

**AN INDUSTRY ANALYSIS OF INFLATION AND THE
MARKUP IN THE UNITED STATES^{*}**

GRAPHS AND TABLES

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ABSTRACT

United States industry data is examined so as to explain the source of the long-run inflation-markup relationship routinely found in aggregate data. It is shown that the long-run relationship is not present in the data of all industries and that there is wide variation in the statistical processes of inflation and the markup across industries. These findings lead us to a better understanding of the dynamics of inflation and how to model inflation.

Keywords: Inflation, markup, profits, firms, cointegration, panel estimation

JEL Classification:

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Table 1: Unit Root Tests

ADF Unit Root Tests of Individual Industry and Aggregate Series							
	Markup		Inflation		BC		Int
	C & T	C	C & T	C	C & T	C	
1. <i>Agriculture, forestry, fishing and hunting</i>	- 3.23			- 6.69		- 6.71	1,0,0
2. <i>Mining</i>	- 2.32			- 4.81		- 4.77	1,0,0
3. <i>Utilities</i>	- 2.68			- 3.59		- 3.62	1,0,0
4. <i>Construction</i>	- 3.96			- 3.23		- 4.15	0,0,0
5. <i>Manufacturing</i>	- 2.14			- 3.36		- 4.79	1,0,0
6. <i>Wholesale trade</i>	- 2.40			- 4.57		- 4.14	1,0,0
7. <i>Retail trade</i>		- 3.05		- 3.61		- 4.32	0,0,0
8. <i>Transportation and warehousing</i>		- 2.59		- 4.11		- 4.41	1,0,0
9. <i>Professional and business services</i>		- 2.40		- 2.03		- 3.66	1,1,0
10. <i>Educational services, health care, and social assistance</i>		- 3.87		- 2.20		- 3.67	0,1,0
11. <i>Arts, entertainment, recreation, accommodation, and food services</i>		- 3.30		- 2.51		- 4.56	1,1,0
12. <i>Finance, insurance, real estate, and leasing</i>	- 2.94			- 1.46		- 3.98	1,1,0
Total Private Industries		- 3.25		- 2.03		- 6.30	1 [#] ,1,0
Panel Unit Root Tests							
	Markup		Inflation		BC		I
	LL	IPS	LL	IPS	LL	IPS	
Constant only	0.64	- 1.43	0.39	0.64	-16.10	-22.44	1,1,0
Constant and trend	- 1.09	- 2.67	- 0.56	0.23	- 13.3	-22.30	?,1,0

Notes: Right hand column, **Int**, reports the order of integration implied by the tests at the five per cent level as i,j,k representing the markup,inflation,BC respectively where 1 and 0 indicate integrated of order 1 and 0 respectively. **Individual unit root tests**: Data comprises 51 observations for the period 1955 to 2007. Testing methodology is to choose the optimal lag length using BIC starting with a maximum of thirteen lags and then test for significance of trend. If the trend is significant then report ADF test. If the trend is insignificant then choose optimal lag length using BIC with only a constant in the model. One, five and ten per cent ADF critical values assuming a constant, trend: - 4.04, - 3.45 and - 3.15 respectively. One, five and ten per cent ADF critical values assuming a constant and no trend: - 3.51, - 2.89 and - 2.58 respectively. # indicates at the one per cent level. **Panel Unit Root Tests**: Levin-Lin (LL) and Im, Pessaran and Shin (IPS) ADF test statistics are distributed N(0,1) under the null hypothesis that the data contains a unit root.

Table 2: Panel Cointegration Tests

<i>Test</i>	<i>Statistic</i>
<i>Panel pp- statistic</i>	2.6504
<i>Panel adf- statistic</i>	2.8453
<i>Group pp- statistic</i>	2.5098
<i>Group adf- statistic</i>	2.5729

Notes: Pedroni (1999, 2004) test statistics computed using 60 periods of data for all 12 industries and distributed $N(0,1)$ under the null of no cointegration. Test of no cointegration of the panel model that includes inflation, markup and the business cycle.

Table 3: Panel Industry Estimates of the United States long-run relationship between Inflation and the Markup, 1955 - 2007

INDUSTRY	DOLS			FMOLS	
	W	LR	Business Cycle	LR	Business Cycle
<i>1. Agriculture, forestry, fishing and hunting</i>	0.012	2.2339 (0.96)	3.5077 (0.23)	0.2777 (0.34)	- 0.5433 (- 0.36)
<i>2. Mining</i>	0.015	0.8499 (2.12)	- 4.2320 (- 1.03)	0.7952 (2.62)	- 0.7968 (- 0.63)
<i>3. Utilities</i>	0.024	- 0.3196 (- 0.47)	1.1526 (0.31)	- 0.1162 (- 0.22)	- 0.0056 (- 0.00)
<i>4. Construction</i>	0.055	- 0.1470 (- 0.63)	0.1907 (0.25)	- 0.1610 (- 0.69)	0.0400 (0.16)
<i>5. Manufacturing</i>	0.180	- 1.3121 (- 4.94)	0.8965 (1.55)	- 1.1381 (- 3.50)	0.1402 (0.52)
<i>6. Wholesale trade</i>	0.075	0.8827 (1.27)	- 2.9964 (- 1.01)	0.5281 (1.20)	- 0.6951 (- 1.03)
<i>7. Retail trade</i>	0.084	- 0.2482 (- 0.66)	- 0.6385 (- 0.42)	- 0.3477 (- 1.04)	0.0527 (0.11)
<i>8. Transportation and warehousing</i>	0.038	- 1.3390 (- 1.29)	2.1480 (0.62)	- 0.6541 (- 0.75)	0.2754 (0.32)
<i>9. Professional and business services</i>	0.144	- 1.4167 (- 1.77)	0.1641 (0.07)	- 1.2829 (- 1.86)	0.2459 (0.33)
<i>10. Educational services, health care, and social assistance</i>	0.086	- 4.3147 (- 1.74)	6.7176 (0.48)	- 2.9413 (- 1.55)	1.6618 (0.30)
<i>11. Arts, entertainment, recreation, accommodation, and food services</i>	0.044	0.3382 (1.46)	- 1.1331 (- 1.15)	0.3240 (1.65)	- 0.2478 (- 0.86)
<i>12. Finance, insurance, real estate, and leasing</i>	0.244	- 0.8171 (- 0.3860)	- 4.8338 (- 0.26)	- 0.2877 (- 0.15)	- 0.7188 (- 0.15)
Panel Group Mean Estimate		- 0.4697 (- 1.75)	0.0786 (- 0.10)	- 0.4170 (- 1.13)	- 0.0493 (- 0.38)
Panel Group Weighted mean Estimate		- 0.9757 (- 3.57)	- 0.6463 (0.37)	- 0.7075 (- 2.73)	- 0.0371 (0.08)

Notes: The estimated models are of the markup regressed on inflation and the business cycle. Data are annual for the period 1955 to 2007. A trend is included if significant and indicated (t). Shown in () are t-statistics.

Table 4: Individual Industry DOLS Estimates of the United States long-run Inflation-Markup relationship 1955 - 2007

INDUSTRY	W	Int	Dp	Trend	BC
1. <i>Agriculture, forestry, fishing and hunting</i>	0.012	1,0,0	1.9028 (2.37)	- 0.0170 (- 6.40)	2.2370 (2.63)
2. <i>Mining</i>	0.015	1,0,0	0.7298 (1.55)	0.0074 (2.18)	- 3.2639 (- 0.75)
3. <i>Utilities</i>	0.024	1,0,0	- 0.5051 (- 2.37)	0.0043 (6.00)	1.1199 (1.43)
4. <i>Construction</i>	0.055	0,0,0	- 0.2733 (- 1.89)	0.0022 (6.46)	0.3343 (1.42)
5. <i>Manufacturing</i>	0.180	1,0,0	- 1.1580 ^(nt) (- 5.86)		0.3441 (0.95)
6. <i>Wholesale trade</i>	0.075	1,0,0	0.2362 (1.27)	- 0.0036 (- 4.95)	- 1.0174 (- 0.91)
7. <i>Retail trade</i>	0.084	0,0,0	- 0.4823 (- 2.71)	- 0.0014 (- 3.88)	- 0.1517 (- 0.40)
8. <i>Transportation and warehousing</i>	0.038	1,0,0	- 1.2957 (- 5.50)	- 0.0028 (- 3.28)	0.7448 (1.38)
9. <i>Professional and business services</i>	0.144	1,1,0	- 1.3261 (- 2.71)	- 0.0020 (- 2.72)	0.1670 (0.17)
10. <i>Educational services, health care, and social assistance</i>	0.086	0,1,0	- 2.6402 (- 5.02)	- 0.0086 (- 10.45)	1.9424 (0.92)
11. <i>Arts, entertainment, recreation, accommodation, and food services</i>	0.044	1,1,0	0.30903 (1.69)		0.0395 (0.08)
12. <i>Finance, insurance, real estate, and leasing</i>	0.244	1,1,0	0.0751 (0.34)	- 0.0090 (- 25.73)	- 1.6648 (- 1.36)
Panel Group Mean Estimate			- 0.3690 (- 5.44) [-1.57]		0.0693 (1.61) [0.46]
Panel Group Weighted Mean Estimate			- 0.6576 (- 5.79) [-2.17]		- 0.1891 (0.08) [0.03]
Total Private Industries		1 [#] ,1,0	- 0.4499 ^(t) (- 5.04)		- 0.6485 (- 0.99)

Notes: All estimation comprises inflation, the markup and the business cycle using annual data for the period 1955 to 2007. DOLS (see Stock and Watson 1993). Dependent variable: the markup. Independent variables: inflation, one lead and lag of the first difference in the markup and inflation, one lag in the business cycle measured as industry constant price value added de-trended using a Hodrick-Prescott filter ($\lambda=10$). A trend is not included if insignificant and indicated (nt). Shown in () are t-statistics.

Table 5: Individual Industry VAR-ECM Estimates of the United States long-run Inflation-Markup relationship 1955 - 2007

INDUSTRY - Int	Long-run			Short-run			
	C	Dp	Trend	α_{MU}	α_{Dp}	BC_{MU}	BC_{Dp}
1. Agriculture, forestry, fishing and hunting - 1,0,0	No	- 8.0846 (- 2.18)	- 0.0191 (- 2.28)	- 0.0987 (- 2.88)	- 0.0986 (- 2.38)	- 1.7887 (- 5.48)	0.5399 (1.37)
2. Mining - 1,0,0	Yes	- 8.2243 (- 5.24)		0.0127 (0.61)	- 0.0399 (- 1.45)	- 0.2065 (- 0.43)	0.6520 (1.01)
3. Utilities - 1,0,0	No	- 0.5198 (- 2.03)	0.0050 (6.64)	- 0.4127 (- 3.18)	- 0.3114 (- 2.7)	- 0.4892 (- 2.48)	1.1086 (5.8)
4. Construction - 0,0,0	No	- 1.5050 (- 3.05)		- 0.0818 (- 1.99)	- 0.1795 (- 3.2)	- 0.2656 (-3.66)	0.3505 (3.49)
5. Manufacturing - 1,0,0	No	- 1.4415 (- 3.89)	0.0013 (2.01)	- 0.2177 (- 3.89)	- 0.1937 (- 2.71)	- 0.3993 (- 6.67)	0.5001 (6.53)
6. Wholesale trade - 1,0,0	No	- 0.4307 (- 1.02)	- 0.0034 (- 5.07)	- 0.2452 (- 3.24)	- 0.1080 (- 0.91)	- 0.4789 (- 4.32)	0.9199 (5.28)
7. Retail trade - 0,0,0	Yes	- 1.1086 (- 6.13)	- 0.0023 (- 6.27)	- 0.1802 (- 2.65)	- 0.5161 (- 5.46)	- 0.5486 (- 6.64)	0.7013 (6.10)
8. Transportation and warehousing - 1,0,0	Yes	- 3.2201 (- 5.95)	- 0.0033 (- 3.01)	- 0.1184 (- 3.64)	- 0.1788 (- 5.39)	- 0.4192 (- 3.79)	0.5607 (4.97)
9. Professional and business services - 1,1,0	No	- 2.2166 (- 5.39)	- 0.0025 (- 3.88)	- 0.0674 (- 1.21)	- 0.1647 (- 3.97)	- 0.4294 (- 4.2)	0.3491 (4.58)
10. Educational services, health care, and social assistance - 0,1,0	Yes	- 3.3618 (- 14.28)	- 0.0097 (- 26.87)	- 0.1421 (- 3.26)	- 0.2946 (- 6.63)	- 0.3776 (- 2.24)	0.6057 (3.53)
11. Arts, entertainment, recreation, accommodation, and food services - 1,1,0	No	2.2215 (3.38)		0.0294 (0.59)	0.1173 (3.27)	- 0.6876 (- 4.83)	0.6081 (5.92)
12. Finance, insurance, real estate, and leasing - 1,1,0	No	0.1012 (0.44)	- 0.0087 (- 27.33)	- 0.4363 (- 3.74)	- 0.0086 (- 0.10)	0.0313 (0.12)	0.6703 (3.46)
Group Mean Estimate		- 2.3159 (- 13.09) [-3.78]		- 0.1632 (- 8.22) [-2.37]	- 0.1647 (- 9.13) [-2.64]	- 0.5049 (- 12.88) [-3.72]	0.6305 (15.02) [4.34]
Weighted average Estimate		- 1.3117 (- 9.58) [- 3.58]		- 0.2193 (- 7.63) [- 2.85]	- 0.1578 (- 6.76) [- 2.52]	- 0.3378 (- 9.46) [- 3.53]	0.5932 (12.57) [4.70]
Total Private Industries	Yes	- 0.3087 (- 2.58)		- 0.4964 (- 4.9)	- 0.0849 (- 0.81)	- 0.4312 (- 6.59)	0.2808 (4.12)

Notes: **Int** is the conclusion from the unit root tests in Table 1 of the likely order of integration of the markup, inflation and business cycle data respectively. **C** indicates the result from the Johansen Trace Test of cointegration where ‘Yes’ indicates acceptance of one cointegration vector at the 5 per cent level of significance. **Dp** and **Trend** are the long run coefficients on inflation and the trend respectively. α_{MU} and α_{Dp} are the adjustment coefficients in the markup and inflation equations respectively. BC_{MU} and BC_{Dp} are the short run business cycle coefficients in the markup and inflation equations respectively.

Table 6: Aggregate Estimates of the long-run Inflation Cost Coefficient λ

	Individual VAR-ECM	Individual DOLS	Panel DOLS	Panel FMOLS
Total Private Industry	- 0.3087	- 0.4499 ⁽¹⁾		
<i>t</i> -statistic	- 2.58	- 5.04		
Mean Estimates				
Group Mean λ	- 2.3159	- 0.3690	- 0.4697	- 0.4170
Pedroni <i>t</i> -statistic	- 13.09	- 5.44	- 1.75	- 1.13
Mean <i>t</i> -statistic	-3.78	-1.57	-0.51	-0.33
Heaton/Dewhurst <i>t</i> -statistic	- 6.57	-3.40	-1.28	-1.58
Weighted Mean Estimates				
Weighted Group Mean	- 1.3117	- 0.6576	- 0.9757	- 0.7075
Pedroni style <i>t</i> -statistic	- 9.58	- 5.79	-3.57	-2.73
Weighted mean <i>t</i> -statistic	- 3.58	-2.17	- 1.33	-1.02
Heaton/Dewhurst style <i>t</i> -statistic	-10.06	-6.03	-1.69	-1.39

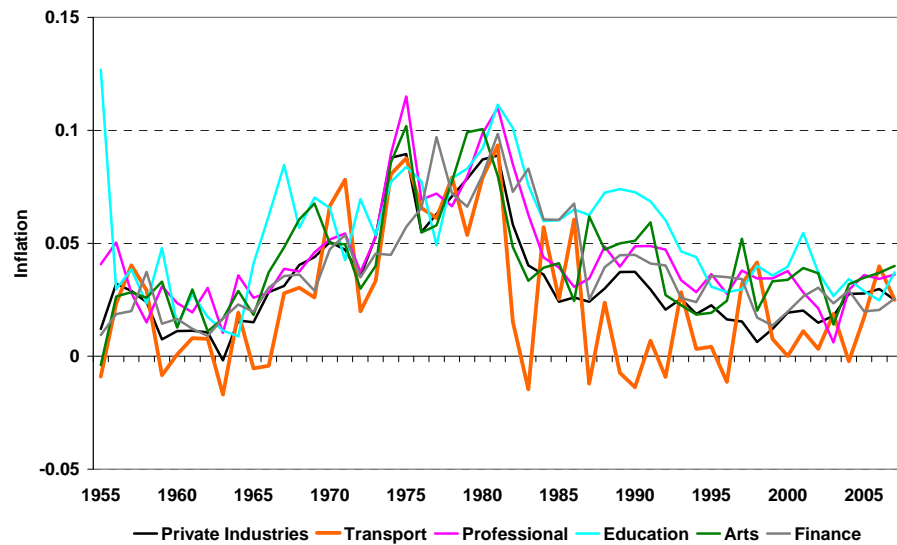
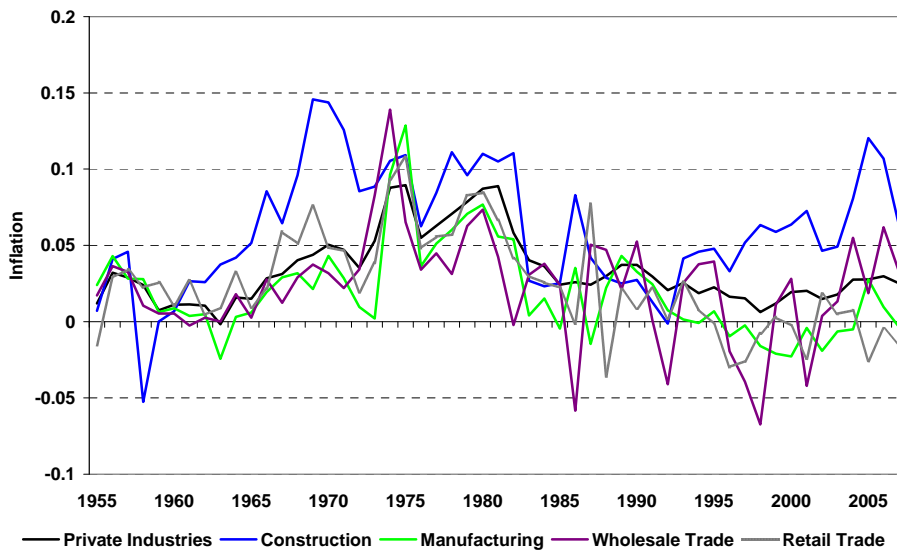
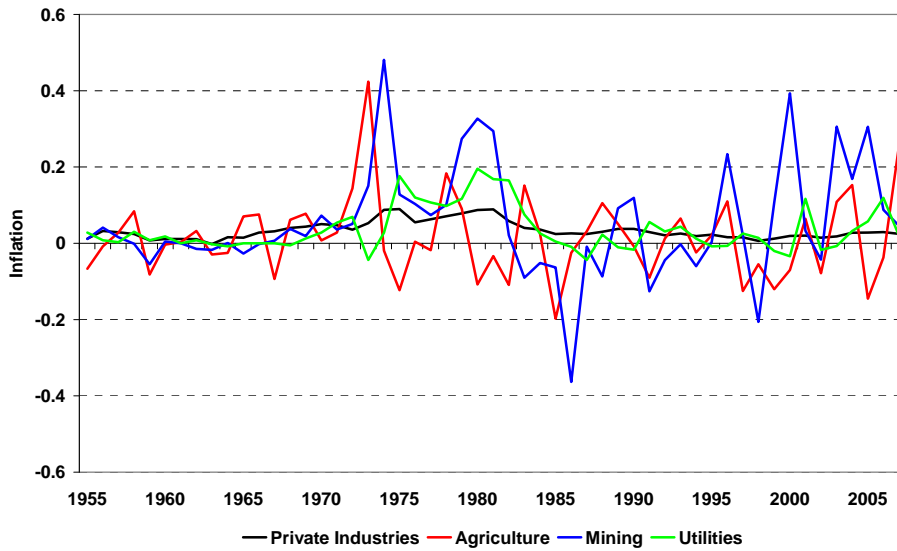
Notes: Group mean is the mean value of the inflation cost coefficients across industries. Weighted group mean is the weighted mean where the weights are the industry share of total GDP in the year 2000.

Table 7: Aggregate Estimates of the Business Cycle Coefficient

	Individual VAR-ECM		Individual DOLS	Panel DOLS	Panel FMOLS
	MU	Inflation	MU	MU	MU
Total Private Industry	- 0.4312	0.2808	- 0.6485		
<i>t</i> -statistic	- 6.59	4.12	- 0.99		
Mean Estimates					
Group Mean λ	- 0.5049	0.6305	0.0693	0.0786	- 0.0493
Pedroni <i>t</i> -statistic	- 12.88	15.02	1.61	- 0.10	- 0.38
Mean <i>t</i> -statistic	-3.72	4.34	0.46	-0.03	-0.11
Heaton/Dewhurst <i>t</i> -statistic	-8.21	8.66	0.15	0.03	-0.076
Weighted Mean Estimates					
Weighted Group Mean	- 0.3378	0.5932	- 0.1891	- 0.6463	- 0.0371
Pedroni style <i>t</i> -statistic	- 9.46	12.57	0.08	0.37	0.08
Weighted mean <i>t</i> -statistic	- 3.53	4.70	0.03	0.18	- 0.09
Heaton/Dewhurst style <i>t</i> -statistic	-4.85	10.47	-0.46	-0.14	-0.03

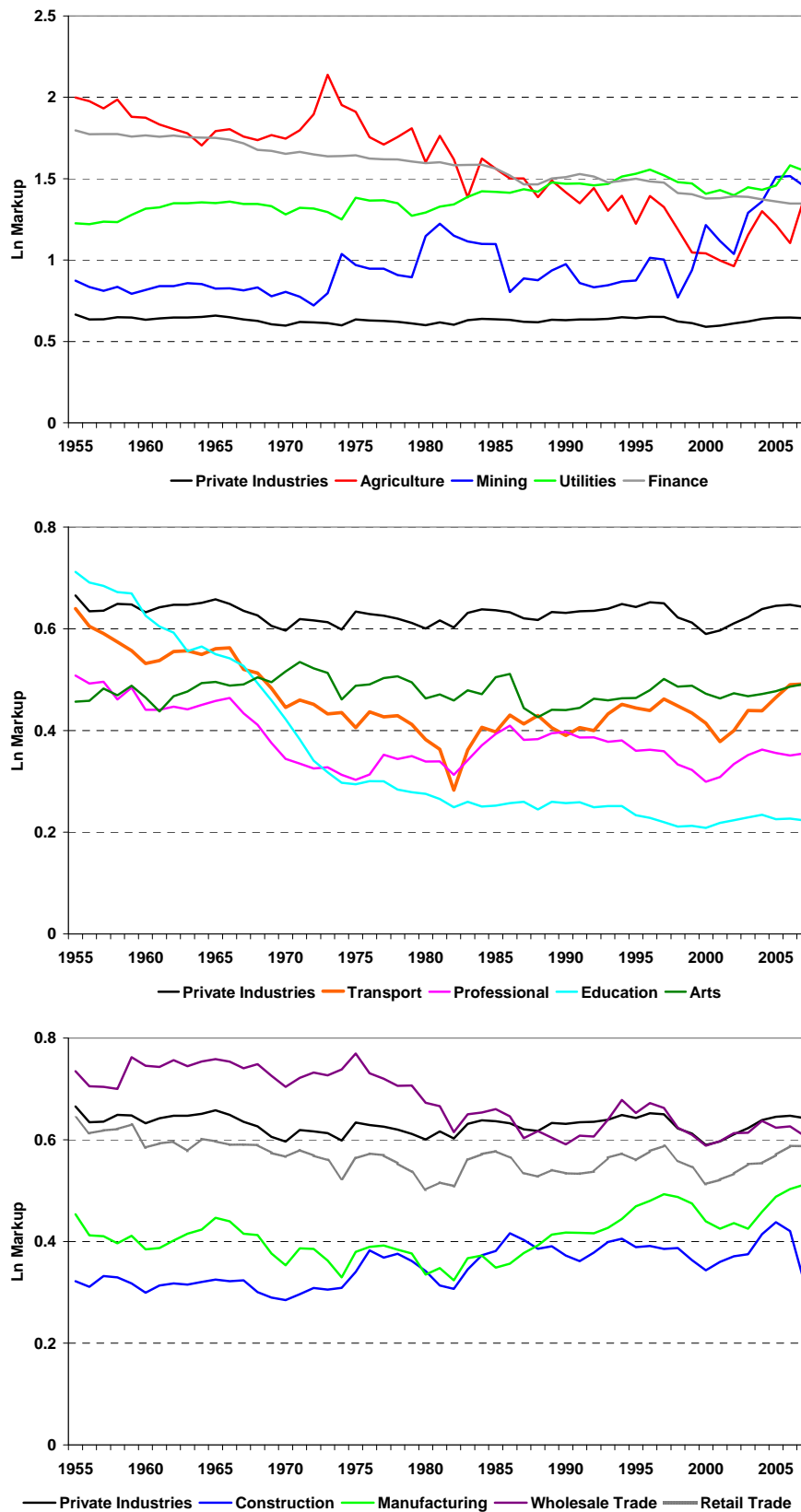
Notes: Group mean is the mean value of the inflation cost coefficients across industries. Weighted group mean is the weighted mean where the weights are the industry share of total GDP in the year 2000.

Graph 1: Inflation – Annual 1955 to 2007



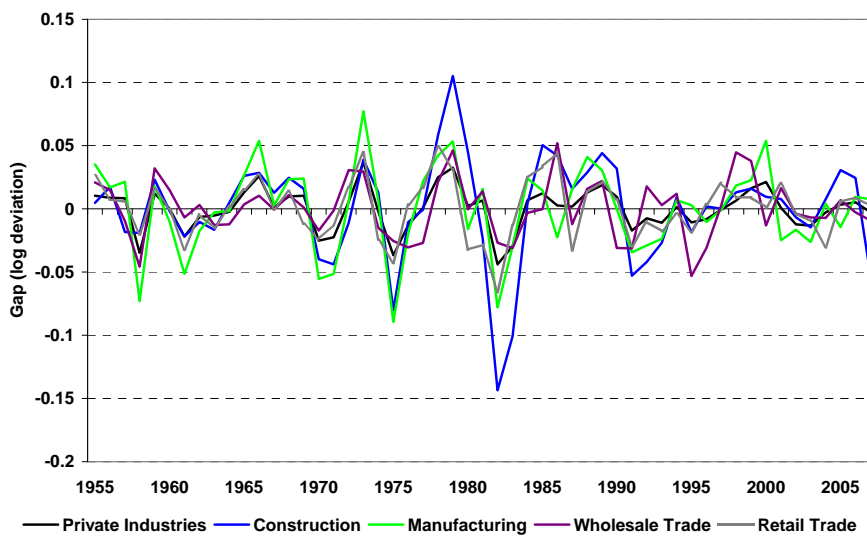
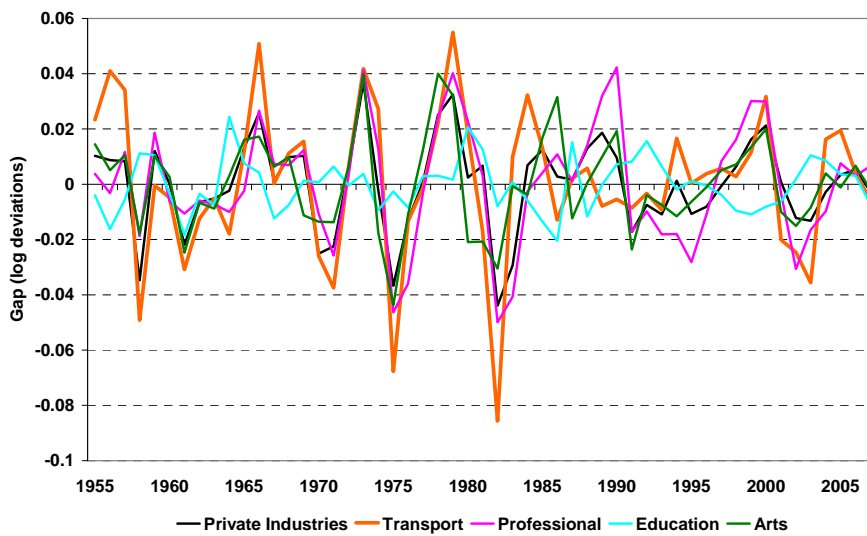
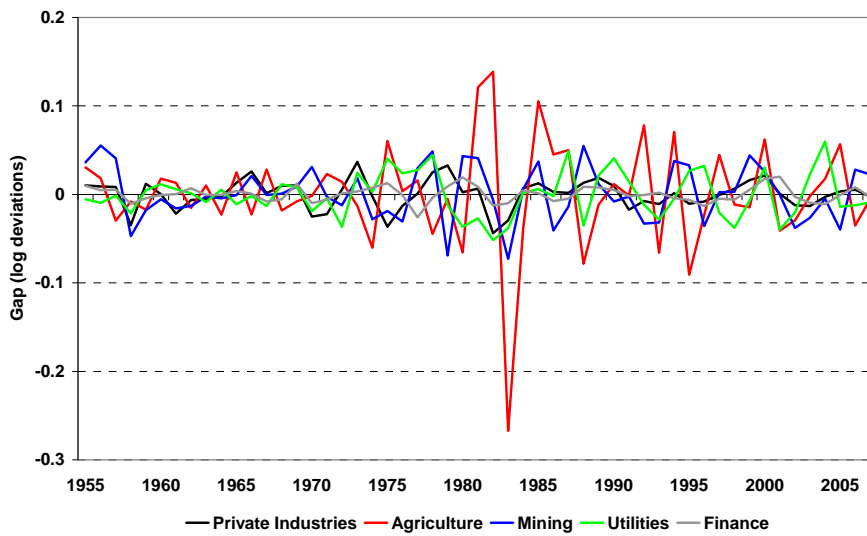
Note: Inflation is the change in the natural logarithm of the implicit price deflator.

Graph 2: The Markup– Annual 1955 to 2007



Note: The markup is the natural logarithm of the implicit price deflator divided by unit labour costs.

Graph 3: Business Cycle – Annual 1955 to 2007



Note: The business cycle is detrended natural logarithm of constant (2000) price GDP.