Online Appendix
"Wage Rigidity and Disinflation in Emerging Countries"
Additional Results

Julián Messina
World Bank, Universitat de Girona and IZA

Anna Sanz-de-Galdeano
Center for Research in Health and Economics (CRES-UPF), World Bank and IZA

Abstract

This appendix presents additional results that are referred to in the main text.

1 Additional Figures

Figure 1 compares kernel estimates of the distribution of median wage changes in Minas Gerais and in the rest of Brazil for all the available years in the period 1995-2004.[1] With the exception of the first two years, when wage changes in the state of Minas Gerais present fatter tails, the wage change distributions are remarkably similar. Figures 2 and 3 show wage change histograms based on the administrative data for all sample years. Figure 4 presents the figures mentioned in Footnote 19 in the main text, which compare occupational wage change distributions from RAIS and PNAD.

[1] The half-width in the kernel estimates is set to 0.05.

2 Heteroskedasticity: Additional Results

Section IV.A examines a model in which the notional wage change distribution follows the process:

$$\Delta y_{it}^{*} = x_{it-1}\beta_{1t} + \varepsilon_{it},$$

where $\varepsilon_{it} \sim N(0, \sigma_{\varepsilon})$. It allows for within-group variance to depend on observable characteristics as follows:

$$\sigma_{it}^{2} = z_{it-1}\beta_{2t}$$

As in the baseline case, estimations are carried out year by year. The model is estimated by iterating a two stage procedure:

1. Obtain by ML the baseline parameter estimates $\hat{\beta}_{1t}$ and the residuals $\hat{\varepsilon}_{it} = \Delta y_{it}^{*} - x_{it-1}\beta_{1t}$
2. Fit a gamma regression with a log link of $\hat{\varepsilon}_{it}^{2}$ on z_{it-1}, and obtain the estimates of $\hat{\beta}_{2t}$
3. Estimate the ML model with weights $1/\hat{\sigma}_{it}^{2}$, where $\hat{\sigma}_{it}^{2} = \exp\left(z_{it-1}\hat{\beta}_{2t}\right)$
4. Evaluate the log-likelihood
5. Iterate steps 2 to 4 until convergence is achieved.

Estimates of $\hat{\beta}_{2t}$ for Brazil and Uruguay are presented in Tables 2 and 3. Table 4 presents the key second-stage results for Brazil, and Table 5 does so for Uruguay. As noted in the main text, the key parameters of the model are virtually unaffected by allowing for heteroskedasticity in the notional wage change distribution.

3 Real Wage Rigidity: Downward or Symmetric? The Case of Uruguay

Table 6 presents the results of the model discussed in Section IV.B of the main text for Uruguay.

4 From Micro to Macro Rigidities: Additional Results

Section V discusses results of the frequency of wage cuts prevented (FWCP) with an alternative methodology based on the assumption of symmetry of the notional wage change distribution. It also discusses results using the same model, but with an alternative measure of wage changes, described in Footnote 21: "This measure is obtained by first running fairly flexible yearly Mincer regressions that include a cubic polynomial in age, gender, education dummies, a full set of interactions terms between all these variables, and occupation dummies. In a second stage, we extract the occupation dummies and take first differences to construct a measure of yearly occupational wage changes that factors out changes in observable characteristics" The FWCP for the two exercises are presented below. Table 7 presents results for Minas Gerais, Table 8 for informal workers, Table 9 for formal employees, and Table 10 for all workers in the sample. "Symmetric" stands for the model imposing symmetry, and "Alt. Wage" estimates the same model used in the main text but with the alternative wage change measure.

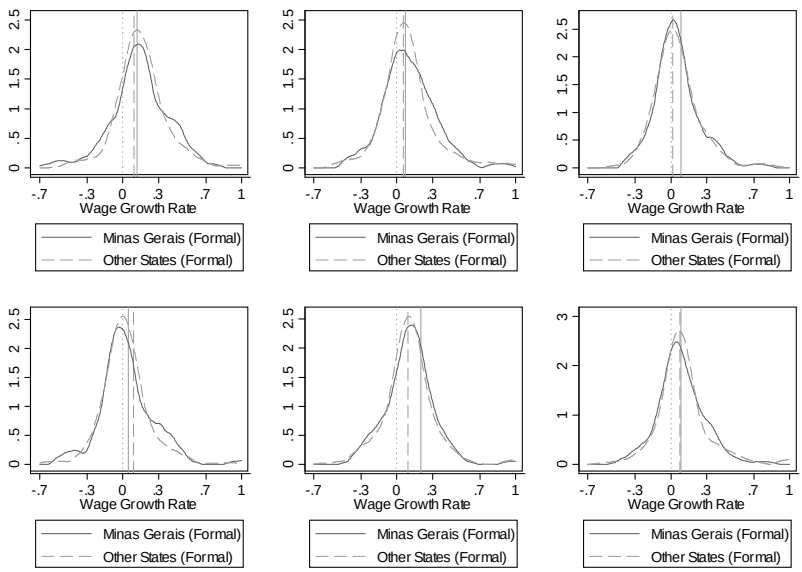

Figure 1: Annual Median Wage Growth Distributions. Minas Gerais vs. Other Brazilian States.

Note: Dotted line: zero growth rate in nominal wages. Dashed line: inflation rate. Solid line: minimum wage growth. Formal employees are those who have an ID card or carteira.

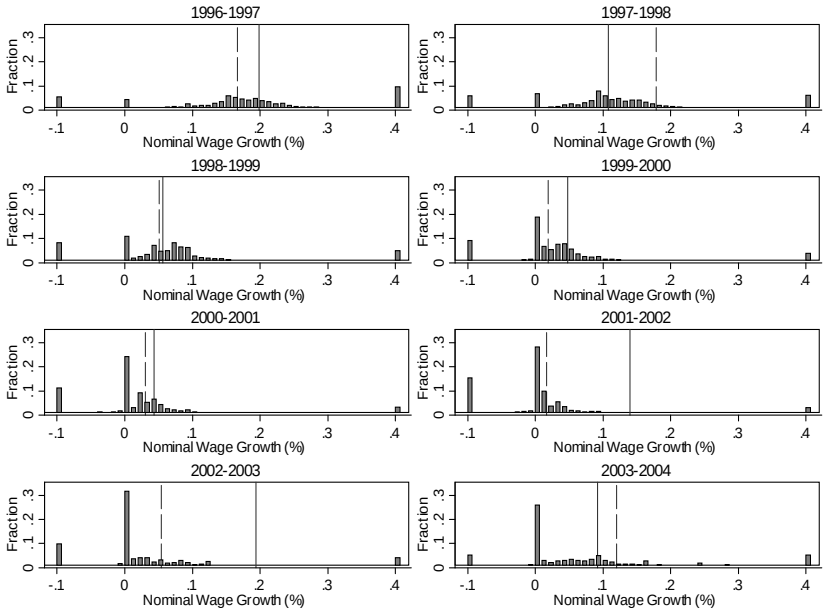

Figure 2: Histograms of Observed Log Hourly Wage Changes. Uruguay.

Note: Solid line: inflation rate. Dashed line: minimum wage growth. The first (last) bin in each histogram corresponds to the frequency of all the observations with an annual growth below (above) -0.1 (0.4).

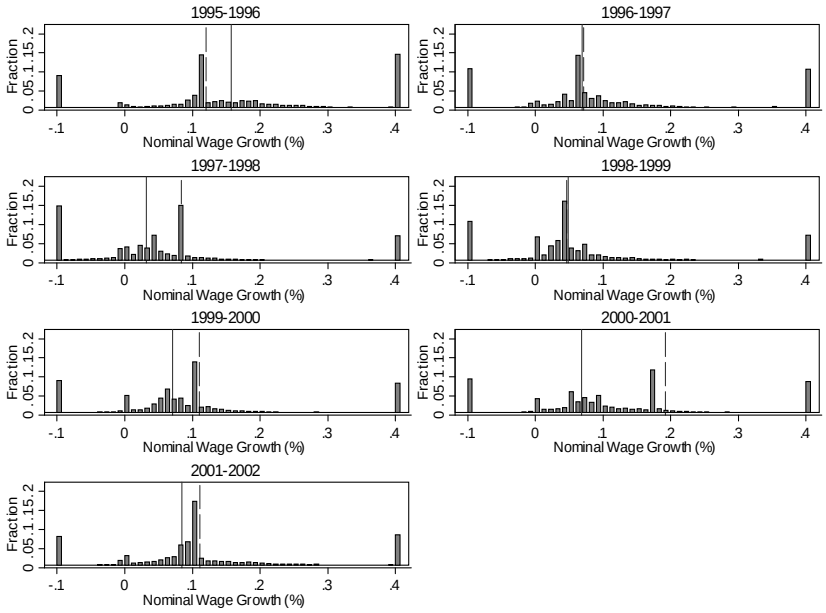

Figure 3: Histograms of Observed Log Hourly Wage Changes. Brazil.

Note: Solid line: inflation rate. Dashed line: minimum wage growth. The first (last) bin in each histogram corresponds to the frequency of all the observations with an annual growth below (above) -0.1 (0.4).

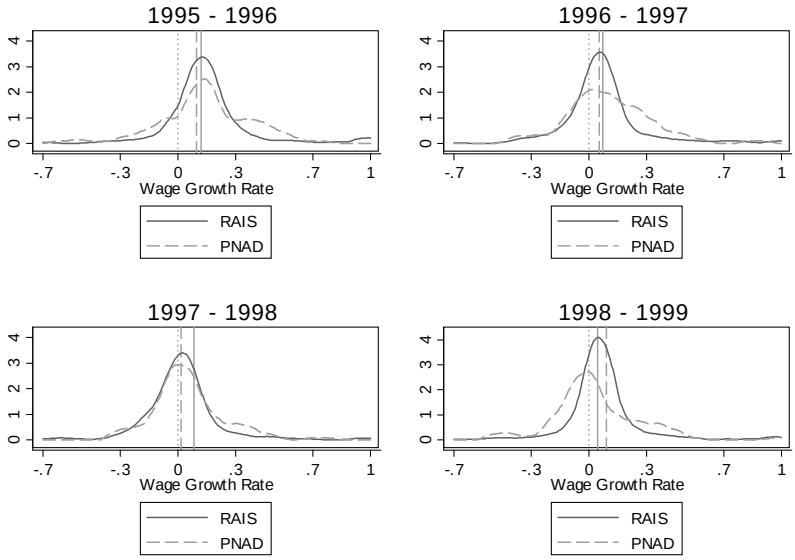

Figure 4: Wage Change Distributions of Formal Workers in Minas Gerais. Administrative (RAIS) vs. Survey (PNAD) Data.

Table 1: Summary Statistics. Minas Gerais vs. the Rest of Brazil. 1995-2002

	Minas Gerais	**Rest of Brazil**
Age	43.60	42.68
Share of males	45.02%	45.26%
Share of urban population	79.73%	82.19%
Years of education		
< 1	16.35%	17.74%
1 to 3	19.26%	16.57%
4 to 7	35.24%	31.17%
8 to 10	10.87%	12.98%
11 or more	6.82%	8.70%
Literacy rate	85.03%	84.04%
Sector of economic activity		
Agriculture, hunting and forestry	31.69%	25.79%
Industry (food, beverages tobacco, textiles)	6.20%	6.31%
Industry (rest)	6.60%	7.59%
Construction	8.22%	7.76%
Commerce, restaurants, hotels	19.38%	23.18%
Electricity, gas, water, transport, communications	5.16%	5.49%
Financial and insurance activities	3.16%	3.97%
Public administration and defence	0.13%	0.15%
Education and health	8.83%	9.23%
Activities of households as employers	10.64%	10.52%
Labor force participation rate	70.80%	70.53%
Employment rate	66.70%	65.69%
Unemployment rate	5.53%	6.64%
Self-employment rate*	27.25%	31.35%
Share of formal workers*	49.69%	51.77%
Weekly hours of work	42.67	43.57
Tenure (in years)	8.89	8.86

Note: *Rates computed as a fraction of the working population. Source: Pesquisa Nacional por Amostra de Domicílios (PNAD). The table displays weighted averages for the period 1995-2002 excluding year 2000, when the PNAD was not collected.

Table 2: Brazil. Estimates of the log variance of wage changes

	1995	1996	1997	1998	1999	2000	2001
Age	0.0174	0.0131	0.0161	0.0104	0.0101	0.0148	0.0056
	(0.0022)	(0.0021)	(0.002)	(0.0059)	(0.0035)	(0.0023)	(0.0022)
Age square	-0.2349	-0.2118	-0.2321	-0.0998	-0.1191	-0.2318	-0.0516
	(0.0282)	(0.0279)	(0.0268)	(0.0783)	(0.0461)	(0.0303)	(0.0286)
Male	0.2173	0.1669	0.1812	0.1168	0.0209	0.1073	0.1643
	(0.0096)	(0.0094)	(0.0089)	(0.0251)	(0.015)	(0.0098)	(0.0091)
Primary	-0.2623	-0.1599	-0.1846	-0.1392	-0.1838	-0.339	-0.6902
	(0.0195)	(0.0196)	(0.0185)	(0.053)	(0.0308)	(0.0199)	(0.019)
Secondary	-0.1056	-0.0222	-0.0184	-0.0327	-0.0234	-0.1595	-0.5315
	(0.0195)	(0.0199)	(0.0185)	(0.0525)	(0.0304)	(0.0195)	(0.0185)
Tenure	-0.0001	0.0001	0.0005	-0.0015	0.0013	0.0000	-0.0012
	(0.0002)	(0.0002)	(0.0002)	(0.0005)	(0.0003)	(0.0002)	(0.0002)
Tenure square	-0.0011	-0.0005	-0.0011	0.0058	-0.0011	0.0001	0.0058
	(0.0006)	(0.0006)	(0.0006)	(0.002)	(0.0011)	(0.0007)	(0.0006)
Constant	-2.5535	-2.5763	-2.8139	-2.5546	-2.575	-2.6951	-2.3457
	(0.0451)	(0.0446)	(0.0425)	(0.121)	(0.0724)	(0.0475)	(0.0451)

Note: Additional covariates include 12 occupation dummies. Standard errors are displayed in parentheses.

Table 3: Uruguay. Estimates of the log variance of wage changes

	1996	1998	1999	2000	2003
Age	-0.0386	-0.0606	-0.0147	0.0029	0.0325
	(0.026)	(0.0191)	(0.0226)	(0.0232)	(0.0214)
Age square	0.4249	0.6814	0.1527	-0.0577	-0.5481
	(0.3165)	(0.2333)	(0.2806)	(0.2817)	(0.2545)
Male	-0.3244	-0.2236	-0.4296	-0.3477	0.0323
	(0.0938)	(0.0734)	(0.0787)	(0.0788)	(0.074)
White	0.1167	-0.081	0.0422	-0.0428	-0.0586
	(0.1452)	(0.111)	(0.1227)	(0.127)	(0.1148)
Montevideo	-0.0503	0.1077	-0.0296	0.1603	0.2955
	(0.1028)	(0.0796)	(0.0885)	(0.091)	(0.0838)
Tenure	-0.0073	-0.0025	-0.0063	-0.007	-0.0034
	(0.0014)	(0.001)	(0.0012)	(0.0012)	(0.0011)
Tenure square	0.0132	0.0000	0.0095	0.0121	0.0007
	(0.0038)	(0.0028)	(0.0034)	(0.0032)	(0.003)
Size					
0-5	-1.4604	-1.113	-1.8028	-1.574	-1.7188
	(0.2296)	(0.1736)	(0.1891)	(0.1721)	(0.1819)
5-15	-1.3128	-0.8614	-1.3593	-1.4533	-1.5499
	(0.225)	(0.1682)	(0.1797)	(0.1703)	(0.1795)
15-30	-0.8379	-0.6278	-0.8395	-0.7455	-1.4016
	(0.2438)	(0.1815)	(0.2031)	(0.1999)	(0.1921)
30-50	-0.8219	-0.41	-0.475	-0.7327	-1.1791
	(0.2458)	(0.1896)	(0.1982)	(0.1876)	(0.1975)
50-100	-1.3208	-0.4238	-0.6766	-1.0959	-0.8882
	(0.2411)	(0.1828)	(0.1955)	(0.1869)	(0.1966)
100-200	-0.8631	-0.6826	-0.7677	-0.6891	-1.0506
	(0.2497)	(0.1882)	(0.2024)	(0.1937)	(0.1968)
200-500	-0.2474	-0.1626	-0.7534	-0.8351	-1.0605
	(0.2356)	(0.177)	(0.1934)	(0.1828)	(0.1948)
500-1000	-0.1417	-0.1036	-0.4906	-0.5265	-0.5441
	(0.2464)	(0.1842)	(0.1969)	(0.1964)	(0.21)
Constant	-0.1036	-0.4013	-0.9535	-1.2735	-1.9927
	(0.5642)	(0.4143)	(0.48)	(0.4823)	(0.4916)

Note: Additional covariates include 12 occupation dummies. Standard errors are displayed in parentheses. Convergence was not achieved for years 1997, 2000 and 2011.

Table 4: Variance Function Regression Estimates of Downward Nominal and Real Wage Rigidity in Brazil.

year	Δy_i^o	Δy_i^*	μ_r	σ_r	p^R	p^N	$1-q$	N
1995-1996	0.174	0.137	0.113	0.000	0.483	0.010	0.220	849,004
1996-1997	0.122	0.075	0.069	0.000	0.536	0.026	0.291	896,797
1997-1998	0.065	0.032	0.080	0.000	0.330	0.041	0.302	985,980
1998-1999	0.078	0.040	0.045	0.000	0.329	0.093	0.253	1,005,791
1999-2000	0.114	0.008	0.080	0.029	0.662	0.083	0.061	1,042,319
2000-2001	0.126	0.103	0.058	0.001	0.138	0.460	0.210	1,085,804
2001-2002	0.126	0.064	0.100	0.009	0.557	0.095	0.126	1,199,888

Note: This table displays mean wage changes in the observed (Δy_{it}^o) and notional (Δy_i^*) distributions, the mean of the estimated focal point of DRWR (μ_r) and its variance (σ_r), the percentages of workers in the DRWR (p^R) and DWNR (p^N) regimes, the share of wage change observations observed with error ($1-q$), and the number of observations (N) for each period.

Table 5: Variance Function Regression Estimates of Downward Nominal and Real Wage Rigidity in Uruguay.

year	Δy_i^o	Δy_i^*	μ_r	σ_r	p^R	p^N	$1-q$	N
1996-1997	0.182	0.124	0.166	0.036	0.582	0.239	0.069	52,217
1998-1999	0.069	0.001	0.065	0.026	0.644	0.224	0.067	71,530
1999-2000	0.036	0.026	0.155	0.076	0.088	0.732	0.089	69,355
2000-2001	0.015	0.016	0.187	0.060	0.054	0.716	0.091	68,136
2003-2003	0.088	0.049	0.094	0.002	0.050	0.814	0.071	63,504

Note: This table displays mean wage changes in the observed (Δy_{it}^o) and notional (Δy_i^*) distributions, the mean of the estimated focal point of DRWR (μ_r) and its variance (σ_r), the percentages of workers in the DRWR (p^R) and DWNR (p^N) regimes, the share of wage change observations observed with error ($1-q$), and the number of observations (N) for each period. Convergence was not achieved for years 1997, 2001 and 2002.

Table 6: Robustness Check. Symmetric Real Rigidity Model in Uruguay

year	Δy_i^o	Δy_i^*	μ_r	σ_r	p^R	p^N	$1-q$	N
1996-1997	0.182	0.179	0.176	0.046	0.482	0.233	0.052	52,217
1998-1999	0.069	0.058	0.070	0.028	0.457	0.286	0.069	71,530
2000-2001	0.015	0.014	0.207	0.064	0.069	0.619	0.100	68,136
2001-2002	-0.016	-0.001	0.158	0.064	0.087	0.621	0.135	66,530
2002-2003	0.041	0.009	0.248	0.074	0.073	0.678	0.092	63,995
2003-2004	0.088	0.051	0.094	0.002	0.031	0.760	0.076	63,504

Note: This table displays mean wage changes in the observed (Δy_{it}^o) and notional (Δy_i^*) distributions, the mean of the estimated focal point of DRWR (μ_r) and its variance (σ_r), the percentages of workers in the DRWR (p^R) and DWNR (p^N) regimes, the share of wage change observations observed with error ($1-q$), and the number of observations (N) for each period. Convergence was not achieved for years 1997 and 1999.

Table 7: Downward Wage Rigidity in Occupational Data. Symmetric Notional and Alternative Wage Specification. Minas Gerais

Year	Inflation		Minimum Wage		Zero	
	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)
1995	0.192	-0.051	0.033	0.012	0.222	-0.024
1996	-0.015	-0.017	0.080	0.048	0.154	-0.148
1997	0.059	-0.008	0.000	-0.024	0.097	-0.189
1998	0.005	-0.029	0.007	0.055	0.012	0.014
2002	0.044	-0.001	0.005	-0.040	-0.265	-0.366
2003	0.000	0.039	0.000	0.017	0.000	-0.172

Note: The table displays the frequency of wage changes prevented (FWCP) by rigidity at the rate of inflation, the growth rate of the minimum wage, and zero. Statistically significant estimates at the 5 percent level are in bold.

Table 8: Downward Wage Rigidity in Occupational Data. Symmetric Notional and Alternative Wage Specification. Informal workers

Year	Inflation		Minimum Wage		Zero	
	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)
1995	0.000	-0.236	-0.184	0.036	**0.318**	-0.997
1996	0.000	-0.055	0.000	-0.057	0.023	-0.001
1997	0.043	0.027	0.029	0.019	-0.005	0.058
1998	0.000	-0.057	0.049	-0.070	0.049	-0.060
2002	-0.059	-0.021	0.003	-0.046	-0.039	-0.702
2003	0.022	-0.016	-0.020	-0.022	-0.056	-0.556

Note: The table displays the frequency of wage changes prevented (FWCP) by rigidity at the rate of inflation, the growth rate of the minimum wage, and zero. Statistically significant estimates at the 5 percent level are in bold.

Table 9: Downward Wage Rigidity in Occupational Data. Symmetric Notional and Alternative Wage Specification. Formal workers

Year	Inflation		Minimum Wage		Zero	
	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)
1995	-0.056	-0.025	-0.087	0.000	0.010	-0.513
1996	0.006	-0.014	0.005	0.008	0.061	-0.060
1997	-0.050	0.031	0.002	-0.010	0.072	-0.011
1998	0.000	-0.009	0.000	0.000	-0.034	0.019
2002	0.052	0.020	0.001	0.009	-0.188	-0.222
2003	-0.025	0.020	0.000	0.053	0.162	-0.316

Note: The table displays the frequency of wage changes prevented (FWCP) by rigidity at the rate of inflation, the growth rate of the minimum wage, and zero. Statistically significant estimates at the 5 percent level are in bold.

Table 10: Downward Wage Rigidity in Occupational Data. Symmetric Notional and Alternative Wage Specification. All Workers

Year	Inflation		Minimum Wage		Zero	
	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)	FWCP (Symmetric)	FWCP (Alt. wage)
1995	0.055	-0.075	0.047	-0.012	0.102	-0.365
1996	-0.045	0.023	-0.004	-0.001	0.071	-0.119
1997	0.004	0.000	0.002	-0.012	**0.136**	0.039
1998	0.002	0.002	0.002	-0.041	0.064	-0.004
2002	0.000	0.029	0.000	0.004	-0.203	-0.267
2003	0.000	-0.017	0.000	-0.023	-0.041	-0.151

Note: The table displays the frequency of wage changes prevented (FWCP) by rigidity at the rate of inflation, the growth rate of the minimum wage, and zero. Statistically significant estimates at the 5 percent level are in bold.