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MINIMUM WAGE EFFECTS IN A DEVELOPING COUNTRY

Sara Lemos, University of Leicester, UK

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Sara Lemos[*†]

University of Leicester

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Abstract

The available minimum wage literature, which is mostly based on US evidence, is not very useful for analyzing developing countries, where the minimum wage affects many more workers and labor institutions and law enforcement differ in important ways. The main contribution of this paper is to present new empirical evidence on minimum wage effects for a key developing country, Brazil. Using a monthly household survey panel from 1982 to 2000 we find evidence of a strong wage compression effect for both the formal and informal sectors. Furthermore, we find no evidence of adverse employment effects in either sector.

Keywords: minimum wage, labor costs, employment, informal sector, Brazil.

JEL code: J38.

[*]Dr. Sara Lemos, University of Leicester, Economics Department, University Road, Leicester LE1 7RH, England, +44 (0)116 252 2480, +44 (0)116 252 2908 (fax), sl129@leicester.ac.uk.

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1 Introduction

The minimum wage literature contains very limited evidence concerning developing countries, as noted by Hamermesh (2002), Harisson and Leamer (1997) and Gidling and Terrell (2004) among others. The available literature, which is mostly based on US evidence, shows that the minimum wage compresses the wage distribution and has, at most, a small adverse effect on employment (Brown, 1999; Neumark and Wascher, 1992; Williams, 1993; Card and Krueger, 1995). However, the economics of the minimum wage is different in developing countries, where the minimum wage affects many more workers and labor institutions and law enforcement differ in important ways. For example, the limited evidence for Latin America indicates that the wage compression and employment effects are considerably stronger in developing countries than they are in developed countries (Castillo-Freeman and Freeman, 1992; El-Hamidi and Terrell, 2002; Maloney and Mendez, 2004; Montenegro and Pages, 2004). Nonetheless, this literature consists of very few studies (mostly one or two for each country) and the results are sometimes conflicting. For instance, although the evidence for Brazil also indicates that the minimum wage strongly compresses the wage distribution, it suggests a small adverse employment effect (Carneiro and Henley, 2001; Neumark et al., 2005; Lemos, 2004). Hamermesh (2002) argues that much more evidence is required to evaluate measures such as recent Latin American policymakers' promises of minimum wage increases (The Economist, 2002 and 2003).

The main contribution of this paper to the literature and policy debate is to present new empirical evidence on the effect of the minimum wage for a key developing country, Brazil. In developing countries a large proportion of workers is outside the umbrella of minimum wage legislation. In such a context, the common theoretical model used as a basis for empirical analysis in the literature is the standard Welch-Gramlich-Mincer Two Sector Model (Welch, 1976; Gramlich, 1976; Mincer, 1976). Following a minimum wage increase, the principal prediction of the Two Sector Model is that wages in the uncovered

sector fall as a result of displaced workers in the covered sector moving into uncovered sector employment. Therefore, the wage effect is expected to be positive in the covered sector and negative in the uncovered sector, while the expected employment effect is negative in the first and positive in the second.

We test these predictions using a monthly Brazilian household survey from 1982 to 2000 and panel data techniques. We find robust evidence of positive wage spillover effects resulting in a strong wage compression in both the covered and uncovered sectors. Furthermore, we find no evidence of adverse employment effects in either sector. These results, which are robust to various different estimation strategies, are in contrast with the predictions of the Two Sector Model. Fajnzylber (2001) also found results in contrast with the theory predictions for Brazil. He used his wage estimates to indirectly derive negative employment elasticities in both sectors. Conversely, Carneiro (2004), Corseuil and Carneiro (2001) and Foguel, Ramos and Carneiro (2001) used time series techniques and reported results in line with the Two Sector Model predictions for Brazil.

To reconcile our results with the existing theory we argue that the Brazilian economy suffers from non-compliance, rather than non-coverage, and thus the predictions from the Two Sector Model may not hold. For example, Mincer (1976) notes that the prediction of falling uncovered sector wages is not robust to alternative assumptions on sectoral choice and unemployment. This suggests that informal sector wages and employment may not respond to an increase in the minimum wage in the same way that uncovered sector wages and employment do. Other researchers have also questioned the validity of the Two Sector Model to explain minimum wage effects in Brazil and Latin America (Barros et al., 1997; Maloney and Mendez, 2004).

The main policy implication from our findings is that the minimum wage could be an effective policy tool in the fight against poverty and inequality without destroying too many jobs in Brazil. The remainder of this paper is organized as follows. In Section 2 we describe

the data, and in Sections 3 and 4 we estimate wage and employment effects. In Section 5 we describe a number of robustness checks and in Section 6 we summarize and conclude.

2 Data and Descriptive Analysis

2.1 Minimum Wage

The minimum wage was first introduced in Brazil in 1940 to provide subsistence income for an adult worker. The bundle of goods upon which it was based varied across regions, which was reflected in 14 different minimum wages. After a steep decline during the 1940s real minimum wages were adjusted reaching their peak during the boom of the 1950s, when productivity was high, unions were strong, and the government was populist. Subsequently, they decreased as a result of the subsequent recession, rising inflation, and passive unions. After the installation of the dictatorship in the mid 1960s, real minimum wages were systematically devalued because the government associated the then high inflation with wage adjustments. In the early 1980s the minimum wage was set at a national level, after slow regional convergence. Since then there has been a universal minimum wage for all regions, demographic groups and labor market categories. However, workers in firms where compliance is incomplete may earn wages that are lower than the minimum wage. Thus, coverage is full but compliance is not. With the end of the military regime in the mid 1980s, the new constitution re-defined the subsistence income for an adult worker and their family. The minimum wage continued to be used as a deflationary policy tool throughout the 1980s and most of the 1990s. Since the mid 1990s, under reasonably stable inflation, the minimum wage has again been used as a social policy tool.

The minimum wage data we utilize is from the Brazilian Labor Ministry. In Figure 1 we plot the log real minimum wage, which clearly shows a negative trend between January 1982 and January 2000. Minimum wage increases during this period were subject to the

rules of five different stabilization plans. The increases were large and frequent, but quickly eroded by subsequent inflation. In early 1986, the nominal minimum wage was increased by 15% and initially adjusted bi-annually. It was then adjusted whenever inflation was higher than 20%. Despite this, the real minimum wage was 25% lower in mid 1987 than it was in early 1986. The nominal minimum wage was then initially frozen for three months 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, the real minimum wage was 45% lower than it was in early 1989. In late 1991, the nominal minimum wage was again indexed monthly. In 1993, adjustments were bi-monthly and then monthly. In early 1994, adjustments were made daily, which did not prevent the real minimum wage from falling 40% by mid 1994. In mid 1995 the nominal minimum wage was increased by 42%, and since then it has been adjusted annually.

2.2 Wages and Employment

The other data we use is from the Brazilian Monthly Employment Survey (PME). The PME is a rotating household panel similar to the US Current Population Survey (CPS). Households are interviewed for four consecutive months, not interviewed for the following eight months, and then interviewed again for four additional months. In the PME the panels are refreshed every two years, rather than every year, as is the case in the CPS. The data was collected by the Brazilian Institute of Statistics and Geography (IBGE) for the six main Brazilian metropolitan regions (Salvador, Recife, Belo Horizonte, Rio de Janeiro, Sao Paulo and Porto Alegre) between January of 1982 and January of 2000. We deflate wages using the IPC (Consumers Price Index), also available from the IBGE.

We split the sample between formal and informal sector workers. The informal sector is the section of the economy where legislation is not complied with. The standard procedure in the Brazilian literature is to classify informal sector workers as those who do not hold a

signed labor contract card, excluding the self-employed (Carneiro and Henley, 2001). (We later perform robustness checks for the self-employed.[1]) In Table 1 we provide descriptive statistics for the poorest region (Recife) and the richest region (Sao Paulo) in the sample. Wages are lower in Recife, where the share of children, retired and low educated is higher. Formal sector employment is lower and informal sector employment is higher in Recife. We thus aggregate the data across regions and across months to exploit this variation across regions to identify the minimum wage effect on wages and employment in our econometric models, as we explain in detail below. The average number of observations per region-month cell is 13,000.

Our wages variable is net monthly real wages. In Figure 2 we plot the Kernel log real wage distribution for the formal and informal sectors in April-May 1992, which is a representative year for the remainder of the sample period. The most striking feature of Figure 2 is that a sizeable spike at the minimum wage level is observed in the distribution of both sectors. This spike is towards the bottom in the formal sector, whereas it is towards the centre of the distribution in the informal sector. That is because wages are lower and more dispersed in the informal sector, as is also evident from Table 1. As a result, the minimum wage is more binding and non-compliance is larger in that sector. The percentile of the wage distribution where the minimum wage bites changes over time and across regions; our data show that while the minimum wage is located between the 5^{th} and 10^{th} percentiles in the formal sector, it lies between the 15^{th} and 30^{th} percentiles in the informal sector (also see Table 1).

The presence of a spike in both sectors suggests that in practice the minimum wage is paid in both sectors, despite of there presumably being non-compliance with the law in the

[1] We first focus our analysis on salaried employees, all of which are covered by the legislation. Here the main issue is whether firms where such employees work comply with the legislation. We later focus our anlaysis on a group of non-salaried workers that are perhaps less likely to be covered by the legislation, the self-employed. The focus on the formal and informal split results from a traditional hypothesis in the literature that the destination of workers displaced from the formal sector is the informal sector (McDonald and Solow, 1985; Carneiro and Henley, 1998; Maloney, 1999; Gonzaga et al., 1999; Soares, 2003; Corseuil and Carneiro, 2001; McIntyre, 2002).

informal sector. Here, non-compliance is observed in other aspects of the labor contract, such as social security taxes, holidays cashed in money, flexible hours, etc. (Amadeo and Camargo, 1997). Workers take the same pay home (perhaps taking advantage of flexible working hours) and firms have lower labor costs (overhead costs are around 100% of the wage in Brazil). Put differently, the informal sector offers a way of avoiding the inefficiencies of labor market regulations (Maloney, 1999). The presence of a spike in both sectors has been documented for Brazil and other Latin America countries (Maloney and Mendez, 2004; Gonzaga et al., 1999). The presence of a spike in the uncovered sector has also been documented for the US (Card and Krueger, 1995; Brown, 1999).

We plot the size of the spike, or "fraction at", over time across the formal and informal sectors in Figure 3. "Fraction at" is defined as $0.98w_t^M \leq w_t \leq 1.02w_t^M$, where w^M is the monthly nominal minimum wage and w is the nominal wage.[2] This is the main minimum wage variable that we use in our econometric models below. Figure 3 shows that "fraction at" has considerable variation over time. For example, it jumped from 2% to 14% (0.3% to 12%) in the formal (informal) sector in response to the minimum wage increase in September of 1991, immediately after the real minimum wage reached its lowest ever level. This is large when compared to the 4% spike in the US in 1993 (Dolado et al., 1996). Table 1 shows that "fraction at" also has considerable variation across regions and is significantly larger in Recife. "Fraction at" in the formal sector is almost five times larger in Recife than it is in Sao Paulo, and in the informal sector it is almost twice as large in Recife.

Another striking feature of Figure 2 is the strong compression effect on the wage distribution of both sectors following a minimum wage increase. The compression effect is at the bottom of the distribution in the formal sector and towards the centre of the distribution in the informal sector. This is in line with the position of the spike in each sector's distribution.

[2] The bounds account for measurement error introduced by rounding approximations. This is because in the presence of high inflation as in Brazil, people tend to report rounded wages. All estimates in the paper were robust to defining "fraction at" with and without bounds.

This suggests that the minimum wage redistributes in favor of the relatively poor in both sectors. It appears to be more effective in reducing inequality in the formal sector, where compliance is more complete. In the informal sector, where non-compliance is larger, the poorest might be out of the reach of the legislation.

If, in the absence of a minimum wage increase, the wage distribution could be assumed to be stable over time (if individuals did not change positions within, or drop out of, the distribution), then this simple comparison of Kernel distributions before and after an increase would provide an estimate the effect of the minimum wage on the wage distribution (Meyer and Wise, 1983). However, shifts in the distribution might also be due to changes in other variables. Thus, we control for the effect of other variables (demand and supply shocks) on wages in our econometrics models below.

Our main employment variable is the employment rate. We calculate the share of those employed in the formal and informal sectors, in relation to the labor force. In Figure 4 we plot these shares over time across sectors. The formal sector share is roughly twice as large as the informal sector share, as is also illustrated in Table 1. The trend is negative for the formal sector but positive for the informal sector. (The two figures show a clear change in their trend following the 1988 constitutional shortening of the length of the working week and working day, which we control for in our econometrics models below.)

These plots, together with that of the real minimum wage (see Figure 1), do not offer much support for a negative employment effect in the formal sector, but might offer some support for a negative effect in the informal sector. For example, the correlation between the minimum wage and the employment rate is 0.57 in the formal sector and -0.67 in the informal sector. However, such raw correlations need to be proved robust when the effect of other variables (demand and supply shocks) on employment is controlled for. We control for such shocks in our econometric models below. The other employment variable we use is average hours worked in the working population. The correlation between this variable and

the minimum wage is 0.12 in the formal sector and 0.45 in the informal sector. The final employment variable we use is total employment, which is the product of the first two.[3] The correlation between this variable and the minimum wage is 0.59 and -0.57 respectively in the formal and informal sectors.

3 Wage effects

3.1 Model Specification

We estimate wage effects for the formal and informal sectors separately using a common reduced form equation that is grounded in the standard neoclassical model (Dickens et al., 1999; Card and Krueger, 1995):

$$\Delta \ln W_{rt} = \alpha^W + \beta^W \Delta \ln W_{rt}^M + \delta^W \Delta u_{rt-1} + \lambda^W \Delta X_{rt} + f_r^W + f_t^W + \epsilon_{rt}^W \qquad (1)$$

where W_{rt} is our measure of wages; W_{rt}^M is the monthly real minimum wage; u_{rt-1} is the past unemployment rate; X_{rt} are labor supply shifters; f_r^W and f_t^W are region and time fixed effects; and ϵ_{rt}^W is the error term in region r and month t, $r = 1, ..., 6$, and $t = 1, ..., 214$. Regional dummies model region growth specific trends. We take W_{rt} to mean, in turn, the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles, the average and the standard deviation of the monthly real wage distribution. This allows us to estimate the effect of the minimum wage throughout the wage distribution (Dickens et al., 1999). Supply shifters are the proportion of the total population who are younger than 10 years old, between 10 and 24 years of age, women, illiterates, retirees, students, in urban areas, with completed basic

[3] Total employment (or average hours worked in the labor force) equals average hours worked by the working population times the employment rate, i.e. $\frac{\sum_{i=1}^{N} h_i}{N} = \frac{\sum_{i \in e}^{N} h_i}{N_e} \frac{N_e}{N}$, where N and N_e are the sample sizes of the labor force and working population respectively, and h is hours worked.

(8 years) education and high school (11 years) education; the average years of schooling in the total population; the proportion of the working population holding two jobs, in the public, construction and metallurgy sectors. A GLS correction is performed in all models in the paper to correct for heteroskedasticity arising from aggregation and to account for the relative importance of each region. Also, standard errors are corrected for serial correlation across and within regions.

As the nominal minimum wage is constant across regions in Brazil, β^W does not fully identify the effect of the minimum wage on wages in Equation (1). That is because the denominator of the real minimum wage drives the variation in the ratio. As a result, the effect of the inverse of the deflator on wages is what is ultimately estimated (Welch and Cunningham, 1978). Other minimum wage variables that have been suggested in the literature to circumvent this problem are "fraction affected", which is defined as the proportion of workers earning a nominal wage between the old and the new nominal minimum wage (Card, 1992), and "fraction at", which we defined in Section 2.2. The intuition for the later is that a constant minimum wage affects a different proportion of workers depending on the initial level and shape of the wage distribution across regions. This cross region variation is then exploited to ensure identification of the effect of the minimum wage on wages. "Fraction at" is superior because "fraction affected" does not capture the erosion of the minimum wage in relation to other wages because it is constant at zero when the minimum wage is constant (Brown, 1999).

The main drawback with using such variables in place of the log real minimum wage in equations such as Equation (1) is that the interpretation of their coefficient is not straightforward. For example, the coefficient of "fraction at" would be informative of the change in employment given a change in the proportion of workers earning one minimum wage but not given a change in the minimum wage itself. A more intuitive and policy relevant minimum wage variable is the interaction of the minimum wage with "fraction at". This

gives a weighted minimum wage, where the impact of a national minimum wage increase in each region is measured by the proportion of workers earning one minimum wage in that region. Thus, we modify Equation (1) in the following way:

$$\Delta \ln W_{rt} = \alpha^W + \beta^W \Delta \ln W_{rt}^M + \eta^W F_{rt} + \gamma^W F_{rt} \Delta \ln W_{rt}^M + \delta^W \Delta u_{rt-1} + \lambda^W \Delta X_{rt} + f_r^W + f_t^W + u_{rt}^W \tag{2}$$

where F_{rt} is "fraction at" as defined in Section 2.2 and u_{rt}^W is the new error term. The change in wages given by a marginal change in the minimum wage is $\beta^W + \gamma^W F_{rt}$. We can evaluate this derivative at the average "fraction at" across all regions and sectors (11.6%) or at the average "fraction at" for a particular sector in a particular region (e.g. 12% in the Recife informal sector or 3.3% in the Sao Paulo formal sector, as shown in Table 1). However, as discussed above, β^W does not identify the effect of the nominal minimum wage on wages, which has been expanded out in the time effects. Thus, we interpret the γ^W coefficient as deviations from the mean effect that would have been captured by β^W, but instead is captured by the time effects. Therefore, our coefficient of interest here is γ^W. To illustrate, if γ^W was 1, then a 1% increase in the minimum wage would increase wages by 0.12% in the Recife informal sector and by 0.03% in the Sao Paulo formal sector over and above the common mean effect.

3.2 Results

We estimate Equation (2) separately for the formal and informal sector. The GLS γ^W estimates across sectors are shown in Table 2. They confirm that the minimum wage strongly compresses the wage distribution of both sectors, as illustrated by the Kernel distributions in Figure 2. Whereas the compression effect is at the very bottom of the formal sector

distribution, it is higher up in the distribution of the informal sector. In the formal sector we observe that the wage effect decreases throughout the distribution, while in the informal sector it first increases then decreases. In the formal sector, a 1% increase in the minimum wage increases the wages of those in the 25^{th} percentile by 0.33% and of those in the 50^{th} percentile by 0.10% (evaluated at the average "fraction at" 11.6%). The wage effect is significant and robust up to the 50^{th} percentile. In the informal sector, it increases the wages of those in the 25^{th} percentile by 0.31% and of those in the 50^{th} percentile by 0.48%. The wage effect is not significant at the 10^{th} percentile; it is significant and robust between the 25^{th} and 90^{th} percentile. This suggests that the wages of the poorest, who are in the informal sector, remain unaffected by the minimum wage legislation. With the compression effect being towards the centre of the informal sector distribution, its bottom is unaffected by minimum wage increases. As a result, reduction in inequality is small in that sector, as shown in the last row of Table 2. Finally, despite the different location of the compression effect, the effect on average wages is similar across sectors, though a bit stronger in the informal sector.

Our main conclusion following from these results is that the minimum wage strongly compresses the wage distribution of both the formal and informal sectors in Brazil between 1982 and 2000. This is in line with previous empirical evidence on the (aggregate) wage effect across the wage distribution in the literature (Brown, 1999; Card and Krueger, 1995; Lemos, 2004). While many authors found limited spillover effects for the US and the UK (Card and Krueger, 1995; Dickens et al., 1999), spillovers for Brazil and for various countries in Latin America have been found to be considerably more extensive (Maloney and Mendez, 2004; Gindling and Terrell, 1995 and 2004). Such extensive spillovers may arise because of the sizeable fraction of workers affected by the minimum wage in Brazil, and because these workers are present in several sectors, which propagates the minimum wage effect throughout the economy. For example, Fajnzylber (2001) found spillover effects throughout

the entire wage distribution of both formal and informal sectors in Brazil. Neumark et al. (2005) documented more limited effects at the bottom of the formal sector wage distribution for Brazil.

However, although our results are in line with previous empirical results in the literature, they are in contrast with the predictions of the Two Sector Model. Instead of the expected positive wage effects in the formal sector and negative wage effects in the informal sector, we have so far found positive effects in both sectors. We probe the robustness of our results further in Section 5.

4 Employment Effects

4.1 Model Specification

We estimate the employment effects using a common reduced form equation that is grounded on the standard neoclassical model (Brown, 1999), modified in the same fashion as Equation (2) to ensure identification of the effect of the minimum wage on employment:

$$\Delta \ln N_{rt} = \alpha^N + \beta^N \Delta \ln W_{rt}^M + \eta^N F_{rt} + \gamma^N F_{rt} \Delta \ln W_{rt}^M + \lambda^N \Delta X_{rt} + \sum_{l=1}^{24} \rho_l^N \Delta \ln N_{rt-l} + f_r^N + f_t^N + u_{rt}^N \tag{3}$$

where N_{rt} is our measure of employment, f_r^N and f_t^N are region and time fixed effects, and u_{rt}^N is the error term. We take N_{rt} to mean, in turn, average hours worked by the labor force, average hours worked by the working population and the employment rate, as defined in Section 2.2. The λ^N estimates in the second and third of these equations add to the one in the first equation. This allows us to decompose the total effect of a minimum wage increase on employment into a hours effect and a jobs effect. To preserve the decomposition, lagged

average hours worked by the labor force (N_{rt-l}) is used in all three equations.[4] Nonetheless, the decomposition is only approximately true, because the OLS additivity property is not preserved when a GLS correction is performed.

4.2 Results

We estimate Equation (3) separately for the formal and informal sector. The GLS γ^N estimates across sectors are shown in Table 3. They indicate that there is little evidence of adverse employment effects in either sector, whether in the short run or in the long run after 2 years of adjustment. Thus, neither the number of workers nor the number of hours worked appear to change in eather sector following a minimum wage increase. All estimates are statistically indifferent from zero, and the evidence is taken to mean that the minimum wage does not affect employment in Brazil.

Our main conclusion is therefore that the minimum wage has no adverse effect on employment in Brazil between 1982 and 2000, despite the sizeable wage effects found in both the formal and informal sectors. This is in line with prior evidence in the literature (Card and Krueger, 1995; Machin et al., 2003), although it is smaller than the -0.1% employment effect reported in Brown's (1999) survey. It is also in line with some of the previous employment effect evidence for Brazil and for other developing countries. For example, Neumark et al. (2005) estimate small negative, but not always significant, hours and jobs effects for Brazil using formal sector data in low inflation periods. In contrast, Fajnzylber (2001) found evidence supporting negative employment effects for both sectors in Brazil, and Carneiro (2004), Corseuil and Carneiro (2001) and Foguel, Ramos and Carneiro (2001) found evidence supporting negative effects in the formal and positive effects in the informal sector. Maloney and Mendez (2004) found evidence supporting negative employment effects in the formal and the self-employed sectors in Colombia. Gindling and Terrell (1995) were

[4] The results were robust to using 12 lags instead but that was thought to prematurely censor the dynamic adjustment process.

unable to find evidence of an employment effect in the formal sector in Costa Rica, but found positive effects in the self-employed (informal) sector for Costa Rica. In contrast, El-Hamidi and Terrell (2002) found evidence supporting an increase in formal employment and no effect on the self-employed for Costa Rica.

Once again, although our employment results are consistent with our wage results and are in line with previous empirical results in the literature, they are in contrast with the predictions of the Two Sector Model. Instead of the expected negative employment effect in the formal sector and positive employment effect in the informal sector, we found no effect in either sector. Fajnzylber (2001) also found results in contrast with the theory predictions. He used his wage estimates to indirectly derive negative employment elasticities in both sectors. Conversely, Carneiro (2004), Corseuil and Carneiro (2001) and Foguel, Ramos and Carneiro (2001) used time series techniques and reported results in line with the Two Sector Model's predictions. We probe the robustness of our results further in Section 5.

5 Robustness Checks

5.1 Regional Shocks

The specifications used above are quite demanding. We have controlled for the effect of macro shocks on wages and employment by defining one dummy for each time period. We also have controlled for the effect of region specific growth trends on wages and employment by adding one dummy for each region to specifications already in first differences. We further included dynamics to allow for lagged adjustment, as minimum wage increases might not affect employment contemporaneously, but in future periods (Brown et al., 1982). Finally, we have controlled for supply side variables that might be affecting wages and employment directly. Given such stringent specifications, we are confident that the remaining variation in wages and employment is due to minimum wage changes.

Our underlying assumption in these specifications is that unobservable variables that affect changes in wages and changes in employment are uncorrelated with "fraction at" and with changes in the real minimum wage. If, however, macro shocks correlated with either "fraction at" or changes in the real minimum wage affect different regions differently, our assumption might not be realistic. This assumption might also be unrealistic in the presence of region specific shocks correlated with either "fraction at" or change in the real minimum wage. Therefore, we need to control both for region specific shocks and for the potentially differentiated effect of macro shocks across regions that could be confounded with the effect of the minimum wage on wages and employment.

We include the change of three regional shock measures in our specifications, namely, past regional GDP, past regional inflation, and regional tax revenue. Following Card and Krueger (1995), we also include political measures in our specifications. These are proxy for otherwise unobservable factors in a region related to the impact of minimum wage increases. We use the number of votes in favor and against minimum wage bills to construct our first measure of political support across regions (Card and Krueger, 1995). We also define two further variables. We use the timing of elections to define an "election cycle" (Carmignani, 2003).[5] Our basic assumption is that incentives for more generous minimum wage increases depend on the proximity of elections (Sobel, 1999). We then interact the "election cycle" with our regional dummies to construct our second measure of political support across regions. Next, we consider the frequency of minimum wage increases to define a "voting cycle" (Lemos, 2005).[6] Here our assumption is that when politicians are willing to support minimum wage increases they might also be more willing to support other macro employment growth policies. We then interact the "voting cycle" with our regional dummies to construct our third measure of political support across regions.

[5] The "election cycle" is defined as a linear time trend between two consecutive elections, but the results were robust to other functional forms (exponential, squared, square root and log).

[6] As before, the "voting cycle" is defined as a linear time trend between any two minimum wage increases, but again the results were robust to other functional forms.

We re-estimate Equations (2) and (3) including our regional shock measures and our regional political support measures. These estimates, shown in Panel A of Tables 4 and 5, are qualitatively similar to our previous estimates (compare with Tables 2 and 3) and thus our main conclusion from before is maintained. The minimum wage strongly compresses the wage distribution of both sectors but does not affect employment in either sector. The compression effect is evident at the bottom of the formal sector distribution, but is higher up in the distribution of the informal sector. The strongest effect is always at the 10^{th} percentile in the formal sector and at the 50^{th} percentile in the informal sector.

We further control for region specific seasonal shocks that might be correlated with "fraction at" or with changes in the real minimum wage. This is because the minimum wage in the sample period is systematically increased in May (in 13/16 years), which also causes the variation in "fraction at" to be systematic. First, we define seasonal-month dummies to control for unobserved fixed effects across months (Burkhauser et al., 2000). Then, we interact these seasonal-month dummies with our regional dummies to separate the effect of region specific seasonal shocks from the effect of the minimum wage on wages and employment. We re-estimate Equations (2) and (3) including our region specific seasonal shock measure. These estimates, shown in Panel B of Tables 4 and 5, are again qualitatively similar to our previous estimates and thus our main conclusion from before is unchanged.[7]

[7] We have also investigated the possibility of other forms of endogeneity biasing our results. Firstly, our GLS estimates were robust to SUR estimation where we allow for the error terms of our formal and informal sector equations to be correlated. This indicates that we have controlled for the relevant macro shocks that could affect employment simultaneously in both sectors. We also performed SUR estimation allowing for the error terms across regions to be correlated and found robust estimates. Secondly, our GLS estimates were again robust to GMM estimation using lags of the minimum wage variable and lags of "fraction at" as well as a number of political variables as instruments following Lemos (2005). The associated F test, Shea R^2, Cragg-Donald and Hansen-Sargan tests confirmed the relevance and validity of our instruments, while the Hausman test showed no evidence of endogeneity between employment and the real minimum wage or "fraction at". Thirdly, we combined GMM and SUR on a three-stage estimation procedure and again found robust estimates. Finally, we considered the simultaneous effect of the minimum wage on both sectors. If workers sort themselves into the formal or informal sectors following a minimum wage increase, the sorting rule is correlated with the minimum wage. However, the Hausman test associated to our GMM estimates suggests that this correlation is zero in Brazil. This is what we expected, as we argue that workers decide in which sector to work based on things other than the minimum wage (see Section 2.2). Soares (2003) and Corseuil and Carneiro (2001) show that there is little evidence of transitions from the formal sector to the informal sector or self employment, or from the informal sector into unemployment following a minimum wage increase in Brazil. More generally, most of the literature on sectoral composition changes, selectivity, sorting and segmentation in the labor market does not include the minimum wage in their sorting rule (Gaag

5.2 Low Inflation

A further robustness check consists of restricting our sample to low inflation periods (after July 1994, when inflation was stabilized). The motivation here is that the earlier estimates are for the full sample period, which might be diluting more adverse employment effects in low inflation periods. That is because firms might respond differently to a minimum wage increase depending on the level of inflation. In high inflation periods, firms may perceive the increase as temporary, anticipating the subsequent accommodating monetary policy and wage-price spiral. Hence they would not adjust employment to avoid adjustment costs (Cox and Oaxaca, 1981). Conversely, more adverse employment effects might be expected in low inflation periods. Put differently, we want to test whether our estimates change after the July 1994 structural break. Furthermore, the high inflation period was characterized by large macroeconomic volatility in Brazil – in particular, with several failed stabilization plans and stop-and-go cycles. Therefore, the low inflation period allows for a better possibility to identify the effect of a particular variable, i.e. the minimum wage, on wages and employment.

We re-estimate Equations (2) and (3) restricting our sample period to July 1994 onwards. These estimates, shown in Panel C of Tables 4 and 5, confirm our main conclusion as before (compare with Tables 2 and 3). The minimum wage compresses the wage distribution of both sectors but does not affect employment in either sector. In the formal sector, the compression effect is again evident at the bottom of the distribution. The strongest effect is still at the 10^{th} percentile, but the compression effect is now higher up in the distribution. In the informal sector, the compression effect is again towards the centre of the distribution. The effect on the 10^{th} percentile becomes negative, though it remains statistically insignificant, and the compression effect is now limited to the bottom half of the distribution.

and Vijverberg, 1988; Funkhouser, 1997; Chahad and Fernandes, 2000; Pisani and Pagan, 2004; Menezes-Filho et al., 2004). Finally, we estimate reduced form equations at the aggregate regional level and do not attempt to separate supply effects (e.g. workers self-selection between sectors or decision to participate in the labor market) and demand effects (e.g. firms decisions to fire or hire workers), which ultimately depend on structural mechanisms of adjustment at the micro level.

In sum, the wage effect, while a little weaker, remains robust. Nonetheless, all employment effect estimates are stubbornly statistically indifferent from zero. Thus, even in low inflation periods, where more adverse employment effects are expected, the minimum wage does not adversely affect employment. Neumark et al. (2005) also find small negative, but not always significant, hours and jobs effects for Brazil using formal sector data in low inflation periods.

5.3 Low Educated

Our next robustness check consists in restricting our sample to low wage workers. As our earlier estimates are for the entire working population, more adverse employment effects for low wage workers might have been diluted. That is because in any region-month cell only a minority of workers are affected by changes in the minimum wage and any employment effects for this minority may get swamped by no employment effect for the majority (Stewart, 2002).

We re-estimate Equations (2) and (3) for low educated workers only (those with 4 or less years of schooling). These estimates, shown in Panel D of Tables 4 and 5, again strengthen our earlier main conclusions (compare with Tables 2 and 3). The minimum wage strongly compresses the wage distribution of both sectors but does not affect employment in either sector. In the formal sector, the compression effect is again evident and substantially stronger at the bottom of the distribution; furthermore, the minimum wage now affects the entire distribution. In the informal sector, the compression effect is once again towards the centre of the distribution.

In sum, the wage effect is overall stronger and robust. Nonetheless, all employment effect estimates still remain statistically indifferent from zero, indicating that the minimum wage does not adversely affect low educated employment in either sector. These estimates are in line with evidence for US teenagers and for UK low wage workers, where no adverse effects

on employment have been documented (Card and Krueger, 1995; Machin et al., 2003).

5.4 Self Employed

So far, we have focused on salaried employees, all of which are covered by the legislation, and the main issue has been whether the firms, where such employees work, comply with the legislation. We now focus our anlaysis on a group of non-salaried workers that are more truly uncovered by the legislation, the self-employed. The intuition is to use the self-employed as a control group which do not receive the treatment. This will allow us the possibility to further test the validity of the standard Two Sector Model for Brazil. If the results for the uncovered self-employed are consistent with the traditional Two Sector Model, we expect a negative wage effect and a positive employment effect.

We re-estimate Equations (2) and (3) for the self-employed. These estimates, shown in Panel E of Tables 4 and 5, reinforce our principle finding that the minimum wage strongly compresses the wage distribution but does not affect employment. The results here qualitatively resemble the results for the informal sector (compare with Tables 2 and 3). The compression effect is evident at the bottom of the distribution, and it extends throughout the wage distribution. Nonetheless, all employment effect estimates once again remain statistically indifferent from zero. This suggests that even in the self-employed uncovered sector the minimum wage raises wages but does not destroy employment in Brazil.

6 Conclusion

In this paper we have presented new empirical evidence on the effect of the minimum wage across the formal and informal sectors in Brazil, using a monthly household panel survey from 1982 to 2000. Our principal finding is that the minimum wage strongly compresses the wage distribution of both sectors but does not affect employment. The compression effect is

at the bottom of the formal sector distribution, while is higher up in the distribution of the informal sector. The employment effect indicates that neither the number of workers nor the number of hours worked change in either sector following a minimum wage increase. Our results are robust to different estimation strategies and to a number of robustness checks. For example, in low inflation periods, the compression effect is a little weaker. Nonetheless, even then, when more adverse employment effects were expected, none could be found. The compression effect is stronger for low educated workers, which could again hint at more adverse employment effects. Nonetheless, no employment effects could be found. Finally, no employment effects could be found for the self-employed, despite strong wage effects.

In sum, our evidence for both formal and informal sectors clearly indicates that wage effects in Brazil are large whereas employment effects are not found. Although this evidence is in line with previous empirical evidence, it is not in line with theory. The predictions of the Welch-Gramlich-Mincer Two Sector Model do not seem to hold true for Brazil. Firstly, a sizeable spike is observed in the wage distribution not only of the formal, but also of the informal sector. Secondly, substantial positive wage spillover effects are observed in the informal sector, not only in the formal sector, resulting in a strong compression effect in the wage distribution of both sectors. Thirdly, no evidence of negative employment effects is found in either sector. We argue that the predictions of the Two Sector Model do not hold for Brazil because they follow from the assumption of non-coverage but that the Brazilian economy suffers from non-compliance instead. We argue that there is no obvious reason why informal sector wages and employment would respond to an increase in the minimum wage in the same way that uncovered sector wages and employment do, as informality and uncoverage are rather different labor market features. We therefore advocate that the economics of the minimum wage in developing countries might be very different from that of developed countries – for which most of the literature is available – and that more research is needed in this area.

The main policy implication deriving from our findings is that the minimum wage could be an effective policy tool in the fight against poverty and inequality without destroying too many jobs in Brazil. The minimum wage is effective not only in the formal, but also in the informal sector, where legislation is presumably not complied with. It might thus be a more effective policy to reduce poverty than policies that attempt to incorporate informal sector workers into the formal sector, which might generate higher unemployment. Minimum wage policy could then be complemented by other policies specifically targetted at the 10% poorest, as the minimum wage does not reach those at the very bottom of the informal sector wage distribution. A related policy-relevant issue is the hidden fiscal costs of informality as informal sector workers do not pay social security but receive universal benefits such as health service and old age retirement pensions. A further related policy implication is that minimum wage hikes might adversely affect public deficits in the longer term (via the public sector wage bill and the benefits and pensions bill), undermining the fight against poverty and inequality. Given these policy implications, we advocate that more research is needed in this area before the minimum wage can be more convincingly justified as a poverty alleviation policy.

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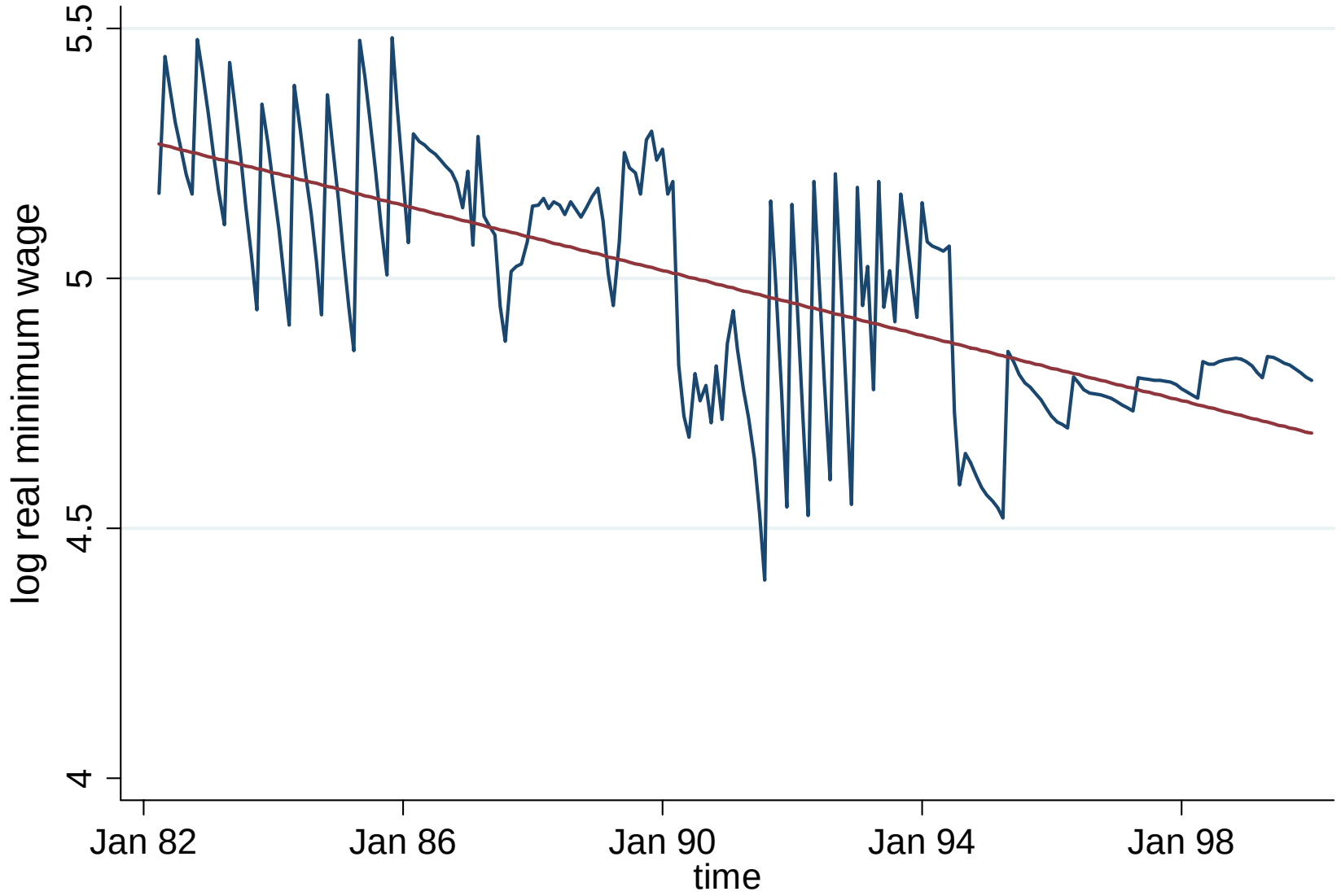

Figure 1 - REAL MINIMUM WAGE IN BRAZIL, 1982-2000

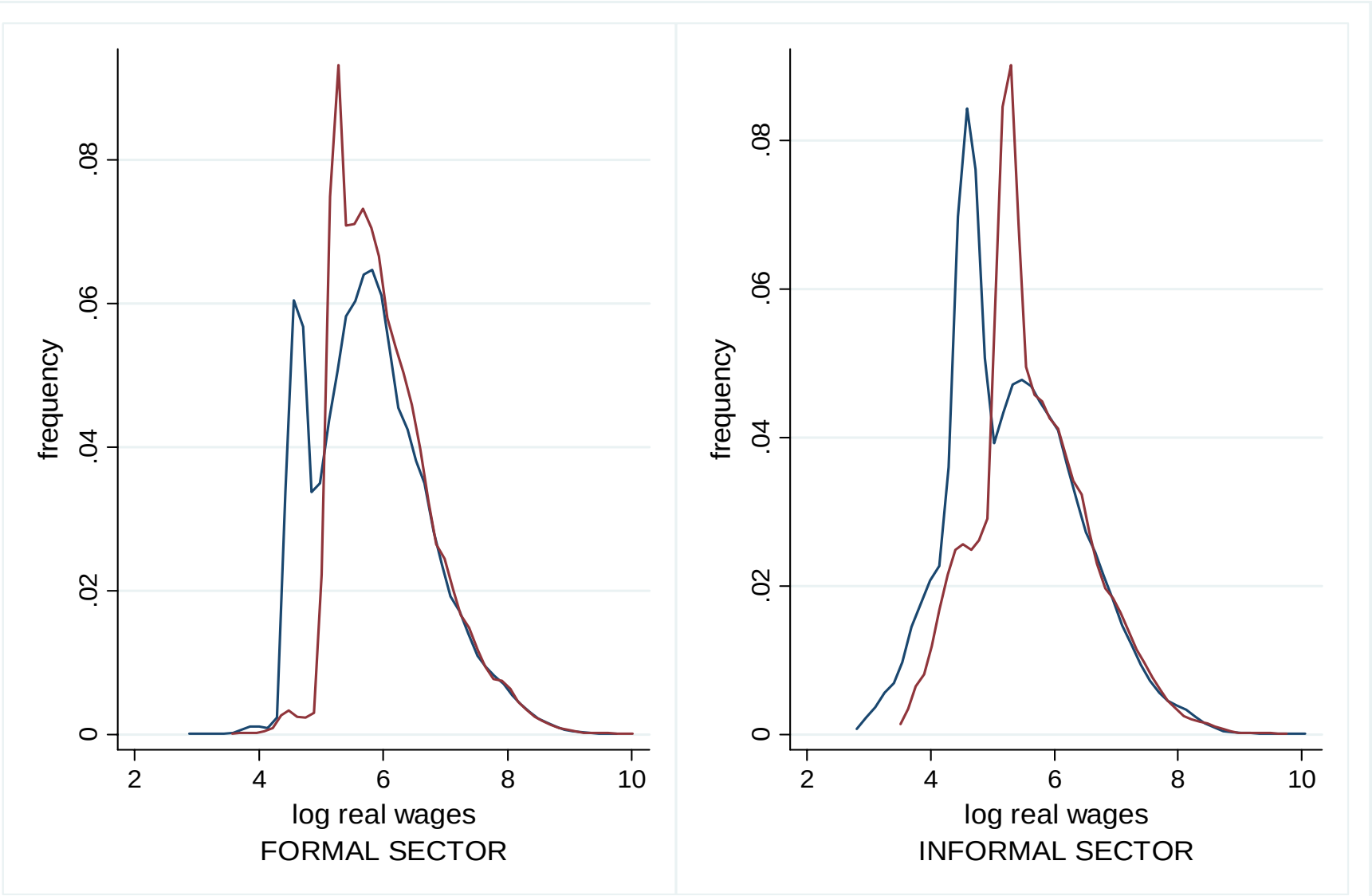

Figure 2 - WAGE DISTRIBUTIONS, BRAZIL 1992

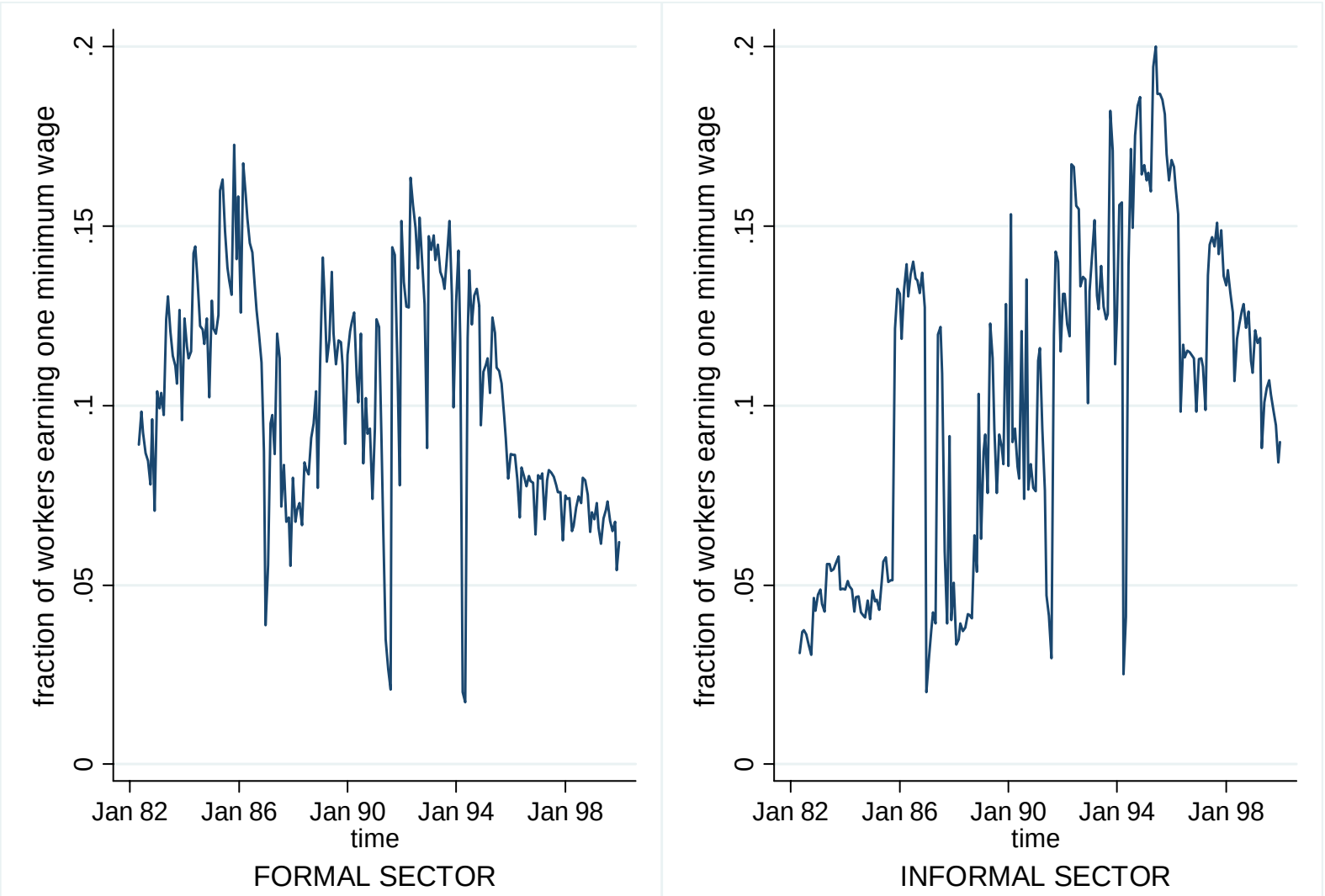

Figure 3 - FRACTION OF WORKERS AT THE MINIMUM WAGE IN BRAZIL, 1982-2000

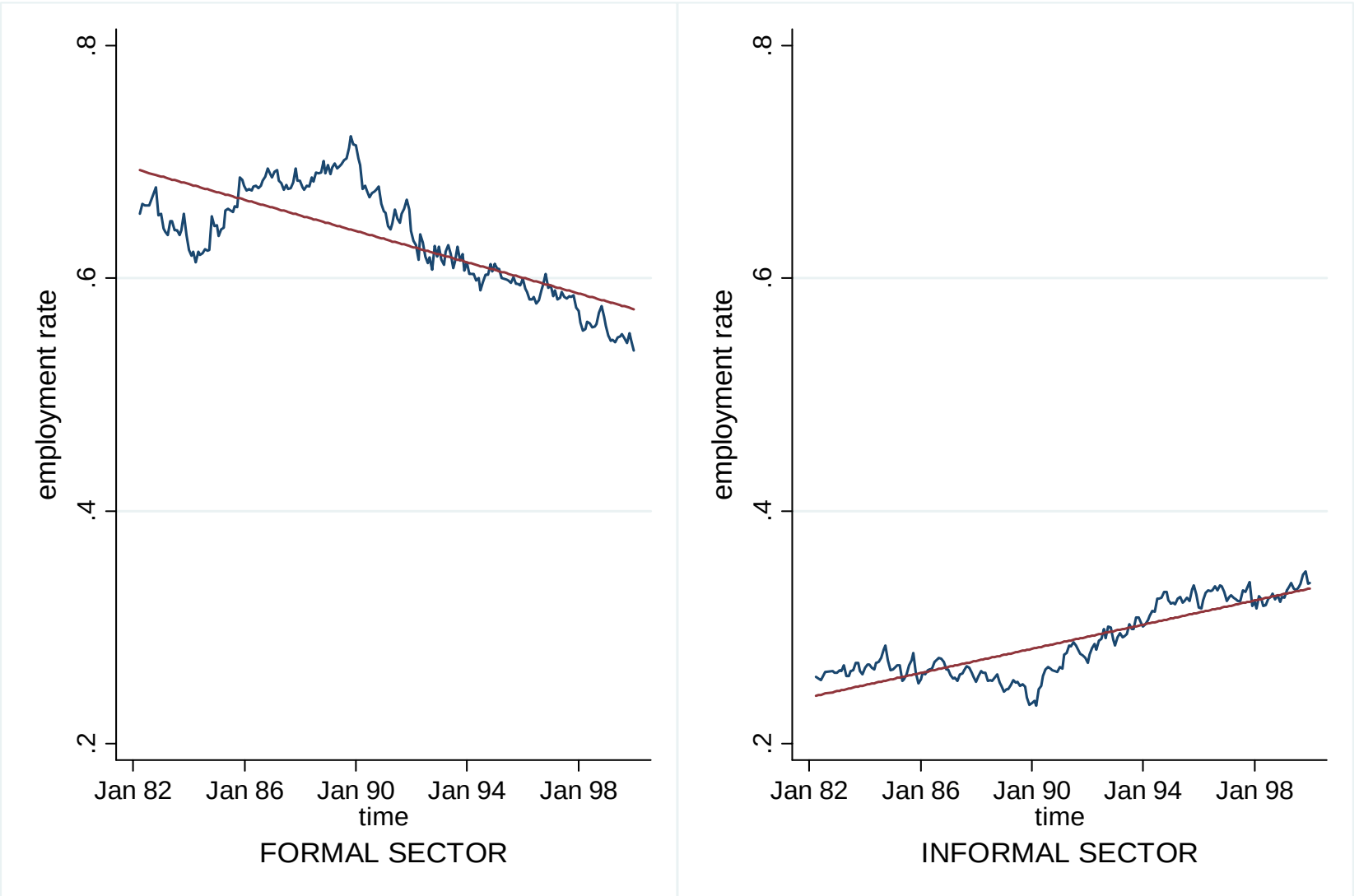

Figure 4 - EMPLOYMENT RATE IN BRAZIL, 1982-2000

Table 1 - DESCRIPTIVE STATISTICS ACROSS REGIONS AND SECTORS

Variables	Recife (a poor region)		Sao Paulo (a rich region)	
I - Percentage of Population				
aged 0 to 14 years old	0.18		0.15	
aged 15 to 24 years old	0.27		0.25	
aged 25 to 64 years old	0.47		0.53	
aged over 65 years old	0.07		0.07	
women	0.45		0.43	
students	0.31		0.22	
enrolled in schooling	0.38		0.31	
literate	0.86		0.95	
elementary education (8 years of schooling)	0.43		0.38	
secondary education (11 years of schooling)	0.14		0.14	
graduates	0.08		0.11	
retired	0.13		0.11	
in urban areas	0.93		0.97	
II - Percentage of Workers				
metallurgic industry	0.07		0.19	
building construction	0.03		0.04	
commerce	0.09		0.09	
services	0.26		0.29	
public sector	0.07		0.05	
sample size	2475815		3708834	
	formal sector	**informal sector**	**formal sector**	**informal sector**
III - Labour Market Indicators				
log 10th percentile real earnings distribution	4.95	4.09	5.51	4.86
log 25th percentile real earnings distribution	5.14	4.56	5.87	5.30
log 50th percentile real earnings distribution	5.57	5.04	6.32	5.86
log 75th percentile real earnings distribution	6.16	5.69	6.89	6.53
log 90th percentile real earnings distribution	6.82	6.47	7.50	7.13
log average real earnings distribution	5.74	5.18	6.43	5.94
log standard deviation real earnings distribution	0.78	0.94	0.79	0.91
log real minimum wage	4.95	4.95	5.09	5.09
"fraction at"	15.4%	12.0%	3.3%	6.5%
employment rate	56.4%	33.2%	66.7%	25.8%
average hours worked by those employed	41.27	42.04	41.43	39.60
average hours worked in the labour force	23.28	13.92	27.64	10.19
sample size	527799	305582	1259047	473507

Table 2 - EFFECT OF A MINIMUM WAGE INCREASE ON WAGES

	FORMAL SECTOR		INFORMAL SECTOR	
percentiles	**coefficient**	standard error	**coefficient**	standard error
Full Sample (controlling for common macro shocks and region specific growth trends)				
10th percentile	**4.87**	0.22	**0.46**	0.33
25th percentile	**2.87**	0.20	**2.65**	0.31
50th percentile	**0.89**	0.19	**4.15**	0.25
75th percentile	**0.04**	0.21	**1.26**	0.25
90th percentile	**0.14**	0.23	**0.73**	0.29
mean	**1.47**	0.12	**1.88**	0.13
standard deviation	**-1.02**	0.06	**-0.27**	0.10

(a) The dependent variable is, in turn, various percentiles, the mean and the standard deviation of the log hourly real wage distribution.
(b) The shock variable is the "interaction of fraction at and the real minimum wage".
(c) These are β^w GLS estimates in Equation (1), estimated in turn for the formal and informal sectors.
The weights are the square root of the inverse of the sample size.
Standard errors are White-corrected and serial correlation corrected across and within regions.
(d) Month and region dummies model time and region fixed effects. Labour supply shifters are included as controls, namely, the proportion of the total population younger than 10 years old, between 10 and 24 years of age, women, illiterates, retirees, students, in urban areas, with completed basic and high school education; the average years of schooling in the total population; the proportion of the working population corresponding to workers holding two jobs, workers in the informal, public, construction and metallurgy sectors.
(e) To reflect a 1% increase in the minimum wage, these estimates have to be multiplied by "fraction at"
(i.e. these estimates need to be evaluated at a particular value of "fraction at", for example, average "fraction at" from Table 1).

Table 3 - EFFECT OF A MINIMUM WAGE INCREASE ON EMPLOYMENT

	FORMAL SECTOR				INFORMAL SECTOR			
dependent variable	**short run coefficient**	standard error	*long run coefficient*	*standard error*	**short run coefficient**	standard error	*long run coefficient*	*standard error*
Full Sample (controlling for common macro shocks and region specific growth trends)								
total employment	**-0.04**	0.07	*-0.02*	0.02	**0.00**	0.10	*0.00*	0.03
hours worked	**-0.04**	0.06	*-0.02*	0.03	**0.05**	0.07	*0.02*	0.03
employment rate	**0.00**	0.03	*0.00*	0.02	**-0.05**	0.07	*-0.02*	0.03

(a) Notes as in Table 2, except that:
(b) The dependent variable is, in turn, log average hours in the labour force, log average hours in the working population and log employment rate.
(c) These are β^n GLS estimates in Equation (3), estimated separately in turn for the formal and informal sectors.

Table 4 - EFFECT OF A MINIMUM WAGE INCREASE ON WAGES (robustness checks)

	FORMAL SECTOR		INFORMAL SECTOR	
percentiles	**coefficient**	standard error	**coefficient**	standard error
A - Full Sample (controlling for common macro shocks, region specific growth trends and region specific shocks)				
10th percentile	**4.95**	0.22	**0.33**	0.33
25th percentile	**2.89**	0.20	**2.59**	0.32
50th percentile	**0.93**	0.18	**4.02**	0.24
75th percentile	**0.13**	0.19	**1.14**	0.25
90th percentile	**0.18**	0.22	**0.61**	0.30
mean	**1.51**	0.10	**1.80**	0.13
standard deviation	**-1.00**	0.06	**-0.29**	0.10
B - Full Sample (controlling for common macro shocks, region specific growth trends, region specific shocks and seasonal region specific shocks)				
10th percentile	**4.80**	0.22	**0.30**	0.35
25th percentile	**2.89**	0.20	**2.44**	0.34
50th percentile	**0.73**	0.19	**3.91**	0.26
75th percentile	**0.09**	0.21	**0.90**	0.27
90th percentile	**0.03**	0.23	**0.56**	0.32
mean	**1.44**	0.11	**1.65**	0.14
standard deviation	**-1.01**	0.06	**-0.26**	0.11
C - Low Inflation Period (controlling for common macro shocks and region specific growth trends)				
10th percentile	**3.62**	0.42	**-1.64**	1.00
25th percentile	**1.06**	0.62	**1.60**	0.92
50th percentile	**1.24**	0.59	**2.27**	0.81
75th percentile	**-0.95**	0.63	**0.53**	0.86
90th percentile	**0.33**	0.92	**-1.44**	1.08
mean	**1.55**	0.32	**1.40**	0.39
standard deviation	**-0.50**	0.22	**-0.55**	0.30
D - Low Educated (controlling for common macro shocks and region specific growth trends)				
10th percentile	**4.52**	0.26	**0.51**	0.35
25th percentile	**4.14**	0.22	**1.92**	0.33
50th percentile	**1.87**	0.21	**4.01**	0.28
75th percentile	**0.59**	0.23	**1.55**	0.32
90th percentile	**0.47**	0.25	**1.01**	0.36
mean	**1.94**	0.14	**1.86**	0.17
standard deviation	**-0.98**	0.09	**-0.22**	0.14
E - Self Employed (controlling for common macro shocks and region specific growth trends)				
10th percentile	**1.86**	0.34		
25th percentile	**2.38**	0.35		
50th percentile	**1.21**	0.30		
75th percentile	**1.16**	0.33		
90th percentile	**1.10**	0.40		
mean	**1.51**	0.13		
standard deviation	**-0.77**	0.06		

(a) Notes as in Table 2.

Table 5 - EFFECT OF A MINIMUM WAGE INCREASE ON EMPLOYMENT (robustness checks)

dependent variable	FORMAL SECTOR short run coefficient	standard error	*long run coefficient*	*standard error*	INFORMAL SECTOR short run coefficient	standard error	*long run coefficient*	*standard error*
A - Full Sample (controlling for common macro shocks, region specific growth trends and region specific shocks)								
total employment	**-0.01**	0.07	*-0.01*	0.02	**0.04**	0.10	*0.01*	0.03
hours worked	**-0.02**	0.06	*-0.01*	0.02	**0.08**	0.07	*0.03*	0.03
employment rate	**0.01**	0.03	*0.00*	0.02	**-0.04**	0.07	*-0.02*	0.03
B - Full Sample (controlling for common macro shocks, region specific growth trends, region specific shocks and region specific seasonal shocks)								
total employment	**-0.04**	0.06	*-0.03*	0.02	**-0.10**	0.10	*-0.04*	0.03
hours worked	**-0.02**	0.05	*-0.01*	0.03	**0.03**	0.07	*0.02*	0.04
employment rate	**-0.02**	0.03	*-0.02*	0.02	**-0.13**	0.08	*-0.06*	0.04
C - Low Inflation Period (controlling for common macro shocks and region specific growth trends)								
total employment	**-0.13**	0.20	*-0.07*	0.08	**0.07**	0.30	*0.03*	0.07
hours worked	**-0.07**	0.18	*-0.03*	0.09	**0.02**	0.22	*0.01*	0.09
employment rate	**-0.06**	0.10	*-0.04*	0.07	**0.05**	0.20	*0.02*	0.07
D - Low Educated (controlling for common macro shocks and region specific growth trends)								
total employment	**-0.04**	0.07	*-0.01*	0.01	**0.09**	0.24	*0.03*	0.06
hours worked	**0.01**	0.06	*0.00*	0.02	**0.02**	0.15	*0.01*	0.08
employment rate	**-0.05**	0.04	*-0.02*	0.02	**0.07**	0.21	*0.02*	0.06
E - Self Employed (controlling for common macro shocks and region specific growth trends)								
total employment	**0.10**	0.12	*0.06*	0.04				
hours worked	**0.10**	0.07	*0.06*	0.04				
employment rate	**0.00**	0.09	*0.00*	0.05				

(a) Notes as in Table 3.