

Are real wages converging among Indian industries? Time series evidence with two structural breaks

Monojit Chatterji & Homagni Choudhury*

University of Dundee, Dundee (UK)

10th GEP PG Conference, Leverhulme Centre for Research on Globalisation and Economic Policy (GEP), University of Nottingham, Nottingham (UK), 14-15 April, 2011

Stylised Facts

- Industry affiliation is an important determinant of wage (Krueger & Summers, 1987).
- There are significant differences in wages across industries for apparently similar workers (Dickens & Katz, 1987; Murphy & Topel, 1990).
- The existence of such differentials has not been clearly understood and the fact that they remain persistent across time and countries remains an intricate and unresolved puzzle.

Motivation

- Although the theme of inter-industry wage differentials has been a topic of great interest in empirical labour economics, not much work has been done for India. This study aims to partially fill this gap.
- We've found some evidence of a deteriorating inter-industry wage structure in India in our earlier work (Chatterji & Choudhury, 2010a).
- Contrasting findings on the relationship b/w industry wage premiums and the trade reforms for India (Dutta, 2007; Mishra & Kumar, 2008).

Objectives

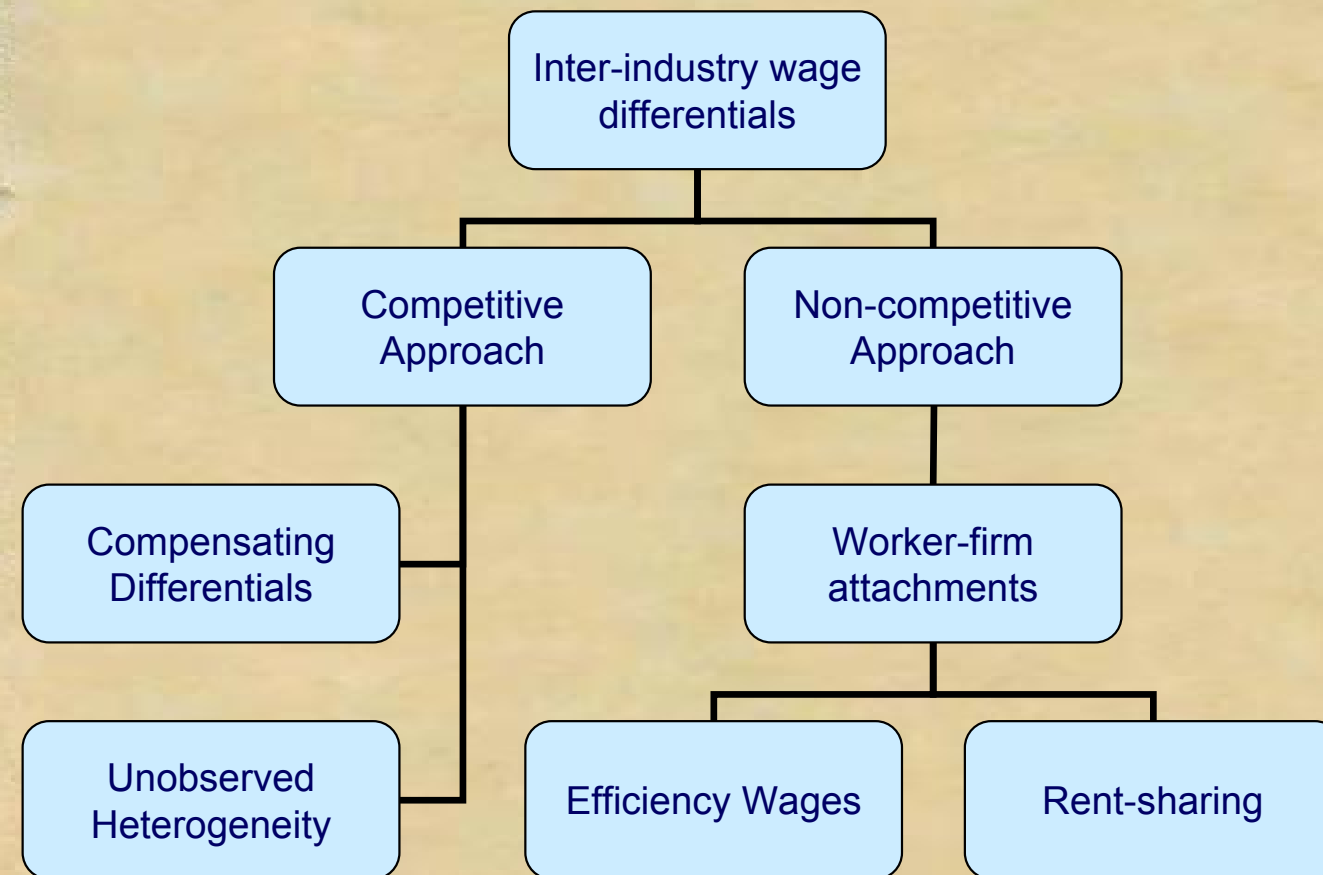
- The main objective is to determine if real wages per worker by industry are stochastically converging. The central idea behind the exercise is to determine whether the economic reforms of the 1980s and 1990s in India had any effect on the inter-industry wage structure.
- The study also aims to exploit long time series data to fully capture the impact of the gradual and uneven diffusion of the reforms over many years and capture the time dimension of the inter-industry wage structure in India.

Contribution

- First study to use stochastic convergence framework to address the inter-industry wage structure (definitely for India).
- By allowing for two structural breaks, our study benefits from a greater ability in the tests it employs to find evidence for stochastic convergence.
- The only study to conclude, for India, that there is "*stochastic convergence*" of real wages per worker to their "*compensating differentials*" among industries, i.e. "*stochastic convergence*" is compatible with "*conditional convergence*".

The Analytical Framework

Sources of Inter-industry Wage Differences (IIWD): Theoretical Predictions



Data

Source: Annual Survey of Industries (CSO, GOI), India.

Scope: Organised manufacturing sector, production workers only.

Industries: 51 at 3-digits of the NIC, 1998.

Time: 1973 to 2003.

Variable: Real wages per worker, i.e. Annual average real wages by industry (Base: 1983)

Economic Reforms in India

1980s: Continuous attempt to carry out reforms.

1990s: Radical reforms undertaken following the IMF induced macro- and structural reforms in 1991.

80s and 90s reforms loosened both trade restrictions and domestic controls; labour market reforms have been very weak.

Stochastic Convergence of inter-industry wages

Pre-reforms:

High protection + Restrictive inward looking ISI → Distortions → Generation of industry rents. Thus, IIWD will reflect rent-sharing capacity of workers rather than "compensating differentials".

Post-reforms:

Economy opens up + Market based reforms (trade lib. + industrial deregulation) → Distortions decrease → Industry rents ↓. If this is accompanied by fall in bargaining power of Labour then industry wage premiums due to rent-sharing fall and IIWD should stochastically converge to their compensating differentials.

Thus liberalisation targeted at both product and factor markets should theoretically result in "conditional convergence" of the inter-industry wages to their own steady state or "compensating differentials" as industry related premiums are eliminated.

Methodology

To test for stochastic convergence, we use time-series methodology as suggested in Carlino & Mills (1993). For each industry, i ,

$$W_t = \ln(RWPW_i / \text{AverageRWPW}_t) \text{ for all } i=1-51, t=1973-2003 \quad (1)$$

where $RWPW$ is real wage per worker in industry " i " at time " t " and AverageRWPW is the employment weighted average real wage per worker for all the industries at time " t ". Now,

$$W_t = W^c + v_t \quad (2)$$

Where W^c is the time invariant equilibrium "steady state" or "compensating differential" and v_t is the deviations from this equilibrium. Now,

$$v_t = u_0 + \beta t + u_t \quad (3)$$

where u_0 is the initial deviation from equilibrium and β is the deterministic rate of convergence. Baumol (1986): β convergence requires: if $u_0 > 0$ then $\beta < 0$ and if $u_0 < 0$ then $\beta > 0$. Using (3) in (2),

$$W_t = W^c + u_0 + \beta t + u_t \quad (4)$$

$$W_t = \alpha + \beta t + u_t \quad (5)$$

where $\alpha = W^c + u_0$. (5) captures the notion of stochastic convergence: for a specific industry's RWPW to β -converge to all the industries average RWPW in the deterministic manner, deviations from the trend growth, u_t , must be temporary, i.e. **W_t must not contain any unit root.**

Stochastic Convergence: Unit root tests and results

Unit Root Test

- ADF test: low in power, biased towards the non-rejection of the unit root null due to its inability to account for structural breaks (Perron, 1989).
- Perron proposes an ADF type test that allows for one known (exogenous) structural break (in intercept/slope/both).
- Perron's assumption of exogenous break date draws criticism: "data mining" and problems associated with "pre-testing" (Christiano, 1992; Zivot & Andrews, 1992 [ZA])
- Ensuing literature adopted agnostic approach: determine break-date endogenously from the data, e.g. ZA test. Literature also starts allowing for more than one break, e.g. Lumsdaine & Papell, 1997.
- Unit root tests that endogenously determine break(s) but based on an ADF type approach are not free from problems: they derive their critical values while assuming no break(s) under the null, which leads to size distortions in the presence of a unit root with break(s) (Nunes et al. 1997; Lee & Strazicich, 2001). As such, when using these tests, one might erroneously conclude that a time series is trend-stationary, when in fact the series is non-stationary with break(s) (Lee & Strazicich, 2003).
- We therefore use, the minimum LM unit root test, developed by Lee & Strazicich (2003, 2004), that endogenously determines two (LS2) and one (LS1) structural break. Throughout we use a model that allows both intercept and slope break(s).

Results

- For 45 of the 51 industries the W_t series reject the unit root null at 10% significance level when we perform the LS2 test (see Table 1).
- Two structural breaks in intercept and/or slope are significant in 44 industries, while only one structural break is significant in the 7 remaining industries (Rows highlighted with red in Table 1).
- For the 7 industries, for which one break is significant, we perform the LS1 test. Results in Table2.

Table 1: Minimum LM Unit root test, with two endogenously determined breaks (Lee & Strazicich, 2003), 1973-2003

Industry Codes	Breaks		Test Statistic	Industry Codes	Breaks		Test Statistic
151	1983	1993n	-4.5178	271	1992	1997	-6.3158***
152	1990	1996	-6.6251***	272	1986	1990	-5.4083*
153	1984	1996	-7.7774***	281	1983	1996	-7.1279***
154	1986	1995	-6.7632***	289	1995	1998	-6.0574**
155	1987	1995	-6.9302***	291	1984	1996	-8.4414***
160	1986	1994	-5.0459	292	1986	1991	-4.3274
171	1986	1992	-6.4726***	293	1988	1999	-7.5368***
172	1984	1993	-6.5505***	300	1987	1994	-9.3639***
173	1985n	1990	-9.1732***	311	1988n	1996	-4.6414
181	1989	2000n	-6.7415***	312	1988	1996	-8.2379***
182	1986	1994	-8.9478***	313	1983	1988	-5.6539**
191	1986	1998	-10.0286***	314	1985	1989	-5.3110*
192	1988	1992	-6.7916***	319	1988	1998	-13.401***
201	1990	1996	-5.9290**	321	1987	1996	-5.9391**
202	1984	1995	-8.0600***	323	1987	1993	-9.9606***
210	1986	1992	-7.1527***	331	1988n	1993	-7.4655***
221	1983	1997	-7.6125***	332	1987	1996	-10.4056***
222	1986	1995	-6.5020***	333	1988	1993	-6.1352**
231	1993	2000	-8.4941***	341	1987	1996	-10.7033***
232	1985	1998	-8.3419***	342	1984	1996n	-6.1685**
241	1983	1995	-4.9455	351	1988	1998	-5.1796
242	1990	1996	-8.0450***	352	1983	1996	-5.7804**
251	1992	1996	-6.3741***	359	1988	1995	-8.2926***
252	1992n	1995	-8.1649***	361	1983	1990	-6.5337***
261	1987	1994	-7.5430***	369	1985	1992	-7.0613***
269	1993	1997	-6.8058***				

*, **, *** denotes significance levels of 10%, 5% and 1% respectively.

Stochastic Convergence: Results, Findings and Conclusions

Table 2: Minimum LM Unit root test, with one endogenously determined break (Lee & Strazicich, 2004), 1973-2003

Industry Codes	Breaks	Test Statistic
151	1983	-5.6927***
173	1985	-7.7284***
181	1989	-4.0101
252	1983	-4.7868**
311	1997	-4.7624**
331	1997	-4.5131**
342	1983n	-4.6569**

Table 3: Summary of findings for 51 industries

		2 significant breaks	1 significant break
LS2 test (51 industries)	No unit root	40	5
	Unit root	4	2
LS1 test (7 industries)		1 significant break	No significant break
	No unit root	5	1*
	Unit root	1	0

*We do a no break minimum LM test and find that there is no unit root

Total No. of series with no unit root: 46

Key Findings

- RWPW among industries have stochastically converged to their “*compensating differentials*”. In other words, there is “*conditional convergence*” of the inter-industry wages to their own steady state.
- The statistically significant structural breaks identified by our tests, which are industry specific, imply a permanent change in an industry’s compensating differential suggesting that industry specific conditioning variables, such as the relative level of technology, can be permanently altered by major shocks. Following a major shock, the time path of relative RWPW for industries can be permanently altered.
- The impact of liberalisation has not been uniform across all the industries. The fact that the break date(s) occur at different time points for different industries highlight the differential impact of the reforms on different industries.
- Lend support to the rent-sharing hypothesis as an explanation of the existence IWD in the pre-reforms period, whose importance has declined over the reforms period.

Conclusions

- “*Stochastic Convergence*” of real wages to their “*Compensating Differentials*” among Indian industries, i.e. there is “*Conditional Convergence*” of RWPW to their steady state.
- Industry wage premiums have declined over the reforms period which is in line with the findings of Mishra & Kumar, 2008.
- Economic reforms have been favourable for the inter-industry wage structure in India.
- The existence of the breaks suggest that relative real wages are stochastically converging, but subject to a small number of significant shocks that permanently alter industry-specific compensating differentials.

Notes: References and detailed results are available on the main paper, available at the GEP conference website.

Unit Root Tests conducted in GAUSS. Codes and intermediate results available from the authors, upon request.

Thanks to Mrs. J. Campbell and Mr. C. Boonyanate for poster design ideas.

***Comments/Feedback can be sent to: h.choudhury@dundee.ac.uk**