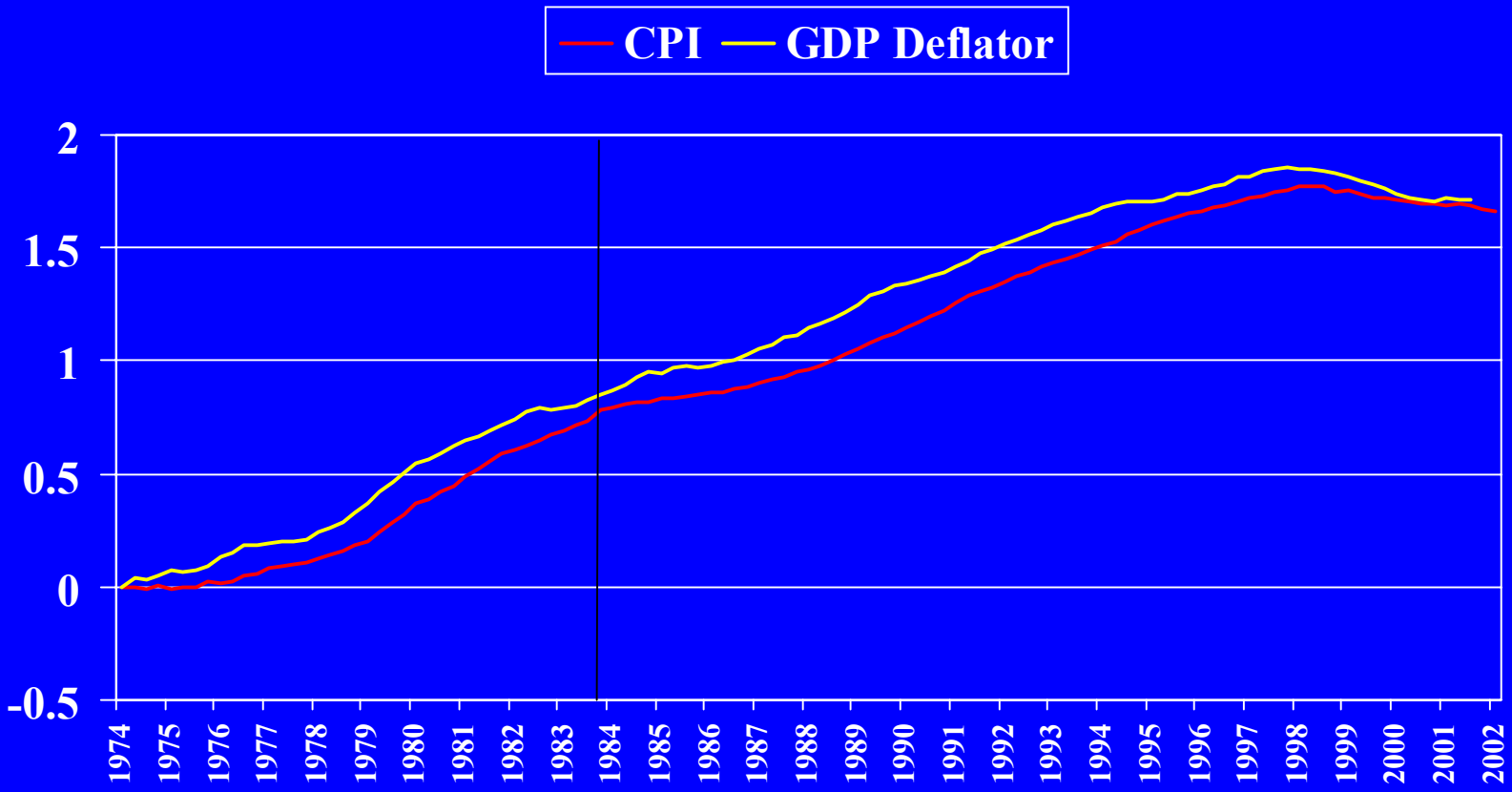
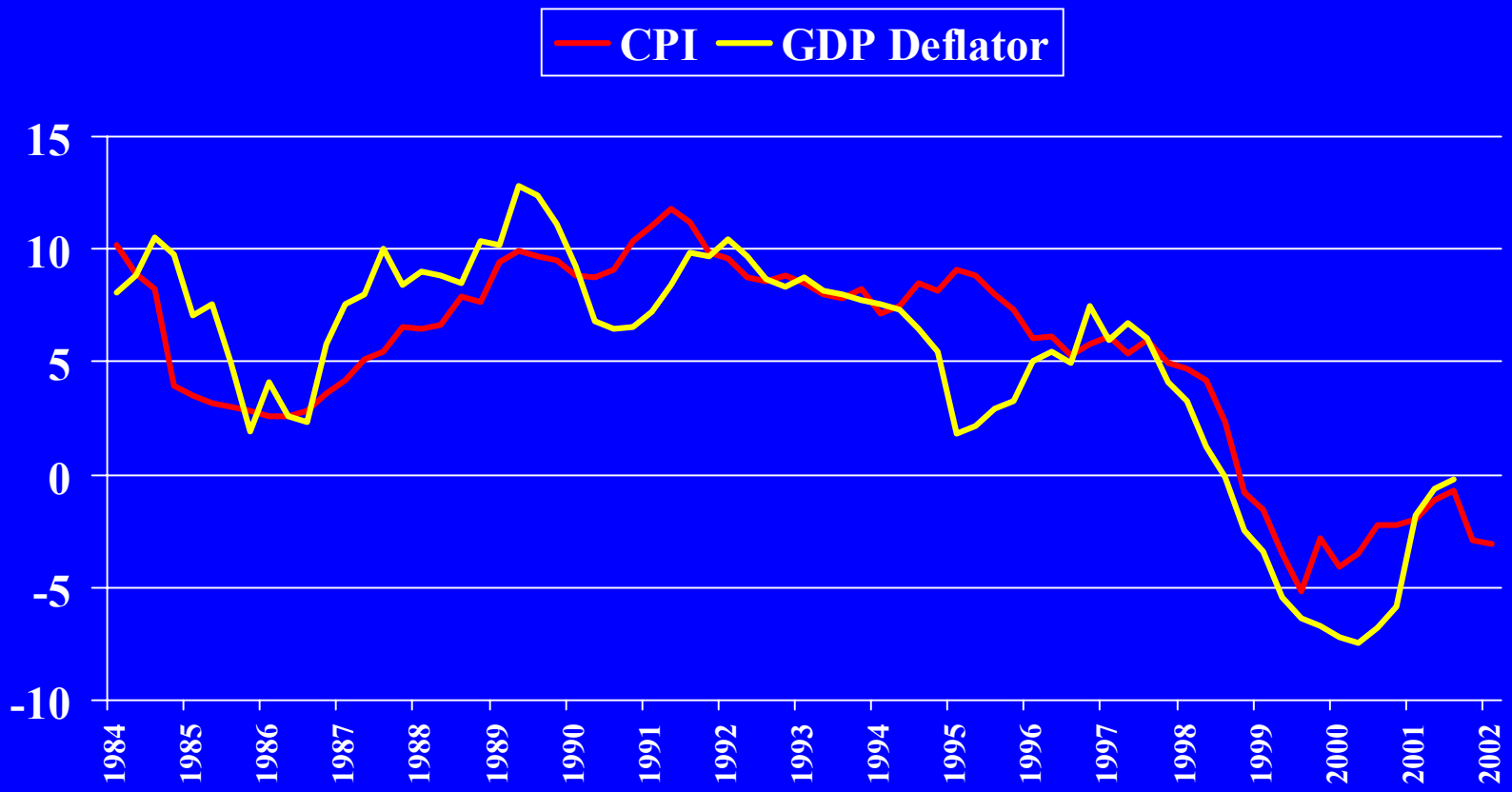
Agenda

- What we are trying to explain
- The theoretical framework
- Some evidence from non-structural equations
- A Phillips curve for Kong Kong, marginal cost vs. the output gap

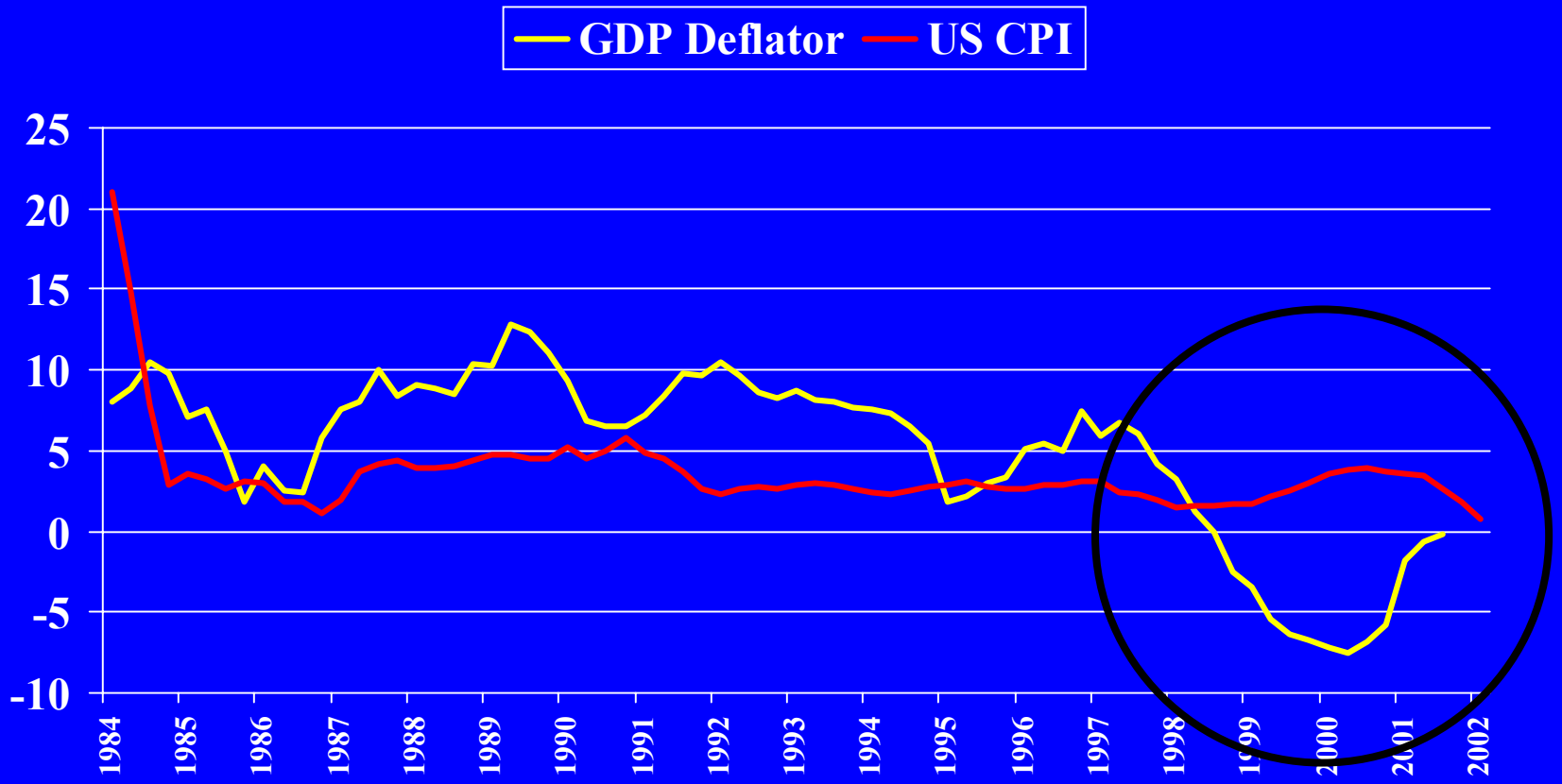
What we are trying to explain



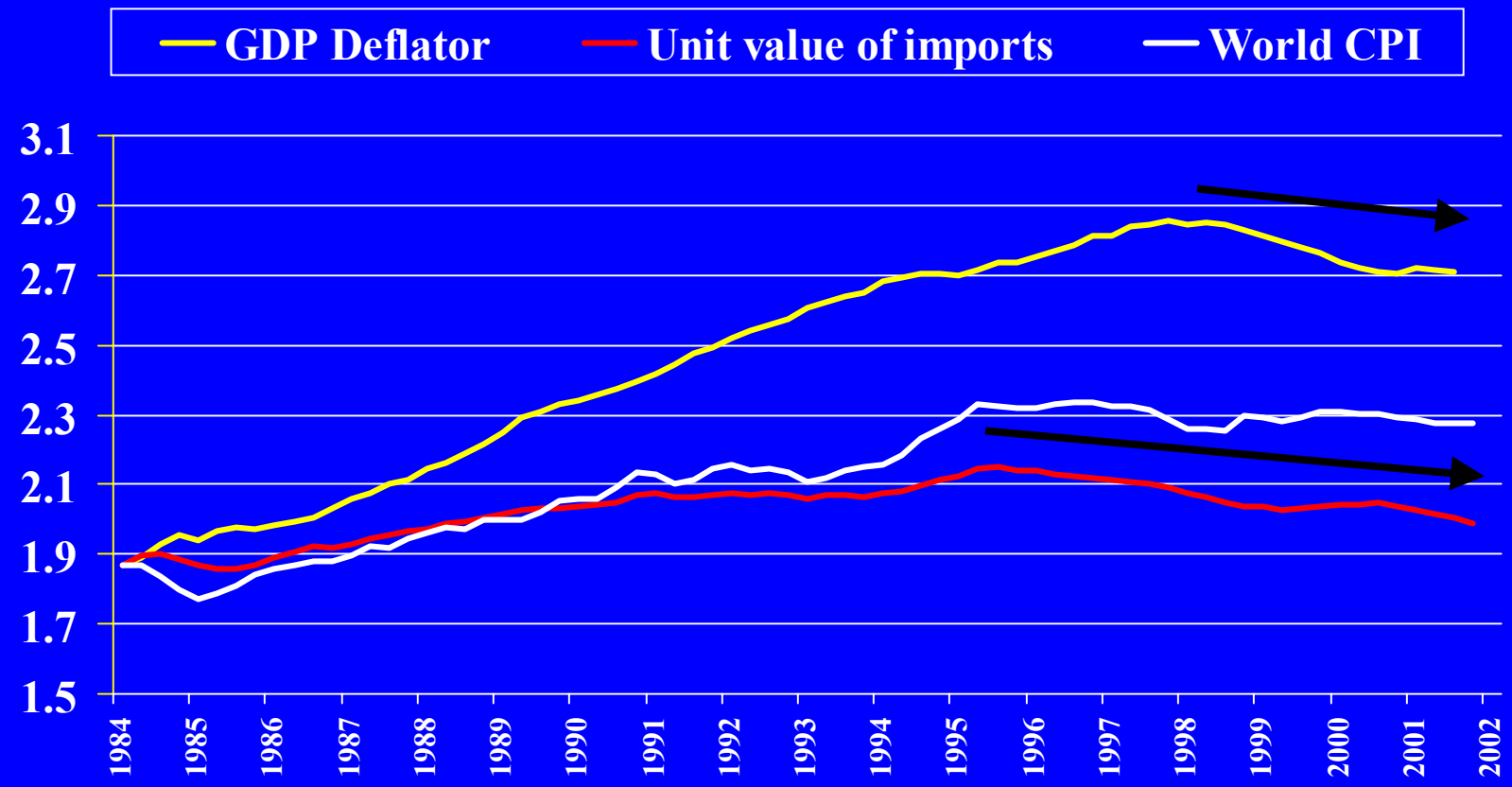
What we are trying to explain



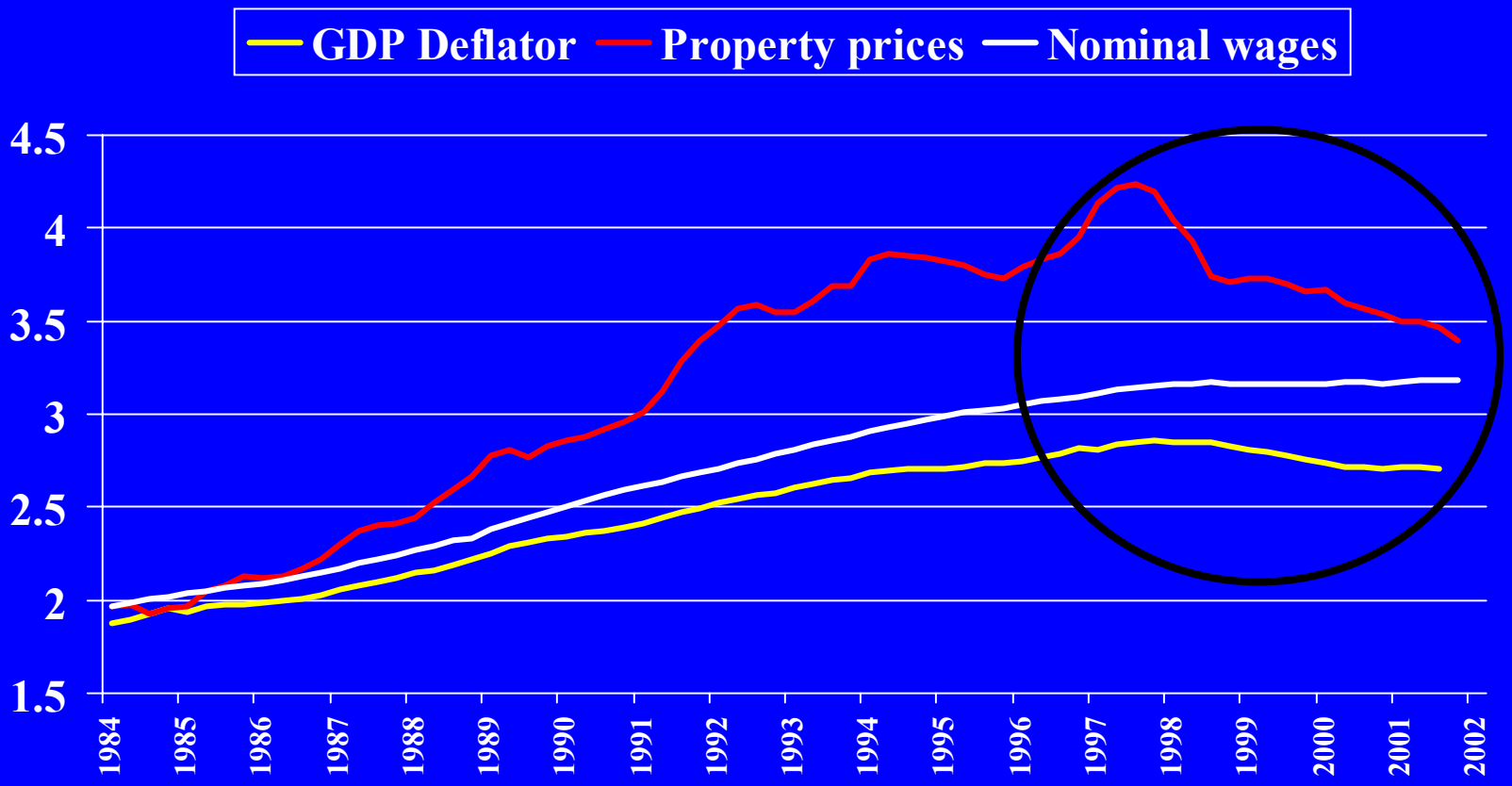
How are we going to explain it?



How are we going to explain it?



Other possible candidates



A bit of theory

The traditional Phillips curve

- $\pi_t = c_1 + c_2\, u_t + c_3\, E_{t-1}\, \pi_t$
- $\pi_t = c_1 + c_2\, u_t + c_3\, \Sigma \lambda_i \pi_{t-i}$

The "New" Phillips Curve

- $\pi_t = c_1 + c_2\, s_t + c_3\, E_t\, \pi_{t+1}$
  - s_t = output gap (Taylor, Fuhrer-Moore)
  - s_t = marginal cost (Gali-Gertler)

Gali-Gertler (1)

- Monopolistic firms setting price as a mark-up over marginal cost (New Keynesian)
- Only a fraction of firms adjust prices each time period. The probability that a firm adjusts the price = $1-\theta$ (Calvo)
- If labor is the only variable factor of production and then prices will be adjusted in response to the difference between the real wage and the marginal product of labor (Gali-Gertler)

Gali-Gertler (2)

- Assume that the marginal product of labor = average product
- Then prices will adjust in response to the labor share (and of course expectations of prices in the future)

Gali-Gertler (3)

- The 'hybrid' Phillips curve. Only a fraction 1-ω of firms reflect forward-looking behavior. The remainder is backward looking. Then,
- $\pi_t = c_1 + c_2\, rmc_t + c_3\, E_t\, \pi_{t+1} + (1- c_3)\pi_{t-1}$
  - Under certain assumptions
  - $c_2 = (1-\omega)(1-\theta)^2/(\omega+\theta)$
  - $c_3 = \theta/(\omega+\theta)$.

A wider view of marginal cost

- Devereux-Yetman
  - Imports are intermediate inputs in the production of goods for the local market
    - Prices will adjust in response to the real price of imports relative to their marginal product
- What about rent for factory-office-retail space?
- Potentially important components of marginal cost {wages, import prices, rental rates of real estate}

A further look at the data

- Unit roots
- Cointegration
- ‘Causality’

Unit root properties of the data

Variable[(2)]	1984:1 – 1997:1	1984:1 – 2001:4
CPI^{HK}	I(2)	I(2)
$PGDP^{HK}$	I(2)	I(2)[(3)]
CPI^{US}	I(2)	I(2)
CPI^{CN}	I(2)	I(2)
CPI^{JA}	I(2)	I(1)
CPI^{W}	I(1)[(4)]	I(1)
W^{HK}	I(2)	I(2)
PIM^{HK}	I(1)	I(1)
$PPROP^{HK}$	I(1)	I(1)

Bivariate relationships: cointegration

Pair of variables	**1984:1 – 1997:1**	**1984:1 – 2001:4**
$D(CPI^{HK})$ **$D(CPI^{US})$**	Trace: None (1%), Two (5%) Max-E: None With Trend: One	None
$D(PGDP^{HK})$ **$D(CPI^{US})$**	None (1%) Two (5%) With trend: None	None
CPI^{HK} **CPI^{US}**	Two (5%) With trend: One	None
$PGDP^{HK}$ **CPI^{US}**	None	None
CPI^{HK} **CPI^{W}**	None With trend: One	One With trend: Trace: None Max-E: One
$PGDP^{HK}$ **CPI^{W}**	None With trend: One	One (5%) With trend: None

Bivariate relationships: ‘causality’

Pair of variables	**1984:1 – 1997:1**		**1984:1 – 2001:4**	
	Granger causality	VAR (VEC) relationships	Granger causality	VAR (VEC) relationships
$D(CPI^{HK})$ $D(CPI^{US})$	None	VAR: No significant interaction VEC: US influences HK	None	No significant interaction
$D(PGDP^{HK})$ $D(CPI^{US})$	None	No significant interaction	None	No significant interaction
CPI^{HK} CPI^{US}	US ? HK	US influences HK in both VAR and VEC	None	Weak effect of US on HK
$PGDP^{HK}$ CPI^{US}	US ? HK (10%)	US influences HK in VAR	None	No significant interaction
CPI^{HK} CPI^{W}	HK ? World World ? HK (10%)	Some influence of World on HK in both VAR and VEC	World ? HK HK ? World (6%)	Evidence of mutual dependence
$PGDP^{HK}$ CPI^{W}	HK ? World	No significant interaction	HK ? World	Some influence of HK on World in both VAR and VEC

Bivariate relationships: 1984: - 2001:4

Pair of variables	Cointegration	Granger Causality	VAR or VEC relationships
$PGDP^{HK}$ PIM^{HK}	Two (5%) One (1%) With trend: Trace: One (5%) Max-E: None	PIM^{HK} ? $PGDP^{HK}$	Import prices influence GDP deflator in VAR and VEC
$PGDP^{HK}$ W^{HK}	None	W^{HK} ? $PGDP^{HK}$	Wages influence GDP deflator in VAR
CPI^{HK} PIM^{HK}	Two With trend: One	PIM^{HK} ? CPI^{HK} CPI^{HK} ? PIM^{HK}	Import prices influence CPI in VAR and VEC
CPI^{HK} W^{HK}	None With trend: Trace: One Max-E: None	W^{HK} ? CPI^{HK} CPI^{HK} ? W^{HK} (6%)	Wages influence CPI in VAR and VEC
W^{HK} PIM^{HK}	None	W^{HK} ? PIM^{HK} PIM^{HK} ? W^{HK}	Import prices influence wages in VAR
$PGDP^{HK}$ $PPROP^{HK}$	Trace: One Max-E: None With trend: Trace: None Max-E: One	$PGDP^{HK}$? $PPROP^{HK}$	GDP deflator influences property prices in VAR and VEC
CPI^{HK} $PPROP^{HK}$	None	$PPROP^{HK}$? CPI^{HK} CPI^{HK} ? $PPROP^{HK}$ (8%)	Mutual dependence
W^{HK} $PPROP^{HK}$	None	W^{HK} ? $PPROP^{HK}$	Property prices influence wages in VAR
PIM^{HK} $PPROP^{HK}$	Two (5%) One (1%) With trend: None	PIM^{HK} ? $PPROP^{HK}$	Some influence of import prices on property prices in VAR, somewhat stronger in VEC

‘Bottom line’

- “the direct link between HK inflation and foreign CPI inflation, even if it is measured by an average of trading partners’ inflation rates, does not capture adequately the transmission mechanism”
- “development of import prices and wages do seem to have a significant causal role”

Implication of the rmc-version of the New Phillips curve

- $\pi_t = c_1 + c_2\, rmc_t + c_3\, E_t\, \pi_{t+1} + (1 - c_3)\pi_{t-1}$
- If inflation, and therefore expected inflation are stationary then rmc must be stationary. In this case:
- Components of nominal marginal cost and the general price level must be cointegrated.

Table 3a. Tests of cointegration between GDP deflator and marginal cost variables.

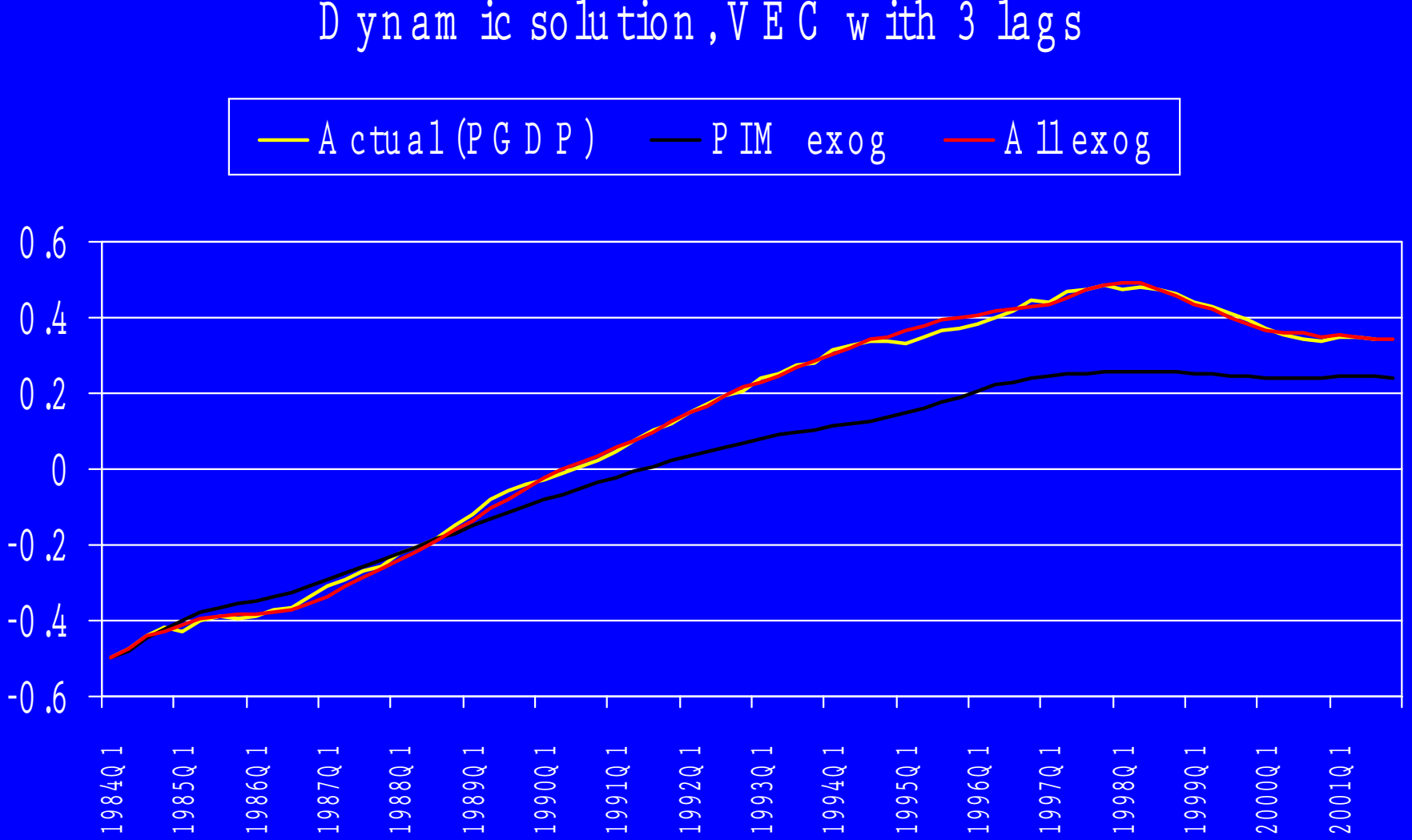
# of lags of 1st differences	Cointegration test results	Cointegration vector		Adjustment coefficient	
1	Trace: One at 5% and 1% Max-e: One at 5% and 1%	β_1	.53 (.03)	$\Delta\ln(P^{GDP})$	-.24 (.05)
		β_2	.24 (.05)	$\Delta\ln(P^{IM})$	.04 (.04)
		β_3	.23 (.02)	$\Delta\ln(w)$	-.06 (.03)
		$\Sigma\beta_i = 1$: p-value = .14		$\Delta\ln(P^{PROP})$	.35 (.27)
3	Trace: One at 5% Max-e: One at 5%	β_1	.45 (.03)	$\Delta\ln(P^{GDP})$	-.29 (.09)
		β_2	.38 (.05)	$\Delta\ln(P^{IM})$	.20 (.07)
		β_3	.18 (.02)	$\Delta\ln(w)$	.03 (.05)
		$\Sigma\beta_i = 1$: p-value = .46		$\Delta\ln(P^{PROP})$	.71 (.45)
5	Trace: One at 5% and 1% Max-e: One at 5% and 1%	β_1	.50 (.10)	$\Delta\ln(P^{GDP})$	-.49 (.10)
		β_2	.31 (.05)	$\Delta\ln(P^{IM})$	-.04 (.09)
		β_3	.19 (.02)	$\Delta\ln(w)$	-.01 (.06)
		$\Sigma\beta_i = 1$: p-value = .51		$\Delta\ln(P^{PROP})$	-.47 (.54)

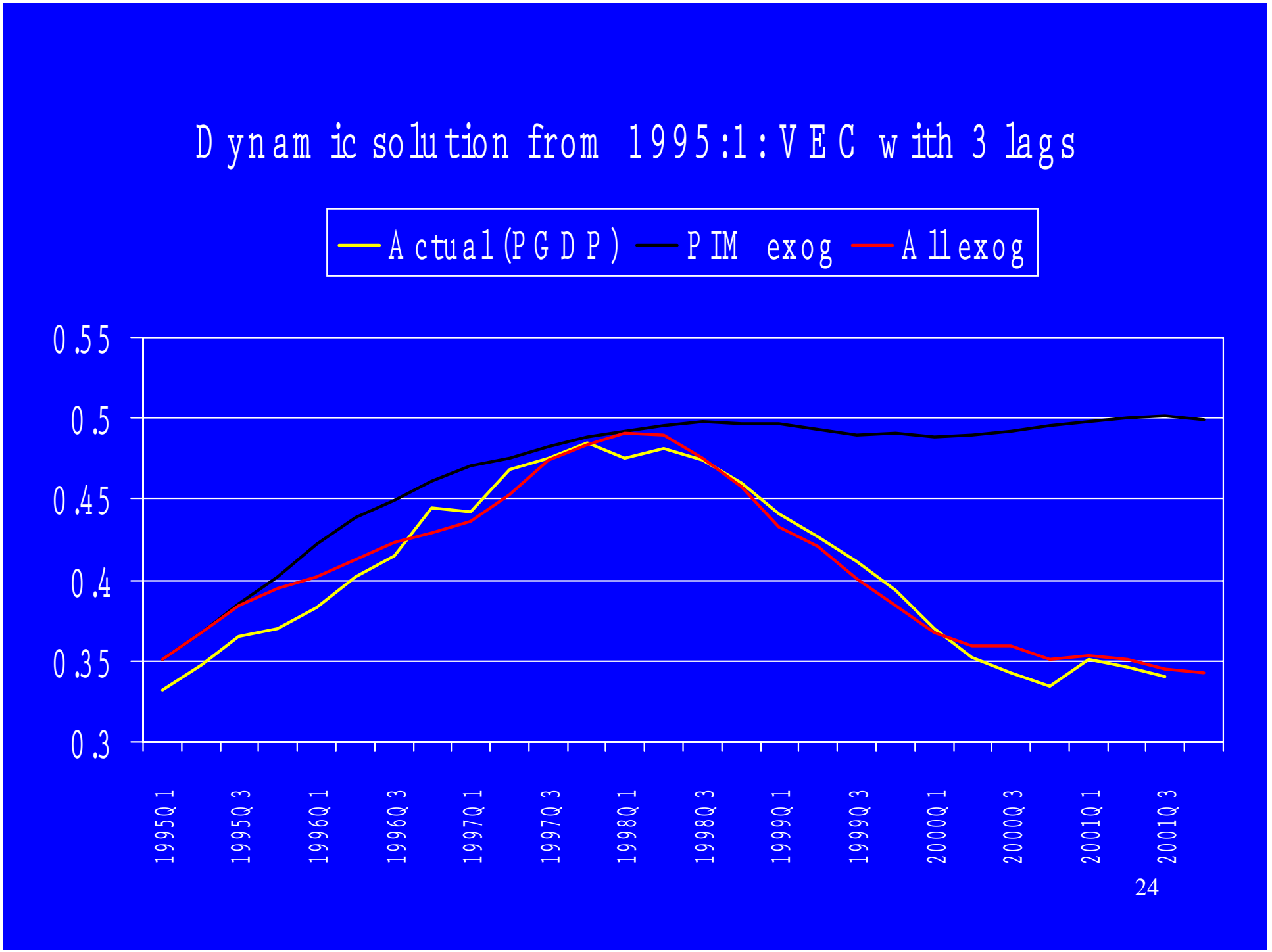
Notes: The cointegration equation is $\ln(P^{GDP}) = \beta_1 \cdot \ln(P^{IM}) + \beta_2 \cdot \ln(w) + \beta_3 \cdot \ln(P^{PROP})$

Table 3b. Tests of cointegration between CPI and marginal cost variables.

# of lags of 1st differences	Cointegration test results	Cointegration vector		Adjustment coefficients	
1	Trace: Three at 5% and one 1% Max-e: One at 5% and 1%	β_1	.44 (.02)	$\Delta\ln(CPI)$	-.14 (.03)
		β_2	.37 (.04)	$\Delta\ln(P^{IM})$	-.04 (.04)
		β_3	.19 (.02)	$\Delta\ln(w)$	-.11 (.02)
		$\Sigma\beta_i = 1$: p-value = .17		$\Delta\ln(P^{PROP})$	.26 (.23)
3	Trace: Two at 5% and one at 1% Max-e: One at 5%	β_1	.41 (.02)	$\Delta\ln(CPI)$	-.16 (.04)
		β_2	.42 (.04)	$\Delta\ln(P^{IM})$	-.10 (.06)
		β_3	.17 (.02)	$\Delta\ln(w)$	-.13 (.03)
		$\Sigma\beta i = 1$: p-value = .97		$\Delta\ln(P^{PROP})$	.05 (.42)
5	Trace: Two at 5% and two at 1% Max-e: Two at 5% and one at 1%	β_1	.46 (.03)	$\Delta\ln(CPI)$	-.19 (.05)
		β_2	.32 (.05)	$\Delta\ln(P^{IM})$	-.09 (.07)
		β_3	.23 (.03)	$\Delta\ln(w)$	-.11 (.04)
		$\Sigma\beta_i = 1$: p-value = .42		$\Delta\ln(P^{PROP})$	-.22 (.48)

Notes: The cointegration equation is $\ln(CPI) = \beta_1 \cdot \ln(P^{IM}) + \beta_2 \cdot \ln(w) + \beta_3 \cdot \ln(P^{PROP})$


Dynamic solution, VEC with 3 lags
Actual (PGDP)
PIM exog
All exog
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1984Q1
1985Q1
1986Q1
1987Q1
1988Q1
1989Q1
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1


Dynamic solution from 1995:1: VEC with 3 lags
Actual(PGDP)
PIM exog
All exog
0.55
0.5
0.45
0.4
0.35
0.3
1995Q1
1995Q3
1996Q1
1996Q3
1997Q1
1997Q3
1998Q1
1998Q3
1999Q1
1999Q3
2000Q1
2000Q3
2001Q1
2001Q3

$$\pi_t = c_1 + c_2\, rmc_t + c_3\, E_t\, \pi_{t+1} + (1 - c_3)\pi_{t-1}$$

Table 4a. GMM estimates of equation (4). Dependent variable $\Delta\ln(P^{GDP})$.

Equation #	c_2	c_3	Lag length of instruments
1	.079 (.044)	.45 (.12)	1
2	.157 (.063)	.52 (.10)	2
3	.092 (.035)	.44 (.05)	3
4	.099 (.033)	.67 (.04)	4

Notes: The estimated equation is $\Delta_1\ln(P^{GDP}) = c_1 + c_2(\ .45\ln(P^{IM}) + .38\ln(w) + .17\ln(P^{PROP}) - \ln(P^{GDP})) + c_3\ \Delta_4\ln(P^{GDP})_{t=4} + (1-c_3)\ \Delta_1\ln(P^{GDP})_{t-1}$.
Instruments are lagged values of $\ln(P^{IM})$, $\ln(w)$, $\ln(P^{PROP})$, $\ln(P^{GDP})$, $\ln(CPI^{world})$.

If the model is right, then

- $c_2 = (1-\omega)(1-\theta)^2/(\omega+\theta)$
- $c_3 = \theta/(\omega+\theta)$.
- Taking the values $c_2 = .099$ and $c_3 = .67$ (obtained with 4 lags of the instruments) as an illustration, the implied values for ω and θ are 0.32 and 0.63 respectively. In other words, if the model is correct, the estimates indicate that 68% of firms are forward looking in the context of their price setting, and the probability of price adjustment in any period is 0.37, which implies that prices would remain fixed for 2.7 quarters on average.

The output gap vs. the price gap

$$\pi_t = c_1 + c_2\, s_{t-1} + c_3\, \Sigma\lambda_i \pi_{t-i}$$

- s = output gap (y-HPfiltered y)

  or

- s = price gap (α_1 lnW+ α_2 lnP^{im} + α lnP^{prop} -lnP)

Table 6. OLS estimates of equation (6).

	Dependent variable: $\Delta_1 \ln(P^{GDP})$			Dependent variable: $\Delta_1 \ln(P^{CPI})$		
	s-variable			s-variable		
	pricegap	ygap	both	pricegap	ygap	both
c_{2p}	0.29 (.05)		0.27 (.06)	.14 (.02)		0.14 (.02)
c_{2y}		0.14 (.05)	0.03 (.05)		0.05 (.03)	0.03 (.02)
c_{31}	0.07 (.11)	0.15 (.12)	0.07 (.11)	-0.04 (.10)	0.24 (.12)	-0.06 (.10)
c_{32}	0.27 (.10)	0.37 (.11)	0.27 (.10)	0.04 (.10)	0.27 (.12)	0.04 (.10)
c_{33}	0.15 (.10)	0.19 (.12)	0.15 (.11)	0.30 (.10)	0.46 (.12)	0.34 (.10)
R^2	.61	.50	.61	.86	.77	.86

Some tentative conclusions

- Direct pass through from foreign general price levels is not an adequate description of transmission mechanism
- "New" Phillips curve based on mark-up pricing gives plausible description of the data
  - Prices are relatively flexible in HK
- But a full description of the inflation process requires modelling of the price-wage-property price nexus