
# DEPARTMENT OF ECONOMICS

# THE EFFECTS OF THE MINIMUM WAGE IN THE PRIVATE AND PUBLIC SECTORS IN BRAZIL

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**Working Paper No. 04/12**
**April 2004**

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The wage and employment effects of the minimum wage predicted by the standard neoclassical theory rely on a profit maximizing firm, not on a Government employer that can cover the higher wage bill by raising taxes, reducing expenditure, or simply printing money. If the public sector has an inelastic labour demand, the associated non-negative employment effect might offset some of the negative employment effect observed in the private sector and the overall employment effect might be less adverse. This is particularly so if the public sector is overpopulated by minimum wage workers, as in Brazil. There is very limited evidence on the minimum wage effects in developing countries, and none whatsoever on the minimum wage effects across the private and public sectors. This paper estimates the effects of the minimum wage on wages and employment in both the private and public sectors. The data used is an under-explored monthly Brazilian household survey from 1982 to 2000 at individual and regional levels. Robust results suggest that the minimum wage compresses the distribution of both sectors, but in line with a stronger effect in the private sector, more adverse employment effects in the long run are also observed in that sector. In the public sector, no evidence of adverse employment effects was uncovered.

*Keywords:* minimum wage, wage effect, employment effect, private sector, public sector, Brazil.
*JEL code:* J38.

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## INTRODUCTION

The evidence in the international literature shows that the minimum wage compresses the wage distribution and has a small adverse employment effect, as predicted by standard theory (Card and Krueger, 1995; Brown, 1999).[1] The limited evidence for Latin America suggests that the compression effect is a lot stronger in developing than it is in developed countries, and as a result, adverse employment effects are also stronger (Gregory, 1981; Castillo-Freeman and Freeman, 1992; Bell, 1997; Gindling and Terrell, 2002; Angel-Urdinola, 2002; Cowan et al., 2003; Maloney and Mendez, 2003; Montenegro and Pages, 2004). The evidence for Brazil also suggests that the minimum wage strongly compresses the wage distribution, but it suggests a small adverse employment effect (Carneiro, 2002; Corseuil and Servo, 2002; Neumark et al., 2003; Lemos, 2004).

This evidence uses mainly private sector data; there is no available evidence in the literature on the effects of the minimum wage on the public sector. However, evidence regarding the private sector need not carry over to the public sector. The wage and employment effects predicted by the standard neoclassical theory rely on a profit maximizing firm, not on a Government employer that can cover the higher wage bill by raising taxes, reducing expenditure, or simply printing money, as it is often the case in developing countries. If the public sector has an inelastic labour demand, the associated non-negative employment effect might offset some of the negative employment effect observed in the private sector and the overall employment effect might be less adverse. This is particularly so if the public sector is overpopulated by minimum wage workers, as in Brazil, where 15% of the labour force are civil servants over the sample period, and 6.6% of those earn a minimum wage. It is therefore important to investigate the private and public sectors effects underlying the overall effect, as the latter might mislead policymakers to increase the minimum wage more generously than they would otherwise. This might not affect the public sector, but might adversely affect the private sector.

This paper estimates the effects of the minimum wage on wages and employment in both the private and public sectors. It estimates the effect of the minimum wage throughout the wage distribution in each sector; and it decomposes the total employment effect of the minimum wage into hours and jobs effects in each sector. The data used is an under-explored monthly Brazilian household survey from 1982 to 2000 at individual and regional levels. This is an important contribution to the literature because it will fulfil the gap on evidence on the minimum wage effects in the public sector and it will extend the current understanding on the minimum wage effects in developing countries.

This paper is organized as follows. Section 2 discusses the data, Section 3 estimates wage effects, Section 4 estimates employment effects, and Section 5 concludes. Robust results suggest that the minimum wage compresses the distribution of both sectors, but in line with a stronger effect in the private sector, more adverse employment effects in the long run are also observed in that sector. In the public sector, no evidence of adverse employment effects was uncovered.

## 2. DATA

The data used is PME (Monthly Employment Survey) for the six main Brazilian metropolitan regions between 1982 and 2000, available from IBGE (Instituto Brasileiro de Geografia e Estatistica). This data has a similar design to the US CPS (Current Population Survey). The regional deflator, IPC (Consumers Price Index), along with the minimum wage data, is also available from IBGE.

[1] Some authors have been unable to find negative employment effects (Card and Krueger, 1995; Dickens et al, 1999; Machin et al. 2003).

The minimum wage in Brazil is national and coverage is full.[2] Graph 1.a shows that the log real minimum wage has a negative trend during the sample period. This erosion over time is due to persistent under-indexation of the nominal minimum wage according to the rules of successive stabilization plans. For example, the minimum wage was bi-annually adjusted in early 1986, but then adjusted whenever inflation was higher than 20%. In mid 1987, it was frozen before it was indexed monthly by past inflation. In early 1989, it was again frozen, and in mid 1989 it was again indexed monthly. In early 1990, no indexation rules were in place. In late 1991, it was again indexed monthly by past inflation. In 1993, it was indexed bi-monthly and then monthly adjusted. In early 1994, it was indexed daily, and from 1995, it has been annually adjusted. As the nominal minimum wage adjustments were quickly eroded by inflation, the real minimum wage presents a saw-toothed pattern, also observed, though less pronounced, in the US (Brown, 1999).

Graphs 1.b to 1.d plot the $25^{th}$, $50^{th}$ and $75^{th}$ percentiles of the log real earnings distribution both for the private and public sectors over time. The trend is negative for all percentiles. The correlations with the log real minimum wage (on the top of each graph) suggest that these correlations are stronger for the private sector. The correlation between the minimum wage and the $25^{th}$ ($75^{th}$) percentile is 0.86 (0.75) in the private sector, and 0.66 (0.46) in the public sector.

Graphs 2.a and 2.b show the log real earnings distribution for each month of 1992 for both sectors (the vertical line is the minimum wage). The initial wage is lower and as a consequence the minimum wage cuts deeper into the private sector wage distribution. The spike is substantial in both sectors, but larger in the private sector. On average over the sample period, spike is 11% (6.6%) in the private (public) sector. This is large when compared to the 4% spike in the US in 1993 (Dolado et al., 1996). The spike jumped from 2% to 12% in the national aggregate, and from 2.5% to 14.5% (1.5% to 9%) in the private (public) sector in response to the minimum wage increase in September of 1991, immediately after the real minimum wage was at its lowest.

Graphs 3.a and 3.b show the non-parametric Kernel estimation of the log real earnings distribution for each month of 1992 before and after each minimum wage increase. Graphs titled April-May, August-September and December-January show the change in the shape of the distribution (the right-most distribution), confirming the expected compression effect (see Section 1). The compression effect is strong in both sectors; but in line with a more binding minimum wage and a larger spike in the private sector, it is stronger in that sector.

Graphs 4.a to 4.c show three employment variables for both the private and public sectors over time: log total average hours worked in the working population, log average hours worked for those working and log employment rate. All three variables show a slightly negative (positive) and significant (not significant) trend for the private (public) sector over time.[3] The correlation (on the top of each graph) between the minimum wage and total hours worked, hours worked by those working and employment rate is respectively 0.41, 0.38 and 0.19 (-0.09, -0.12 and -0.01) in the private (public) sector. On the one hand, these correlations do not offer much support for a negative effect of the minimum wage on employment in the private sector, but it might offer some support for negative effect in the public sector. On the other hand, the presence of a spike, spillover effects, and the associated

[2] Accommodation and food costs can be deducted from the wage. That might account for some below minimum wage workers, although the majority of those are informal sector workers. Notice the proportion of below minimum wage workers working in the public sector in Graph 2.b (between 12% and 21% in a poor region, and between 9% and 13% in the aggregate), where there should supposedly be full compliance with the law.

[3] As a result of the 1988 Constitutional shortening of the length of the workweek and workday, the three variables were expected to show clear changes in their trend after that, but this is only observed in the private sector.

compression effect in both sectors, stronger in the private sector, suggest that employment decreases in both sectors, possibly by more in the private sector.

## 3. WAGE EFFECTS

A simple empirical model of wages as a function of the minimum wage, grounded on the standard neoclassical theory, is:

$$\Delta \log wage_{rt} = \alpha^w + \beta^w \Delta \log MW_t + \gamma^w \inf lation_{rt-1} + \delta^w \Delta urate_{rt-1} + \lambda^w controls_{rt} + f_r^w + f_t^w + u_{rt}^w \quad (1)$$

where $wage_{irt}$ is log hourly average wages in region $r$ and month $t$, $r = 1,...,6$, and $t = 1,...,214$; $MW_{rt}$ is log hourly minimum wage;[4] $\inf lation_{rt-1}$ is past inflation; $urate_{rt}$ is past unemployment rate; $f_r^w$ and $f_t^w$ are region and time fixed effects modelled by region and time dummies; $u_{irt}^w$ is the error term; and $controls_{rt}$ are variables that control for region specific demographics correlated with the minimum wage, i.e. the proportion of workers in the population who are: young, younger than 10 years old, women, illiterates, retired, students, in urban areas, in the public sector, in the building construction industry sector, in the metallurgic industry sector, basic education degree holders, high school degree holders, and the proportion of workers with a second job.[5] The regional dummies model region specific trends because regions are expected to differ not only in their business cycles but also in the pace of the cycle. The models were sample size weighted to account for the relative importance of each region (and heteroskedasticity arising from aggregation) and White-corrected.

This model can be estimated not only using average wages, but also the 5th, 10th, 15th, 20th, 25th, 30th, 35th, 40th, 45th, 50th, 90th and 95th percentiles of the wage distribution. This makes it possible to estimate the effect of the minimum wage throughout the wage distribution (Dickens et al., 1999).

Because the nominal minimum wage is national in Brazil, $\beta^w$ is not identified. The typical minimum wage variables used in the literature are the real minimum wage and the "Kaitz index" (Kaitz, 1970), defined as the ratio of the minimum wage to average wage adjusted for coverage of the legislation. Although both vary across regions and over time, the variation in the denominator is what drives the variation in the ratio, because the nominal minimum wage in Brazil is national (see Section 2). As a result, the effect of the inverse of average wages or inverse of the deflator on wages is what would ultimately be estimated (Welch and Cunningham, 1978; Freeman, 1982).

Two other minimum wage variables used in the literature are the "fraction affected", defined as the proportion of workers earning a wage between the old and the new minimum wage (Card, 1992) and the "spike" in the wage distribution (see Section 2), defined as the proportion of workers earning one minimum wage (Dolado et al., 1996) (plus or minus 0.02%, to account for rounding approximations). Brown (1999) compares the "degree of impact" measures (e.g. fraction affected) and the "relative minimum wage" variables (e.g. Kaitz index) and concludes that the former are conceptually cleaner because they measure the effect of the minimum wage at the point that really matters. Nonetheless, fraction is constant at zero when the minimum wage is constant and does not capture its erosion in relation to other wages. Spike is not only a measure of this erosion, but also a measure of those

[4] The hourly minimum wage rate is obtained by dividing the monthly minimum wage by 44x4.3 after and 48x4.3 until September of 1988, when the New Constitution shortened the working week. The hourly wage rate is obtained by dividing monthly earnings by 4.3 times the number of hours worked weekly.

[5] Enrolment rates in school (Card and Krueger, 1995; Neumark and Wascher, 1992 and 1996) was not included here because of the unresolved debate in the literature (Williams, 1993; Baker et al., 1999) as to whether employment and enrolment rates are simultaneously determined with employment or not.

workers whose wages went up and thus, a measure of extra wage and employment costs. Its correlation with the log hourly real minimum wage and the log Kaitz index is 0.61 and 0.67 respectively.[6]

Thus, to ensure identification, the log hourly minimum wage in Equation (1) is replaced by the spike. Even though spike has variation across regions and over time, modelling time effects with interactions of (12) month and (16) year dummies would eliminate all the variation in the model. That is because the variation in the minimum wage (and associated variation in spike) is not independent of the variation in the time dummies since the minimum wage is systematically increased on a particular month (mostly in May). To preserve the relevant variation, only the interaction of (11) month and (16) year dummies, excluding the May interaction but including a seasonal-month May dummy, are included to model time fixed effects.

Equation (1) was estimated separately for each sector. Table 1 shows estimates calibrated to express the effect of a 10% minimum wage increase. A 10% increase in the nominal minimum wage increases spike by 0.3 percentage points and is associated with an increase in the wages of those in the $10^{th}$ ($20^{th}$) percentile of 0.70% (0.56%) in the private and of 0.27% (-0.05%) in the public sector.[7] Table 1 also shows estimates for percentile ratios and standard deviation regressions, whereby percentile ratios and the standard deviation of the log real hourly wage distribution replace log real hourly average wages in Equation (1). A 10% increase in the nominal minimum wage is associated with a decrease in the $90^{th}$-$10^{th}$ percentile gap of 0.95% (0.80%), decomposed into a decrease in the $90^{th}$-$50^{th}$ gap of 0.13% (0.26%) and in the $50^{th}$-$10^{th}$ gap of 0.82% (0.54%) in the private (public) sector.

This evidence shows that the minimum wage compresses the wage distribution of both sectors. The compression effect extends higher in the private sector wage distribution. This is in line with the evidence discussed in Section 2 which shows that the minimum wage cuts deeper into the private sector wage distribution (see Graphs 3.a and 3.b). They are also in line with previous (overall) wage effects empirical evidence in the international and Brazilian literature (see Section 1).

## 4. EMPLOYMENT EFFECTS

A simple empirical model of employment as a function of the minimum wage, grounded on the standard neoclassical theory, is:

$$\Delta \log employment_{rt} = \alpha^e + \beta^e \log \Delta MW_{rt} + \gamma^e \inf lation_{rt-1} + \lambda^e controls_{rt} + f^e_{rt} + f^e_{rt} + u^e_{rt} \qquad (2)$$

[6] Unlike in Section 2, spike is here defined using real hourly wages rather than real earnings. The estimation results in Sections 3 and 4 are robust to either definition, suggesting negligible measurement errors. The hourly definition ensures that the results are consistent with theory and comparable with the existing empirical literature (most countries have an hourly minimum wage). It also plays a crucial role when defining the employment decomposition in Section 4.

[7] The 0.3 calibration factor is the coefficient of the nominal minimum wage on a regression of the difference of spike on the difference of the log of the nominal minimum wage and the other regressors in Equation (1). Because the nominal minimum wage does not vary across regions (see Section 2.1), log Kaitz index and its variations (where the median and the $25^{th}$ percentile replace the average wages) were also used, producing remarkably robust results. This can be intuitively understood by comparing it with a deterministic model where $y = a_1 + b_1 x$, $y = a_2 + b_2 z$, $z = a_3 + b_3 x$ and $b_1 = b_2 b_3$, $\forall\ b_1, b_2, b_3 \neq 0$. Lemos (2004) and Card and Krueger (1995) interpret their fraction estimates in a similar manner.

where $employment_{rt}$ is taken in turn to mean average hours in the population ($\overline{T}$), average hours for those working ($\overline{H}$) and the employment rate ($E$); the other regressors are as in Section 3. Allowing dynamics, to account for lagged responses in employment (Hamermesh, 1995), the new equation is:[8]

$$\Delta \log employment_{rt} = \alpha^e + \beta^e \Delta \log MW_{rt} + \gamma^e \inf lation_{rt-1} + \lambda^e controls_{rt} + \sum_{l=1}^{24} \rho_l^e \log \Delta employment_{rt-1} + f_r^e + f_t^e + u_{rt}^e \quad (2')$$

Estimating Equations (2) and (2') separately using each of the three employment variables ($\overline{T}$, $\overline{H}$ and $E$) in turn as dependent variables and using the same set of regressors in each one of the three equations, the estimate of the real minimum wage in the $\overline{T}$ equation equals the sum of the estimates of the real minimum wage in the $\overline{H}$ and $E$ equations, i.e. $\beta_T^e = \beta_H^e + \beta_E^e$.[9] This makes it possible to decompose the total effect of a minimum wage increase on employment into hours effect and jobs effect (Lemos, 2004). As in Section 3, to ensure identification, the log hourly minimum wage in Equations (2) and (2') is replaced by the spike. The models were again White-corrected and sample size weighted.[10]

Equations (2) and (2') were estimated separately for each sector. Table 2 shows estimates calibrated to express the effect of a 10% minimum wage increase (see Section 3). Estimates for the dynamic model in column 2 shows that a 10% increase in the nominal minimum wage (increases spike by 0.3 percentage points and) is associated with an increase in total employment of 0.10% (0.0%) in the private (public) sector, decomposed into 0.7% (0.01%) increase (decrease) in the number of hours worked and 0.03% (0.01%) increase in the number of jobs. After two years of adjustments, total employment decreases (increases) by 0.07% (0.04%). For both sectors, the total and hours effect estimates were smaller before, but the job effect estimates were larger after including dynamics. The estimates are significant (not significant) in the private (public) sector.

This evidence suggests that the minimum wage employment effects are not adverse in the short run in either sector. In the long run, the minimum wage decreases employment in the private sector mainly via decrease in the number of hours worked, rather than a decrease in the number of jobs. In the public sector, even in the long run, no evidence of adverse employment effects was uncovered. This suggests an inelastic labour demand curve in the public sector.

Thus, despite of sizeable wage effects in both sectors, employment effects are small. They are also small when compared to the -1% (overall) employment effect in the international literature, but in line with previous (overall) employment effect evidence for Brazil (see Section 1).[11] Nonetheless there is neither available empirical evidence across the private and public sectors in the Brazilian or international literature to compare the above results with, nor a specific theory that predicts such effects. However, the results are intuitive and can be argued to be loosely in line with theory. This is because theory predicts a stronger effect on population groups where the minimum wage is more

[8] Employment is reported to be AR(2) using annual data (Layard et al., 1991), which is equivalent to 24 lags on monthly data. The results were robust to including 12 lags only, but that was thought to prematurely censor the adjustment process because lags beyond 12 were still significant.

[9] Because of dynamics, the set of regressors is not the same in all three equations and the OLS additivity property does not hold exact. To preserve the decomposition, lagged $\overline{T}$, which embodies the variation of $\overline{H}$ and $E$, was used in all three equations without affecting the robustness of the estimates.

[10] GMM *a la* Arellano and Bond (1991) is not an option because T>N. Lemos (2003) shows that any endogeneity coming from the simultaneous determination of spike and employment is not too severe and that OLS estimates are robust to GMM estimation using a number of instruments for spike.

[11] Lemos (2004) finds small (overall) employment effects in Brazil, and offers some explanations associated to specificities of developing countries.

binding. In that sense, evidence of stronger compression effects and more robust and more negative employment effects in the private than in the public sector is in line with theory.

## 5. CONCLUSION

This paper estimates the effects of the minimum wage on wages and employment in both the private and public sectors in Brazil. This is an important contribution to the literature because there is very limited evidence on the minimum wage effects in developing countries, and none whatsoever on the minimum wage effects across the private and public sectors.

The minimum wage was found to compress the wage distribution of both sectors. Consistent with the presence of a larger spike, larger spillover effects, and a stronger compression effect in the private sector, more adverse long run employment effects are also observed in that sector. In the public sector, no evidence of adverse long run employment effects was uncovered, suggesting an inelastic labour demand curve in that sector. This is supporting evidence that a Government employer does not respond to a minimum wage increase in the same way that a profit maximizing firm does.

The evidence in this paper implies that the associated non-negative employment effect in the public sector offsets some of the negative employment effect observed in the private sector, diluting the overall employment effect to be less adverse. It is therefore important to investigate the private and public sectors effects underlying the overall effect, as the latter might mislead policymakers to increase the minimum wage more generously than they would otherwise. This might not affect the public sector, but might adversely affect the private sector.

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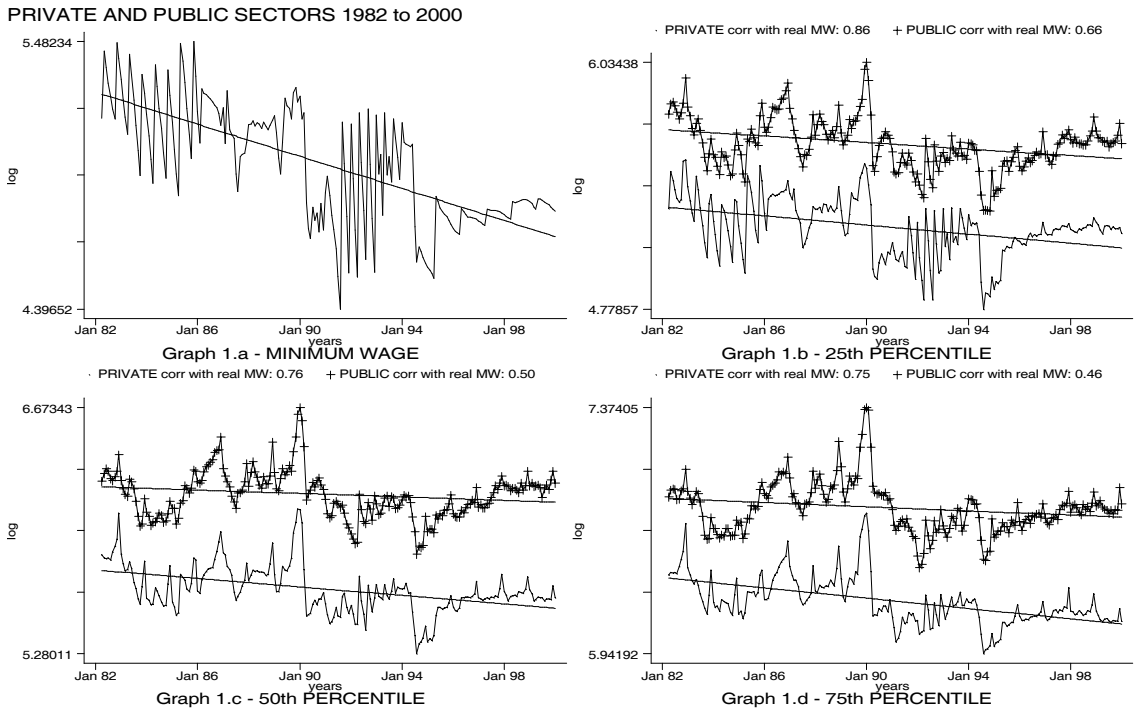


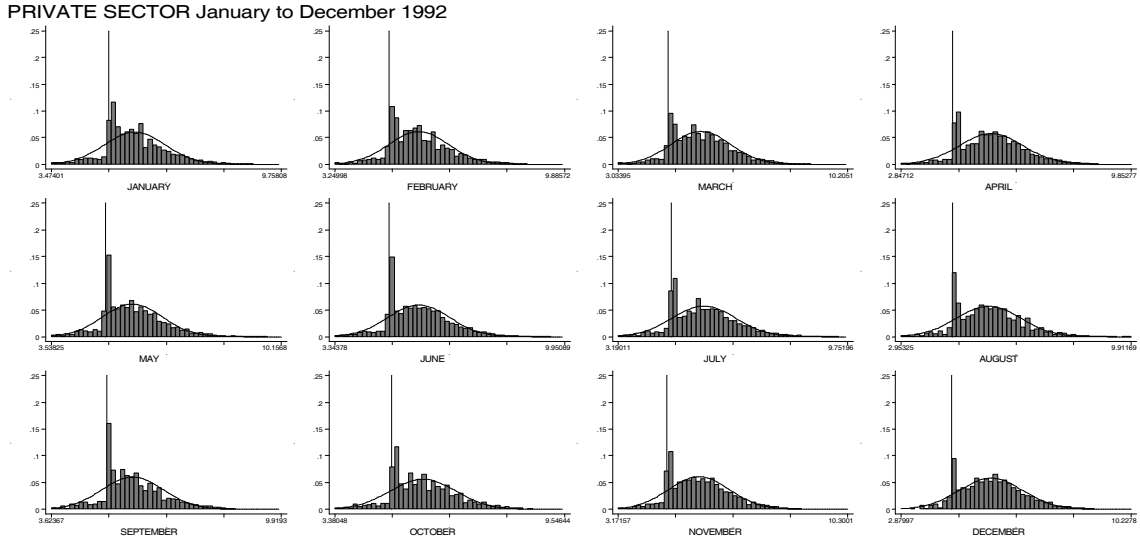

Graph 1.a - MINIMUM WAGE

Graph 1.b - 25th PERCENTILE

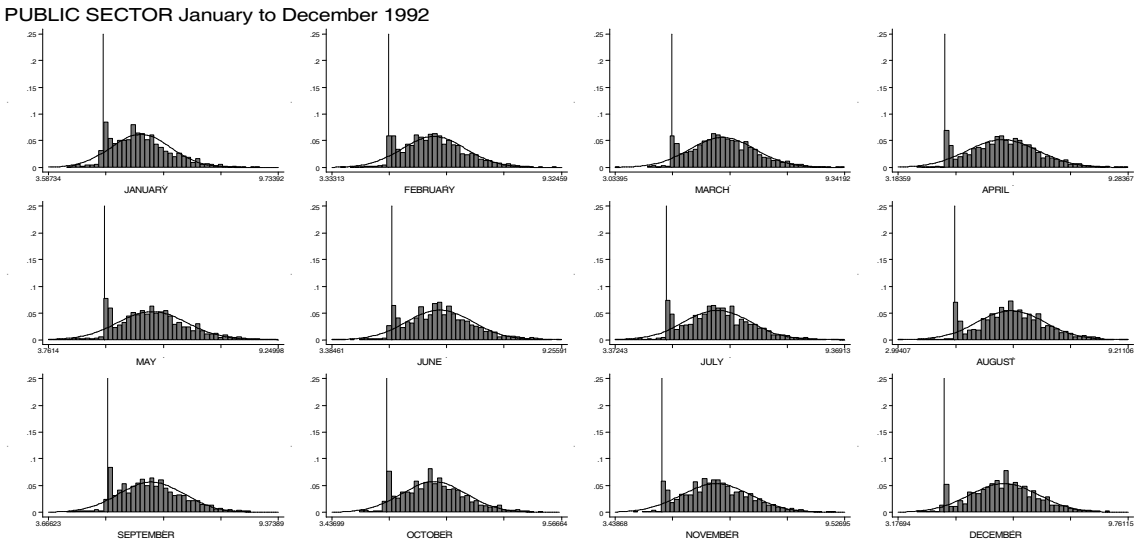
Graph 1.c - 50th PERCENTILE

Graph 1.d - 75th PERCENTILE

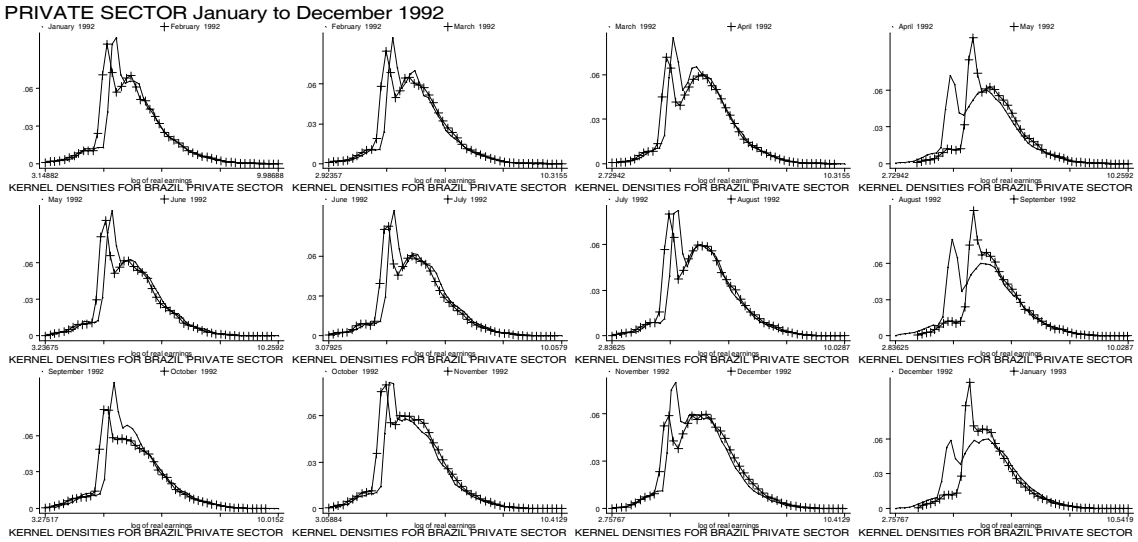
ph 1 - REAL MINIMUM WAGE AND REAL EARNINGS DISTRIBUTION PERCENTI



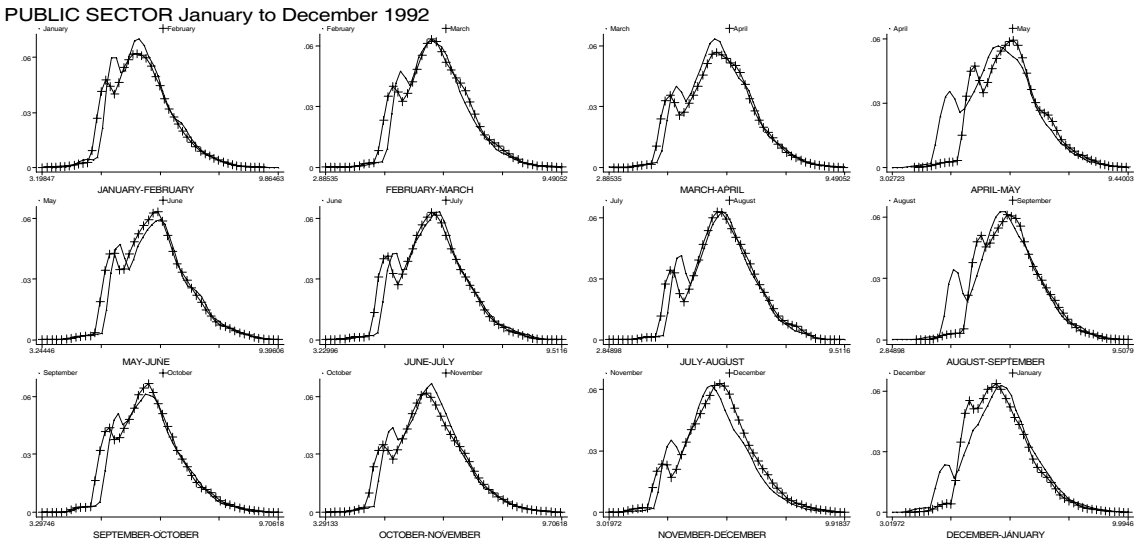

Graph 2.a - EARNINGS DISTRIBUTION



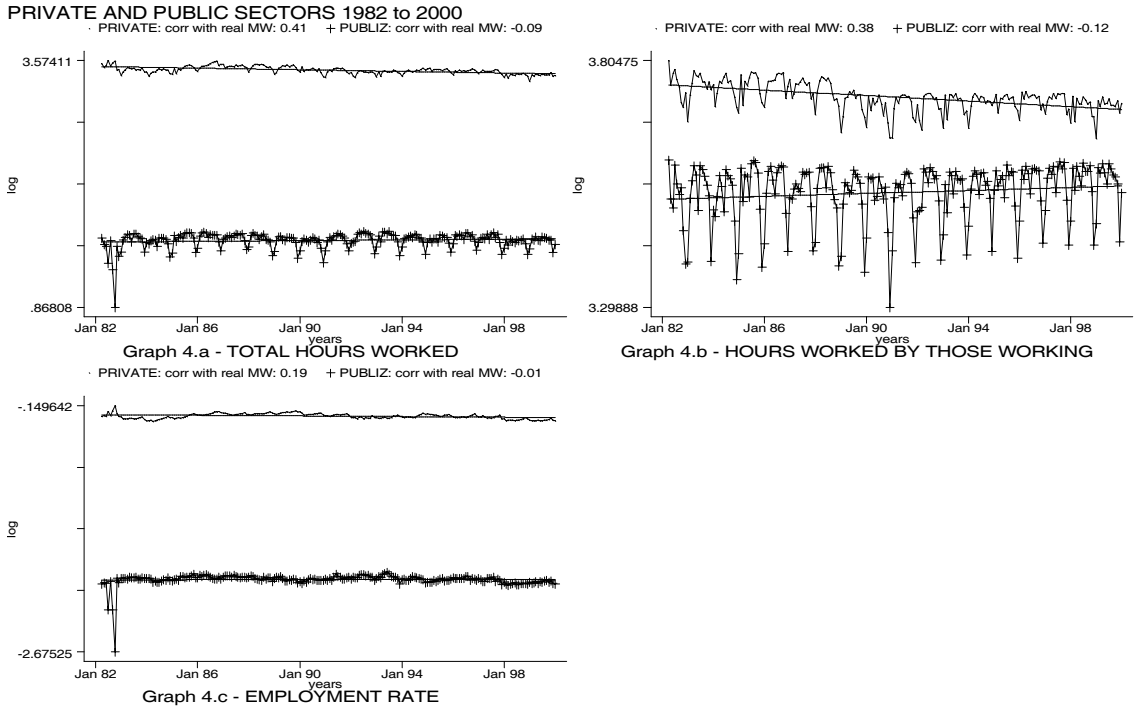

Graph 2.b - EARNINGS DISTRIBUTION




Graph 3.a - EARNINGS KERNEL DISTRIBUTIONS




Graph 3.b - EARNINGS KERNEL DISTRIBUTIONS




Graph 4.a - TOTAL HOURS WORKED

Graph 4.b - HOURS WORKED BY THOSE WORKING

Graph 4.c - EMPLOYMENT RATE

Graph 4 - HOURS WORKED AND EMPLOYMENT RATE

**Table 1 - EFFECT OF A 10% INCREASE IN THE MINIMUM WAGE ON WAGES**

| percentiles | coef | se | coef | se |
|---|---|---|---|---|
| | A - private sector | | B - public sector | |
| 5th | **0.58** | 0.18 | **0.87** | 0.21 |
| 10th | **0.70** | 0.21 | **0.27** | 0.22 |
| 15th | **0.57** | 0.20 | **-0.02** | 0.19 |
| 20th | **0.56** | 0.19 | **-0.05** | 0.17 |
| 25th | **0.16** | 0.18 | **-0.09** | 0.15 |
| 30th | **0.16** | 0.16 | **0.02** | 0.14 |
| 35th | **-0.03** | 0.16 | **0.01** | 0.14 |
| 40th | **-0.10** | 0.14 | **-0.10** | 0.14 |
| 45th | **-0.15** | 0.12 | **-0.12** | 0.14 |
| 50th | **-0.14** | 0.12 | **-0.08** | 0.14 |
| 90th | **-0.20** | 0.12 | **-0.31** | 0.18 |
| 95th | **-0.13** | 0.14 | **-0.38** | 0.20 |
| mean | **0.04** | 0.11 | **-0.02** | 0.11 |
| *90th/10th* | ***-0.95*** | *0.21* | ***-0.80*** | *0.25* |
| *90th/50th* | ***-0.13*** | *0.12* | ***-0.26*** | *0.17* |
| *50th/10th* | ***-0.82*** | *0.16* | ***-0.54*** | *0.21* |
| *st.deviation* | ***-0.19*** | *0.05* | ***-0.19*** | *0.06* |

1) Percentile regressions are shown for selected percentiles, followed by percentile ratio and standard deviation regressions. The dependent variable is the various percentiles, ratios of percentiles and standard deviation of the wages distribution.
2) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors (see Section 3).
3) The A panel shows estimates for the private and the B panel for the public sector.
4) To obtain the equivalent of a 10% increase in the minimum wage, the estimates of spike were multiplied by 0.3.

**Table 2 - EFFECT OF A 10% INCREASE IN THE MINIMUM WAGE ON EMPLOYMENT**

| model | static | | dynamic | | *lr* | static | | dynamic | | *lr* |
|---|---|---|---|---|---|---|---|---|---|---|
| dependent | coef | se | coef | se | *coef* | coef | se | coef | se | *coef* |
| variable | (1) | | (2) | | *(3)* | (1) | | (2) | | *(3)* |
| | A - private sector | | | | | B - public sector | | | | |
| total employment | **0.12** | 0.03 | **0.10** | 0.03 | *-0.07* | **0.07** | 0.09 | **0.00** | 0.07 | *0.04* |
| hours worked | **0.10** | 0.03 | **0.07** | 0.03 | *-0.06* | **0.07** | 0.09 | **-0.01** | 0.07 | *0.05* |
| employment rate | **0.02** | 0.01 | **0.03** | 0.01 | *0.01* | **0.00** | 0.02 | **0.01** | 0.02 | *0.00* |

1) The dependent variable is average hours worked for the working population, average hours worked for those employed and employment rate. Hours and Job elasticities add to Total elasticity.
2) Column 1 shows the base specification with past inflation, controls, region and time fixed effects; and column 2 adds dynamics to the base specification (24 lags of the independent variable). Column 3 shows the long run coefficient associated to the short run coefficient in column 2.
3) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors (see Section 3).
4) Panels A and B show respectively estimates for the private and public sectors.
5) To obtain the equivalent of a 10% increase in the minimum wage, the estimates of spike were multiplied by 0.3.