A Menu Of Minimum Wage Variables For Evaluating Wages and Employment Effects: Evidence From Brazil

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The international literature on minimum wage greatly lacks empirical evidence from developing countries. Brazil's minimum wage policy is a distinctive and central feature of the Brazilian economy. Not only are increases in the minimum wage large and frequent but also the minimum wage has been used as anti-inflation policy in addition to its social role. This paper estimates the effects of the minimum wage on both wages and employment using panel data techniques and monthly household data from 1982 to 2000 at individual and regional levels. A number of conceptual and identification questions is discussed, for example: (1) Various strategies on how to best measure the effect of a constant (national) minimum wage are summarized in a "menu" of minimum wage variables. (2) An employment decomposition that separately estimates the effect of the minimum wage on hours worked and on the number of jobs is used. (3) Robustness checks accounting for sorting into the informal and public sectors are performed. Robust results indicate that an increase in the minimum wage strongly compresses the wages distribution with moderately small adverse effects on employment.

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1. Introduction

The international literature on minimum wage greatly lacks empirical evidence from developing countries. Brazil's minimum wage policy is a distinctive and central feature of the Brazilian economy. Not only are increases in the minimum wage large and frequent but also the minimum wage has been used as anti-inflation policy in addition to its social role. This paper estimates the effects of the minimum wage on both wages and employment using panel data techniques and monthly Brazilian household data from 1982 to 2000 at individual and regional levels. Their expected direction and magnitudes are as follows.

If the minimum wage is binding, the wage effect is positive because workers bargain to maintain their relative wages and firms demand more skilled workers. Further, its magnitude varies across the wages distribution because different occupations have different comparison groups (Grossman, 1983; Akerlof, 1982 and 1984); elasticities are larger at lower percentiles, compressing the distribution (Brown, 1999; Card and Krueger, 1995). Once the compression effect on the wages distribution is established, the policy debate hinges on the employment effect. The aim is to change the shape of the wages distribution but not to destroy jobs.

There is currently not much consensus on the direction of the employment effects. The old debate between Stigler (1946) and Lester (1946), dormant since the early 80s in an apparent consensus of negative significant but modest effects on employment (Brown, Gilroy and Kohen, 1982) has been re-awakened. On the one hand, Neumark and Wascher (1992) and Deere et al. (1995), among others, find results consistent with the standard model prediction of a negative employment effect. On the other hand, Card and Krueger (1995) and Dickens et al. (1999), among others, challenge such a prediction, unable to find disemployment effects. Explanations to non-negative effects range from theory to empirical identification and data issues (Card and Krueger, 1995; Brown, 1999). In a recent survey, Brown (1999, p.2154) remarks: "the minimum-wage effect is small (and zero is often hard to reject)". While there is yet no consensus, small employment effects, clustered around zero, are becoming prevalent in the literature (Freeman, 1994 and 1996; Brown, 1999).

In studies for Brazil, in line with the international empirical literature, an increase in the minimum wage does not always have a significant effect on employment and it is not always negative, despite sizeable wage effects (Camargo, 1984; Velloso, 1988; Gonzaga et al., 1999; Carneiro, 2000; Carneiro, 2002; Corseuil and Servo, 2002). Using national aggregate data, this literature estimates average wage and employment effects imposing restrictions on time modeling, i.e. relying on the so-called *ad hoc* identification predominant in the early time series literature.

This paper contributes to the Brazilian and international literature in a number of ways.

First, it utilizes data only recently released for the public and not yet used for minimum wage studies. The international literature on minimum wage is scanty on non-US empirical evidence. This paper estimates minimum wage effects for a key non-US example. There are compelling reasons to study the minimum wage outside the US. "No single empirical study of an economic phenomenon is ever highly convincing" (Hamermesh, 2002, p. 4). Many data points are needed - many and independent data points are needed. Using non-US data is an unbiased way of extending the understanding of minimum wage effects and assessing the robustness of findings for the US. Hamermesh (2002, p. 15) argues for increased reliance on non-US data and policy evaluations: "policies like hours legislation and the minimum wage provide especially fruitful areas in which to apply the results of studying foreign experiences to the US".

Furthermore, Hamermesh (2002) calls attention for the evidence from developing countries, which is greatly lacking in the literature. Minimum wage increases in Brazil are large and frequent, unlike the typically small increases studied in most of the literature (Deere et al, 1996; Hamermesh, 2002; Castillo-Freeman and Freeman, 1992). Studying such increases allows a better possibility of observing the negative effects predicted by theory and thus the link between empirical data and theoretical models of the minimum wage. Furthermore, Hamermesh (2002) remarks that foreign experiences are especially fruitful if they generate exogenous shocks (an alternative to reliance on statistical methods to circumvent the problems arising from endogeneity), as in Brazil over the past 30 years. Moreover, special features of the Brazilian Economy are valuable for case studies of the minimum wage in presence of: a (low) high inflation; a public sector and a large informal sector both overpopulated by minimum wage workers; and a strong link between benefits and pensions with the minimum wage. This unique data is a result of the important role the minimum wage plays in Brazil, where it has been used as an anti-inflation policy in addition to its traditional social role (Macedo and Garcia, 1978, 1980; Camargo, 1984; Foguel, 1997; Carneiro, 2000).

Second, this paper follows recent strands in the international literature - not previously appearing in the Brazilian literature - that try to uncover the wage distributional effects. Individual micro data is used to estimate non-parametric Kernel wages densities that are a visually appealing illustration of the minimum wage compression effect. Aggregated regional data is then used to formalize the compression effect by estimating the effect of the minimum wage at various percentiles across the distribution controlling for the effect of other variables on wages.

Third, this paper discusses a number of conceptual and identification questions as tentative explanations of the non-negative employment effects found in the Brazilian and international literature. For example: (1) A national minimum wage cannot explain variation in employment across regions (Brown et al., 1982; Card and Krueger, 1995). Identification of the effect of the minimum wage separately from the effect of other variables on employment requires regional variation if no restriction on time modeling is imposed. Many minimum wage variables with regional variation have been suggested in the literature; such a variety of variables makes it difficult to compare estimates across studies. This paper summarizes them in a "menu" of minimum wage variables, establishes a relationship among them, and compares their estimates. (2) Identification of the effect of the minimum wage separately from the effect of unobserved regional macro fixed effects on employment requires modeling fixed effects. This paper uses panel data techniques, scarcely used in the literature, to account for this. (3) This paper formalizes an employment decomposition that separately estimates the effect of the minimum wage on hours worked and on the number of jobs; if the first is positive and the second is negative, this could be an explanation of non-negative (total) employment effects. This decomposition has not been previously formalized in the literature. (4) This paper performs robustness checks accounting for sorting into the informal and public sectors, scarce in the literature. Again, if formal sector employment effects are negative and informal sector positive, this could be an explanation of non-negative (net) employment effects.

This paper is organized as follows. Section II presents the data. Section III describes the minimum wage in Brazil (Section 3.1), presents descriptive statistics (Section 3.2), and wage models (Section 3.3). This motivates a discussion on identification (Section 3.4.1) and the subsequent re-specification of the wages models using various alternative minimum wage variables (Section 3.4.2). Section IV presents the decomposition of the employment effects into hours and jobs effects (Section 4.1), employment models (Section 4.2) and robustness checks (Section 4.3). Further robustness checks, accounting for sorting into the informal (Section 5.1) and public sector (Section 5.2) are performed. Robust results indicate that an increase in the minimum wage strongly compresses the wages distribution with moderately small adverse effects on employment.

2. Data

The data used is from PME (Monthly Employment Survey), a rotating panel data similar to the US CPS (Current Population Survey). Between 1982 and 2000, PME interviewed over 21 million people across the six main Brazilian metropolitan regions: Bahia (BA), Pernambuco (PE), Rio de Janeiro (RJ), Sao Paulo (SP), Minas Gerais (MG) and Rio Grande do Sul (RS). Its monthly periodicity is important because wage bargains during the sample period occurred annually, bi-annually, quarterly and even monthly, depending on the inflation level and indexation rules. Comparisons of demographic and economic characteristics across regions or waves show no selectivity bias in any direction (Neri, 1996). The deflator, INPC (National Consumers Price Index), was regionally disaggregated to reduce measurement error.

3. Wages Effects

3.1 Minimum Wage In Brazil

The minimum wage was introduced in 1940 as a social policy to provide subsistence income (diet, transport, clothing, and hygiene) for an adult worker. The associated bundle varied across regions, which was reflected in 14 minimum wages - the highest (lowest) for the Southeast (Northeast) (Gonzaga and Machado, 2002). Wells (1983, p. 305) believes they were "generous relative to existing standards" since about 60% to 70% of workers earned below them; Saboia (1984) and Oliveira (1981) believe they legitimated the low wages of the unskilled.

The real minimum wage was decreased over time because of two main reasons. The first one has been the failure in adjustments to keep pace with inflation. After a steep decrease, the real minimum wage was adjusted and reached its peak during the boom of the 50s, when productivity was high, unions strong, and the Government populist. After that, it decreased as a result of the subsequent recession, rising inflation, and non-aggressive unions (Singer, 1975). The real minimum wage was then 40% lower than in the 50s.

The minimum wage social role changed when the dictatorship installed in 1964 associated high inflation with wage adjustments. Nominal minimum wage increases can be inflationary because they affect production costs and prices, not only through its direct effect on minimum wage workers, but also through indirect spillover effects (Brown, 1999). The dictatorship limited labour organization, reduced wage militancy, and implemented a centralized wage policy. One of the strategies of this policy was under-indexation of the real minimum wage, via erosion of the nominal minimum wage (Macedo and Garcia, 1978), which transformed the latter "from a social policy designed to protect the worker's living standard into an instrument for stabilization policy" (Camargo, 1984, p.19). The "Teoria do Farol" (Lighthouse Effect) associated the subsequent increase in inequality revealed in the 1970 Census with the pos-64 real minimum wage decrease (Souza and Baltar, 1979, 1980a and 1980b).

According to Carneiro and Faria (1998), the nominal minimum wage was used not only as a stabilization policy but also as a coordinator of the wage policy. One example is that other wages were set as multiples of the minimum wage. Another example is that in the early 80s, wages in the range 1 to 3 minimum wages were bi-annually adjusted by 110% of the inflation rate; the higher the worker's position in the wage distribution, the lower the percentage adjustment. Such increases immediately spilled over higher up the wage distribution; its effects were no longer limited to the bottom of the distribution as when it plays a social role. More generally, the minimum wage played an indexer role. In the presence of high inflation and distorted relative prices, rational agents took increases in the minimum wage as a signal for price and wage bargains - even after law forbade its use as “numeraire” in 1987. Minimum wage indexation and reinforced inflationary expectations was a phenomenon first noticed by Gramlich (1976), Cox and Oaxaca (1981), and Wolf and Nadiri (1981); and more recently discussed by Card and Krueger (1995) and Freeman (1996). Maloney and Nunes (2003) show that the “Efeito Farol” and the “numeraire” effect are a general phenomenon in Latin America.

The second main reason for the decrease of the real minimum wage over time has been its impact on the public deficit - uncontrollably large and growing in the 80s and 90s - via benefits, pensions, and the Government wage bill.[1] This impact has often been the criterion for the affordable increase in the nominal minimum wage, resulting in under-indexation of the real minimum wage.

Because of its effects both on prices and on the public deficit, the under-indexation of the real minimum wage (by erosion of the nominal minimum wage) was used as a deflationary policy. However, when pressure was enough, the Government had to give in, allowing increases in the nominal minimum wage - the nominal minimum wage became the “messenger” of the inflation - which in turn severely affected both prices and the public deficit and were therefore inflationary. This effect was perpetuated in an inflation spiral. The anti-inflation policy became inflationary itself; the remedy became the disease. In this context, the minimum wage has been alternately used as social and anti-inflation policy. The policy choice depended (a) on the level of inflation, (b) on the bargaining power of the workers, and (c) on the party affiliation of the Government (Velloso, 1988; Bacha, 1979). The social role is associated with more populist Governments, lower inflation, and stronger unions.

Graph 1.a shows that the hourly real minimum wage decreased between 1982 and 2000. Its highest (lowest) level was in November 1982 (August 1991), before the acceleration of inflation. In political terms, three events were important in the 80s: (a) in 1984, the minimum wage became national, after slow regional convergence; (b) with the end of the military regime in 1985, the 1988 Constitution re-defined the subsistence income (diet, accommodation, education, health, leisure, clothing, hygiene, transport, and retirement) for an adult worker and his/her family - even though such a bundle was unaffordable at the prevalent minimum wage; (c) the union movement re-emerged and became ever stronger, reaching a high union density for a developing country (Carneiro and Henley, 1998; Amadeo and Camargo, 1993). In economic terms, despite the political changes, the minimum wage was still a component of the centralized wage policy. The 80s and 90s witnessed an exhausting battle against inflation. Five stabilization plans between 1986 and 1994 had different nominal minimum wage indexation rules depending on the inflation level. Since then, under reasonably stable inflation, the minimum wage has not been explicitly used as an anti-inflation policy.

The steady decrease of the real minimum wage over time suggests a move downwards along the labour demand curve. It is then not surprising that minimum wage employment effects in Brazil are non-negative (Lemos, 2003a and 2003c; Carneiro, 2000; Foguel, 1997; Gonzaga et al., 1999; Amadeo et al., 1995; Camargo, 1984), despite sizeable wage effects. Graph 5 (Section 4.2) plots log employment rate against log real minimum wage suggesting a non-negative relationship between the two. Furthermore, Lemos (2003b) shows evidence of full pass-through effect of the minimum wage on prices in Brazil. Evidence of large wage effects, large price effects and small employment effects is consistent with an inelastic labour demand curve and a particularly rapid wage-price spiral under high inflation (note saw-toothed pattern in Graph 1a). Firms anticipate the wage-price spiral - encountering little resistance to upward prices adjustment, as nominal stickiness is smaller the higher inflation (Layard et al., 1991) - and do not adjust employment to avoid adjustment costs.

[1] In the sample period, 12% of the population are pensioners, 7% are civil servants.

3.2 Descriptive Analysis And Minimum Wage Variables

Graph 1 plots the real minimum wage and the average, 25th, 50th, and 75th percentiles of the wages distribution over time. A visual inspection suggests that the minimum wage is more strongly correlated with lower percentiles; this is confirmed by the empirical correlations in the national aggregate of 0.78 and 0.73 for the 25th and 75th percentiles. Such correlations for a poor (PE) and a rich (SP) region are respectively 0.95 and 0.36, and 0.78 and 0.55, which illustrates large regional variation.

The most common way to relate the minimum wage to other wages in the literature is to use the ratio of the minimum wage to average wage adjusted for coverage of the minimum wage - the Kaitz index (Kaitz, 1970) that also received the intuitive name of "toughness" of the minimum wage (Machin and Manning, 1994) if coverage is 100% as in Brazil. Graph 2.a shows log toughness, whose the 0.81 correlation with the log real minimum wage suggests that the minimum wage is tough, i.e. it drives the variation of the ratio. (A minimum wage needs to be either binding or causing spillover effects to drive the variation of the ratio.) Baker et al. (1999) also found the ratio to have a similar path to that of the minimum wage for Canada; so did Machin and Manning (1994) and Dickens et al. (1999) for the UK, and Card and Krueger (1995) for the US. While the Kaitz index was 0.39 for the US and 0.40 for the UK in 1993 (Dolado et al., 1996), it was 0.27 for Brazil, although as high as 0.45 in PE.

Graph 2.b shows both the ratio of the minimum wage to the median (log toughness 50) and to the 25th percentile (log toughness 25) of the wage distribution over time. On the one hand, log toughness 50 is a better central measure of the distribution if wage inequality is substantial as in Brazil (Bacha, 1979; Fernandes and Menezes-Filho, 2000), in which case the average fails to be representative of most people (who are at the bottom). The correlation with the log real minimum wage in the national aggregate is a tough 0.74. On the other hand, the minimum wage affects the low, not the average or median wage worker (Deere et al., 1996), which is indicated by the higher correlation with log toughness 25 (0.78).

Graph 2 also plots other minimum wage variables suggested in the literature. They were called "degree of impact" measures (Brown, 1999), because they focus on the proportion of workers directly affected by increases in the minimum wage. Graph 2.c shows "fraction affected", i.e. the proportion of people earning a wage between the old and the new minimum wage (Card, 1992; and Card and Krueger, 1995), whose correlation with the log real minimum wage in the national aggregate is 0.57. While the fraction affected was 7.4% for the US in 1990 (Card and Krueger, 1995), it was 8% for Brazil, although as high as 49% in PE. Fraction was also defined using real data (Graph 2.d). The path is similar to that of fraction (correlation with the log real minimum wage in the national aggregate is 0.49), although zeros are no longer observed because the real minimum wage was not constant over any two consecutive months.

A measure closely related to fraction is the spike in the wages distribution generated by the minimum wage (Card and Krueger, 1995; Brown, 1999). Graph 2.e shows "spike", i.e. the proportion of people earning one minimum wage (Dolado et al., 1996), whose correlation with the log real minimum wage in the national aggregate is 0.64. Spike moves in response to the minimum wage, being bigger after an increase and smaller as different categories negotiate their salaries and are pulled out of the minimum wage (Card and Krueger, 1995). This is particularly the case if inflation is high and the minimum wage is constant (Carmargo, 1984). Note the corresponding saw-toothed pattern in Graph 1.a, also documented by Brown (1999) for the US. Whereas Graph 2.e shows spike over time, Graph 3 shows the actual spike in the earnings distribution for PE for each month of 1992 (the vertical line is the minimum wage). While the spike was 4% for the US in 1993 (Dolado et al., 1996), it was 12% for Brazil, although as high as 25% in PE.[2]

Because of the minimum wage indexer role in Brazil (Section 3.1) - Gonzaga et al., (1999) expanded spike to embrace those earning not only one, but also 0.5, 1, 1.5, 2, 2.5 and 3 minimum wages. Graph 2.f shows "multiples", whose correlation with the log real minimum wage in the national aggregate is 0.31. Figures almost as large as 20% are observed when Plano Cruzado and Plano Real were implemented (spike and fraction are also large in both events). A related measure is the proportion of people earning the minimum wage or below (Dolado et al., 1996). Graph 2.g shows "spike and below", whose correlation with log real minimum wage in the national aggregate is a high 0.77. Note the resemblance with the minimum wage itself (Graph 1.a). A noteworthy figure of 44% is observed in the early 80s in poor regions. The indexer role also motivated Gonzaga et al., (1999) and Foguel (1997) to define a measure of the effect of a minimum wage increase across the wage distribution. Graph 2.h shows "percentage", i.e. the proportion of people whose wages were increased by the minimum wage percentage increase (regardless of their position in the distribution), whose correlation with the log real minimum wage in the national aggregate is 0.39. Considerable spikes are once again observed at Plano Cruzado and Plano Real. Percentage and multiples measure spillover effects.

3.3 Descriptive Models

Graph 4 shows non-parametric Kernel estimation of the earnings distribution of PE for each month of 1992. Graphs for January, May, and September show the change in the shape of the distribution after each minimum wage increase, confirming the expected compression effect discussed in the Introduction. Just as an increase makes the distribution less dispersed, a decrease (in the remaining months the real minimum wage was inflation eroded) makes it more dispersed. 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 dropped out of the distribution), then this simple comparison of Kernels before and after an increase would 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, regression models were estimated to control for such variables. The simplest model of wages as a function of the minimum wage is:

$$\log rwage_{irt} = \alpha + \beta \log rMW_{rt} + u_{irt}, \qquad (1)$$

where $rwage_{irt}$ is real wages and rmw_t is real minimum wage for individual i in region r in time t, and u_{irt} is the error term. This model can be aggregated for the mean and, for a more complete picture, also for the 5th, 10th, 15th, 20th, 25th, 30th, 35th, 40th, 45th, 50th, 90th, and 95th percentiles of the wage distribution. In this fashion, the effect of the minimum wage at various points across the distribution is estimated (Dickens et al., 1999). This is the counterpart of the above Kernel density estimation.

Region and time dummies model region and time fixed effects. Region dummies separate regional effects and time dummies separate other macro variable effects from the effect of the minimum wage on wages. A macro variable explicitly included is past inflation. This is because, on the one hand, the macroeconomic policy, including the minimum wage policy, was aimed at

[2] As in Graphs 3 and 4, also here spike is defined using real earnings as opposed to real hourly wages used in Graphs 1 and 2. Although the correlation between the two is high (and the regression results are robust to either definition) the first is bigger at every point in time because the labour market in Brazil operates on a monthly basis.

stabilizing the inflation; thus, inflation is driving other variables. On the other hand, the minimum wage was used as indexer (Section 3.1); thus, past inflation captures the portion of the minimum wage increase that merely compensates for past inflation. Also, the unemployment rate, typically used as a measure of demand for labour, was included to control for region specific macro shocks that might be correlated with the minimum wage (Card and Krueger, 1995; Brown, 1999).

The standard neoclassical model underlies the above empirical equation. Assume perfect competition on the input and output markets, and a production function *Y* depending on skilled and unskilled labour, with input and output prices *W*, *MW*, and *p*. Maximization of profits at the (representative) firm level delivers the aggregate demand function for (skilled or unskilled) labour, $L^d=L(p,W,MW)$, which is the theoretical ground for the employment equation in Section 4.[3] This can be rewritten as $W=W(p,L,MW)$, which is the theoretical ground for the wage equation above (wages are modeled as a function of inflation, unemployment rate, and minimum wage).

If the labour supply is perfectly elastic, the effect of the minimum wage on employment can be estimated using estimates of labour demand curve alone. If, however, labour supply is positively sloped, some sort of reduced form is what is being estimated, and supply shifters need to be included. Here, these are mainly population and institutional variables that control for region specific demographics potentially correlated with the minimum wage, the proportion of workers in the population who are: young, younger than 10 years old, women, illiterates, retired, students, in the informal sector, 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.[4]

Thus, the model was estimated with and without controls. Also, the model was estimated in levels and in first-differences (see Section 5.2), as the conceptual interest is on how changes in the minimum wage change wages (Card, 1992; Card and Krueger, 1995; Dickens et al. 1999). Dummies, past inflation, controls and constant were included after differencing. The models were weighted (to account for heteroskedasticity coming from aggregation) and White-corrected, as well as corrected for serial correlation within panels, assuming an autoregressive process of order 1 specific to each region (Dolado et al., 1996; Zavodny, 2000).

The two first columns of Table A (in the appendix) show robust and significant estimates, more robust for lower percentiles and for models in levels. An increase in the minimum wage affects the 10^{th} percentile 10 times more than the 90^{th} percentile of the wages distribution (model in differences). A 10% increase in the minimum wage is associated with a wage increase of 5.53% (3.56%) for those in the 10^{th} (30^{th}) percentile.

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[3] As the demand function is homogeneous of degree zero, all prices can be normalized by *W*, which is the theoretical ground for using toughness as a minimum wage variable in employment models (Card and Krueger, 1995).

[4] There is some agreement that demand side variables should be held constant, but less agreement on whether supply side variables should be included as controls and, if so, which ones. The debate is about whether a reduced form or a demand equation is estimated, depending on whether the minimum wage is binding or not (Neumark and Wascher, 1992, 1995, 1996). For those who earn a minimum wage, employment is demand determined, but for those who earn more, relative supply and demand matter. Typically, employment equations in the literature have been interpreted as demand equations, even though many include supply side variables (Card and Krueger, 1995). Particularly debatable is the inclusion of a variable measuring enrolment rates in school (Card and Krueger, 1995; Neumark and Wascher, 1992). As claimed by Brown (1999), if minimum wage reduces both employment and enrolment, reduced form and enrolment rate constant employment equations have very different interpretations. In Brazil, a large number of minimum wage workers are adults no longer at school. Also, schooling is largely available outside working hours, and therefore working and schooling need not be exclusive alternatives; if present, the simultaneity bias will not be as severe. Due to these particularities and the unresolved debate, enrolment rate was not here included (Williams, 1993; Baker, 1999).

Larger estimates for lower percentiles are the counterpart of the compression effect shown by the Kernel densities (Graph 4). The same compression effect can also be documented by regressing wage distribution percentile ratios on the same regressors as above. The results in Table A show that an increase of 10% in the minimum wage decreases the 50^{th}-10^{th} percentile gap by 3.47%, the 90^{th}-10^{th} gap by 5.04%, and the 90^{th}-50^{th} gap by 1.56%. The same compression effect can be further documented by regressing a measure of dispersion (e.g., the standard deviation) on the same regressors as above; once more, the results in Table A are reassuring of the compression effect. Dickens et al. (1999), and Card and Krueger (1995), among others, found the same effect for the UK and the US.

3.4 Identification And Robustness Check

3.4.1 Identification

Within a month, the minimum wage is a constant and therefore cannot explain variations in wages across regions. The real minimum wage varies across regions simply because the nominal minimum wage has been deflated with regional deflators. This variation cannot be regarded as genuine, as it is completely driven by the variation in the deflators; the effect of the inverse of the deflator on wages is what is ultimately estimated (Welch and Cunningham, 1978; Freeman, 1982). In other words, once the numerator is constant, the variation in the deflator is what drives the estimated impact of the ratio on wages. Lacking genuine regional variation, identification depends on how time is modeled - the so-called *ad hoc* identification predominant in the early minimum wage literature.

Identification requires regional variation if no restriction on time is imposed. Many minimum wage variables with such a regional variation have been defined in the literature; the most used has been toughness. Other variables have also been suggested: fraction, spike and below, spike, multiples, and percentage, as defined above.[5] The idea here is to collect all these variables in a "menu" of minimum wage variables and to compare their estimates. Confidence will be greater if the results are robust across variables.

Once regional variation has been ensured, no restriction needs to be placed on the time dummies. The typical annual data model in the literature includes year and regional dummies to model time and regional fixed effects (Brown, 1999). The monthly analogue of this model would require month in place of the year dummies. However, that would eliminate all the variation in the model because each dummy would capture all that affects wages in each month - including the discrete minimum wage increases. As a result, there would be no variation but noise left to identify the minimum wage effect (Burkhauser et al., 2000). If on the one hand month dummies eliminate all the variation, on the other hand year dummies alone are not sufficient to model time in a month model. An alternative is to include, in addition to year dummies, seasonal-month dummies to control for unobserved fixed effects across months, as in Burkhauser et al. (2000). Also, stabilization plan dummies[6] are included to capture common macro shocks under each stabilization plan.

[5] Also, Lee (1999) and Green et al. (2001) suggested trimmed toughness; Deere et al. (1996) suggested costs of the increase on the firm's side; and various authors suggested some variation of a wage gap measure (Linneman, 1982; Deere at al., 1996; Currie and Fallick, 1996).

[6] Each had very particular rules (Abreu, 1992); macro shocks were similar within, and different across plans. Additionally, a dummy was defined in October 1988, when the new Constitution: shortened the working week from 48 to 44 hours, and introduced an alternative working day of 6 consecutive hours.

3.4.2 Model Specification And Results

To ensure identification, the real minimum wage in the models of Section 3.1 is replaced by the minimum wage variables discussed above. Table A (in the appendix) shows estimates more robust and larger at lower percentiles. At higher percentiles, they are not only smaller but also sometimes not significant, suggesting no spillover effects higher in the distribution. Many authors found limited spillover effects for the US and the UK (Card and Krueger, 1995; Dickens et al., 1999); however spillovers for Brazil are expected to extend relatively higher in the distribution because of the minimum wage indexer role (Section 3.1).

The estimates show a very similar pattern whatever the minimum wage variable used. The fraction estimate, before the inclusion of controls, is 1.202 (0.908) for those in the 10th (30th) percentile of the wages distribution. In other words, an increase in the minimum wage sufficient to increase fraction by 1 percentage point is associated with an increase in the wages of those in the 10th (30th) percentile of the wages distribution of 1.20% (0.91%). A 10% increase in the nominal minimum wage increases fraction by 3.7 percentage points[7] and is associated with an increase in the wages of those in the 10th (30th) percentile of 4.45% (3.36%). Card and Krueger (1995) found an estimate of 0.28 when regressing the mean of log wages on fraction, here comparable with 0.52. Controlling for population and institutional factors affects only marginally the magnitude of the estimates, and does not affect their sign or significance. These figures are respectively 1.401 (1.072) for fraction real;[8] 1.821 (0.954) for spike and below; 3.659 (1.034) for spike; 0.657 (0.220) for multiples; 2.868 (2.391) for percentage. A preferred specification is not chosen; instead, the range of estimates produced across all specifications is expected to embrace the true coefficient. Table 1 presents the interval that brackets the effect of a 10% increase in the minimum wage across models and variables. A 10% increase in the nominal minimum wage is associated with an increase in the wages of those in the 10th (30th) percentile of 0.23%-6.35% (0.06%-4.61%) across models. Tables 1 and A also show percentile ratios and standard deviation regressions, which are supportive of the compression effect reported in Section 3.2.

The effect of the minimum wage on the wage distribution was here exhaustively measured using a variety of specifications and variables. Initially, the mean, median, various percentiles, their ratios, and the variance of the wage distribution were modeled as a function of the minimum wage. Then such models were re-specified using various alternative minimum wage variables defined to capture differently the effect of the minimum wage on the wage distribution: at, below and above the minimum wage, as well as across the distribution. It is therefore very reassuring that such a variety of specifications and variables produce robust results. All the above pieces of evidence consistently suggest that the minimum wage compress the wage distribution.

4. Employment Effects

4.1 Decomposition

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[7] This was obtained by regressing the difference of spike on the difference of the log of nominal minimum wage and controls associated to each equation. However, because the nominal minimum wage does not vary across regions (Section 3.4.1), log toughness, log toughness 50, log toughness 25 and log toughness10 were used instead. A 10% increase in the minimum wage increases fraction by 3.7 percentage point, fraction real by 1.4, spike and below by 1.8, spike by 0.3, multiples by 0.4, and percentage by 0.5. These estimates were fairly robust across specifications.

[8] Fraction real is interacted with a dummy for real minimum wage increases because a decrease might not have as severe an impact (wages are sticky), i.e. an increase is expected to affect the wage distribution more. However, the data did not show enough variation to reject the null hypothesis.

As discussed in the Introduction, having established the expected effect on the wages distribution, the minimum wage policy potential lies on its effect on employment, which can be decomposed into changes in hours of work and changes in the number of jobs. If the first is positive and the second is negative, this could be an explanation of the non-negative (total) employment effects recently found in the literature. Although this issue has not received much attention (Brown et al., 1982; Brown, 1999), more recent research (Michl, 2000; Zavodny, 2000; Card and Krueger, 2000; Neumark and Wascher, 2000) suggests that non-negative effects on jobs are sub-product of adjustments in hours. Zavodny (2000) and Machin et al. (2003) estimate job and hours effects, but do not formalize it as a decomposition.

Let average hours in the population ($\overline{T}$) be equal to the product of average hours for those working ($\overline{H}$) and the employment rate (E):

$$\overline{T} = \overline{H}E \text{ is } \frac{\sum_{i=1}^{N} hour_i}{N} = \frac{\sum_{i \in e}^{N} hour_i}{N_e} \frac{N_e}{N} \qquad (2)$$

where N_e and N are sample sizes of the employed and labour force and $hour$ is hours worked.

As noted by Brown et al. (1982, p. 497), "to measure the employment effect of the minimum wage, the ratio of employment to population is used most often as the dependent variable". However, the above decomposition suggests not only E, but also $\overline{T}$ and $\overline{H}$ as dependent variables; as a result, three specifications for the employment equation naturally arise. If a log-log or semi-log functional form is assumed, and the set of regressors is the same, the additivity property of OLS holds and the estimate in the $\overline{T}$ model equals the sum of estimates in the $\overline{H}$ and E models.

4.2 Model Specification And Results

Each of the three specifications in Section 4.1 was estimated for four alternative data filters: levels, first-difference, twelfth difference, and both first and twelfth differences. This is to account for Baker et al.'s (1999) criticism that negative or positive employment effects are found depending on whether short or long differencing is used.[9] For each of these filters, the following base model is estimated:

$$\log employment_{rt} = \alpha + \beta \log realMW_{rt} + \gamma \inf lation_{rt-1} + f_r + f_t + u_{rt}, \qquad (3)$$

where $employment_{rt}$ is taken in turn to mean E, $\overline{T}$ or $\overline{H}$; $\inf lation_{rt-1}$ is past inflation (Section 3.3); f_r and f_t are regional and time fixed effects (Section 3.4.1); and u_{rt} is the error term. This equation was re-estimated first adding controls, as discussed in Section 3.4, and then dynamics, in the form of 24 lags of the dependent variable. This is because an increase in the minimum wage might not affect employment contemporaneously, but in future periods; the inability to adjust other inputs instantaneously creates lagged responses in employment (Brown, 1982; Hamermesh, 1995).[10] The models were again White-corrected and sample size weighted.

[9] Card and Krueger (1995) found positive results using one and two-year-differencing whereas Neumark and Wascher (1992) found negative results using long differencing. More technically, the aim is to reduce the variables to stationarity preventing spurious regression, which depends on the number of unit roots of the variables.

[10] Employment is reported to be AR(2) using annual data (Layard et al., 1991), which is equivalent to 24 lags on monthly data. 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.

By modeling regional and time fixed effects, including controls and dynamics, and differencing the data, the errors are no longer expected to be serially correlated; few authors worry about that (Brown, 1999).[11] This variety of specifications embraces the typical ones in the literature (Brown, 1999; Card and Krueger, 1995).

Graph 5 plots log employment rate (E) against log real minimum wage. The suggested positive raw correlation in levels fades as the data is differenced; this offers no support for a negative effect of the minimum wage on employment - if anything, the correlation is weakly positive. Nonetheless, such raw correlations need to be proved robust when the effect of other variables (demand and supply shocks) on employment is controlled for. Graph 6 and corresponding panel I of Table B (in the appendix) show estimates for the models discussed above. In line with the plots, such estimates also give little support for a negative effect: they are mostly positive, statistically significant, and small. The coefficient of real minimum wage in the total employment model ranges from -0.009 to 0.014, decomposed into (a) the hours coefficient ranging from 0.003 to 0.018 (darker bars); and (b) the jobs coefficient ranging from -0.007 to 0.003 (lighter bars). The total employment effect appears to be dominated by the hours effect (Brown, 1999). A 10% increase in the minimum wage is associated with a decrease in total employment of 0.09% at the most. Finally, the last two columns of Table B show a decrease in total employment no bigger than 0.07% in the long run.

4.3 Robustness Check

As discussed in Section 3.4, the effect of the minimum wage on employment in the above models is *ad hoc* identified; once more, fraction, spike, spike and below, multiples and percentage, additionally to log toughness, log toughness 50, and log toughness 25 are used as minimum wage variables to ensure identification. Table B shows estimates mostly statistically different from zero. Panel II - FRACTION shows that the total employment estimate ranges from -0.005 to 0.045. In other words, an increase in the minimum wage sufficient to increase fraction by 1 percentage point is associated with a decrease in total employment of 0.005% at the most. As discussed in Section 3.4.2, a 10% increase in the minimum wage (increases fraction by 3.7 percentage points) is associated with a decrease in total employment of 0.017% at the most. Card and Krueger (1995) found an estimate of 0.01 when regressing the change of employment-population ratio on fraction, which lies in the range -0.016 and 0.001 of jobs effects estimate. Panel III - FRACTION REAL shows 0.008 to 0.041; panel IV - SPIKE AND BELOW, -0.074 to 0.347; panel V – SPIKE, -0.036 to 0.779; panel VI – MULTIPLES, -0.031 to 0.068; panel VII – PERCENTAGE, -0.008 to 0.127; panel VIII- TOUGHNESS, 0.011 to 0.066; panel IX - TOUGHNESS 50, 0.005 to 0.055; and panel X - TOUGHNESS 25, 0.016 to 0.072. The largest and most robust estimates are for spike and spike and below. Finally, the last two columns of Table B show a long run estimate no bigger than -0.117 across models.

Table 2 presents the interval that brackets the effect of a 10% increase in the minimum wage across models and variables. The total employment effect ranges from -0.95% to 1.40%, decomposed into (a) the hours coefficient ranging from -0.01% to 1.81%; and (b) the jobs coefficient ranging from -0.73% to 0.28%. Once more, the total employment effect appears to be dominated by the hours effect (Brown, 1999).

The range of estimates produced across all specifications and variables is expected to embrace the true coefficient. The preferred specification is the one in first differences using spike as a minimum wage variable - i.e., column 3, row 2, panel V of Table A. This specification is expected to produce errors serially uncorrelated, and spike can be argued to be a better minimum wage

[11] The results were robust when re-estimating the models using Seemingly Unrelated Regression Estimation method.

variable.[12] Also, spike models produced some of the largest and most robust estimates, conforming to a more cautious approach. Thus, this specification is more reliable both conceptually and statistically; it is also more comparable with specifications in the existing literature, mostly in first differences. Incidentally this "preferred" specification produces estimates fairly similar to the other specifications.

Bracketing the total employment elasticity below 1% across such a variety of models is reassuring; this number goes down to below 0.01% in the preferred specification. These results were remarkably robust to changes in the specification and to various alternative minimum wage variables. They are also in line with the international and Brazilian literature and in line with prior expectations discussed in the Introduction and in Section 3.1. Regarding the above as demand equations, the results are consistent with a fairly inelastic demand curve (Freeman, 1995); minimum wage increases translate into small employment losses and large wage effects (Section III). Barros et al. (2002) also estimated a fairly inelastic labour demand curve for the industry sector in Brazil. All the above pieces of evidence suggest that an increase in the minimum wage does not always have a significant effect on employment and it is not always negative; a cautious reading is that the minimum wage has small adverse effects on employment.

5. Further Robustness Checks

5.1 Formal and Informal Sectors

The standard Welch-Gramlich-Mincer Two Sector Model major prediction is that the uncovered sector wages fall as a result of covered sector displaced workers moving into uncovered sector employment. It follows that, in the uncovered sector, a spike should not be observed in the wage distribution and the labour demand curve should not be downwards sloping (Welch, 1976; Gramlich, 1976; Mincer, 1976). If additionally labour supply is assumed inelastic, the uncovered sector employment increase is just enough to off set the covered sector employment decrease ($\beta_F = -\beta_I$) and the net (full sample) employment effect is zero. This might offer an explanation for the clustered-around-zero employment effect found in the literature (Brown, 1999). It is therefore important to investigate the covered and uncovered sectors coefficients underlying the net coefficient - especially if the uncovered sector is large.

The predictions of the Two Sectors Model follow from the assumption of non-coverage. The Brazilian informal market suffers from non-compliance not non-coverage. That is the key difference between the US and Brazilian literature on uncovered and informal sector minimum wage effects. Informal sector wages and employment need not respond to an increase in the minimum wage in the same way uncovered sector wages and employment respond. First, a large spike is observed in the wages distribution of both sectors for Brazil (Lemos, 2003c; Maloney and Nunes, 2003; Gonzaga et al., 1999; Foguel, 1997) and for other Latin America countries (Maloney and Nunes, 2003). The

[12] As discussed thoroughly in Lemos (2003c), spike is an alternative to toughness and fraction, the most common minimum wage variables in the literature. Toughness varies across regions and over time, but the criticism in Section 3.4.1 applies because the variation in average wages is what drives the estimated impact of the ratio on employment. Brown (1999) compares the 'degree of impact' measures (for example, fraction) and the 'relative minimum wage' variable (for example, toughness) and concludes that the former are conceptually cleaner although not well suited for studying periods when the minimum wage is constant. That is because fraction is constant at zero regardless of how unimportant the minimum wage might become. On the one hand spike is conceptually related to fraction and is therefore methodologically clean; on the other hand spike does not suffer from the same drawback, as it can be defined even when the minimum wage is constant. Beyond statistical identification, spike is a measure of those workers becoming more expensive, i.e. a measure of the extra employment costs, and therefore well suited to study minimum wage employment effects.

same effective pay (one minimum wage) is paid in both sectors; non-compliance is observed either as below minimum wage workers or on other aspects of the labour contract, such as social security taxes, paid holidays, health insurance, etc. (Amadeo et al., 1995). Maloney (1999) argues that the informal sector is a way of avoiding the inefficiencies of labour market regulation. Card and Krueger (1995) and Brown (1999) also document a spike in the uncovered sector wage distribution for the US. Second, spillover effects are also observed in both sectors for Brazil (Lemos, 2003c; Maloney and Nunes, 2003; Gonzaga et al., 1999; Foguel, 1997; Gonzaga et al., 2001; Carneiro, 2000) and for other Latin America countries (Maloney and Nunes, 2003).

The presence of a spike and spillover effects in both sectors suggest employment decreases in both sectors. Maloney and Nunes (2003) question the validity of the standard Two Sector Model to explain the formal and informal sector in Latin America. Mincer (1976) notes that the prediction of uncovered sector wages fall is not robust to alternative assumptions on sectoral choice and unemployment. Card and Krueger (1995) show that the uncovered sector wages rise (and employment falls) if the covered sector labour demand curve is relatively inelastic. The labour demand curve for the industry (mainly formal sector firms) in Brazil is fairly inelastic (Barros et al., 2002). It is, however, important to investigate the formal and informal sectors coefficients underlying the net coefficient in Brazil - especially because the informal sector is large and overpopulated by minimum wage workers.

Panel 1 of Table 3 presents estimates of the employment effect by sector using the preferred employment specification (Section 4.3). The pattern of signs, significance, and magnitudes are remarkably similar in both sectors.[13] The null hypothesis of identical employment effects, $\beta = \beta_F = \beta_I$, could not be rejected. (This result is robust across the specifications discussed in Section 4.) The robustness checks for the formal and informal sectors therefore do not change the previous conclusions. As discussed above, negative employment (rate) effects in both sectors and positive unemployment effects (Table 3) are consistent with the presence of a spike and spillover effects in both sectors; these results are also in line with previous findings for Brazil (Foguel, 1997; Gonzaga et al., 1999; Gonzaga et al., 2001).

5.2 Private and Public Sectors

The employment effects predicted by the neoclassical model relies 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 in Brazil (see Section 3.1). This is not to claim there will be no adverse employment effect in the public sector. Even though they are not predicted by a specific theory, Hamermesh (1993) notes that institutional differences in developing countries do not require changes in the basic theory of labour demand. However, because evidence regarding the private sector need not carry over to the public sector, the same sort of robustness check for the formal and informal sectors in Section 5.1 is performed for the private and public sectors. Investigating the public sector employment effects is particularly relevant if the public sector, as in

[13] As discussed in Section IV, the semi-log specification guarantees that . As a result, log of full sample employment rate (hours worked) no longer equals the sum of the log of formal and informal sectors employment rate (hours worked), and therefore no longer holds. This is a technical issue with no further implications; the functional form does not change the estimates magnitudes significantly, and it surely does not change their signs. Also note that, in line with previous work for Brazil (Menezes-Filho et al., 2002; Tannuri-Pianto and Pianto, 2002; Carneiro, 2002), the self-employed were dropped because the design of the survey does not allow their classification into salaried formal or informal sector workers.

Brazil, is overpopulated by minimum wage workers and has no negligible spillover effects (Lemos, 2003c).

Panel 2 of Table 3 presents the estimates. Once again the pattern of signs and magnitudes are similar in both sectors. The null hypothesis of identical employment effects could not be rejected. (This result is robust across the specifications discussed in Section IV, even though, in a few cases, this might be due to large standard errors). Nevertheless, once again, the robustness checks for the private and public sectors are not sufficiently strong to change the previous conclusions.

6. Conclusion

The international literature on minimum wage is scanty on non-US empirical evidence, in particular on developing countries evidence. Using Brazilian data is an unbiased way of extending the understanding of minimum wage effects and assessing the robustness of findings for the US. This paper estimates the minimum wage effects on wages and employment using Brazilian household data for the 80's and 90's recently released for the public and not yet used for studies of the minimum wage. Brazil's minimum wage policy is a distinctive and central feature of the Brazilian economy. Not only are increases in the minimum wage large and frequent, but also the minimum wage has been used as anti-inflation policy in addition to its social role. It affects employment directly and indirectly, through wages, pensions, benefits, inflation, the informal sector, and the public deficit. This confirms the importance of studying the minimum wage in Brazil.

This paper follows recent strands in the literature that try to uncover the wage distributional effects of minimum wages, and discusses a number of conceptual and identification questions as tentative explanation of the non-negative employment effects recently found in the literature.

The effect of the minimum wage on the wage distribution was exhaustively measured using a variety of specifications and minimum wage variables. Evidence of a compression effect was robust and in line with the international and Brazilian empirical literature. Once the expected effect on the wages distribution is established, the policy debate hinges on its effect on employment. Again, this effect was exhaustively measured using a variety of specifications, minimum wage variables, and estimation techniques. Evidence of a moderately small adverse effect was uncovered and shown to be robust. An increase of 10% in the minimum wage was found to decrease employment by 1% at the most, again in line with the international and Brazilian empirical literature. This is consistent with a fairly inelastic demand curve where minimum wage increases translate into large wage increases and small employment losses.

To test further whether the minimum wage does not destroy too many jobs, this total effect was decomposed into hours and jobs effects. This is because the non-negative effects on jobs have been suggested to be a sub-product of adjustments in hours in the recent debate in the literature. Indeed, the total employment appears to be dominated by the hours rather than the jobs effects. This suggests that the minimum wage does not hurt as much where it hurts the most: causing disemployment.

Another tentative explanation to the non-negative employment effect found in the literature is that the underlying covered and uncovered sectors effects, if opposite-signed as predicted by the standard Two Sectors Model, might drive the net employment effect to be close to zero. The formal and informal sectors effects were both found to be negative, consistent with the presence of a large spike and substantial spillover effects in both sectors. This suggests a downwards sloping labour demand curve in both sectors, challenging the standard Two Sectors Model as inadequate to explain the effect of the minimum wage on the formal and informal sectors in Brazil and in Latin America more generally.

To summarize, an increase in the minimum wage was found to compress the wages distribution, with moderately small adverse effects on employment. In other words, the minimum wage increases the wages of low paid workers and does not destroy too many jobs in Brazil.

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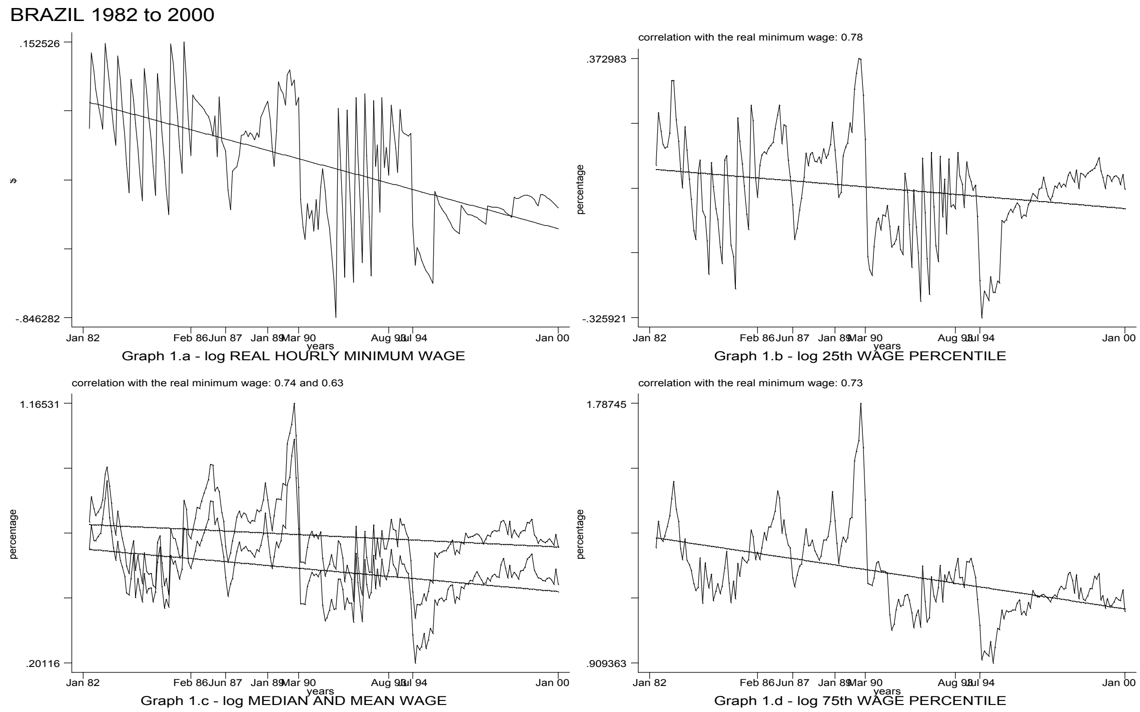
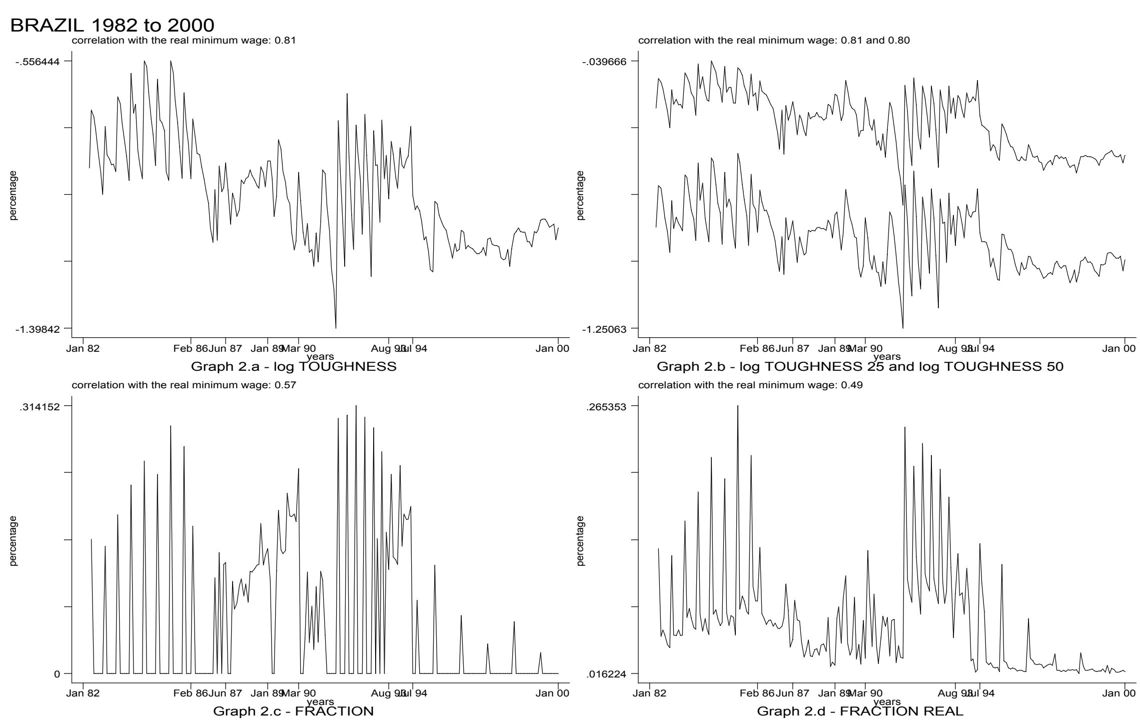
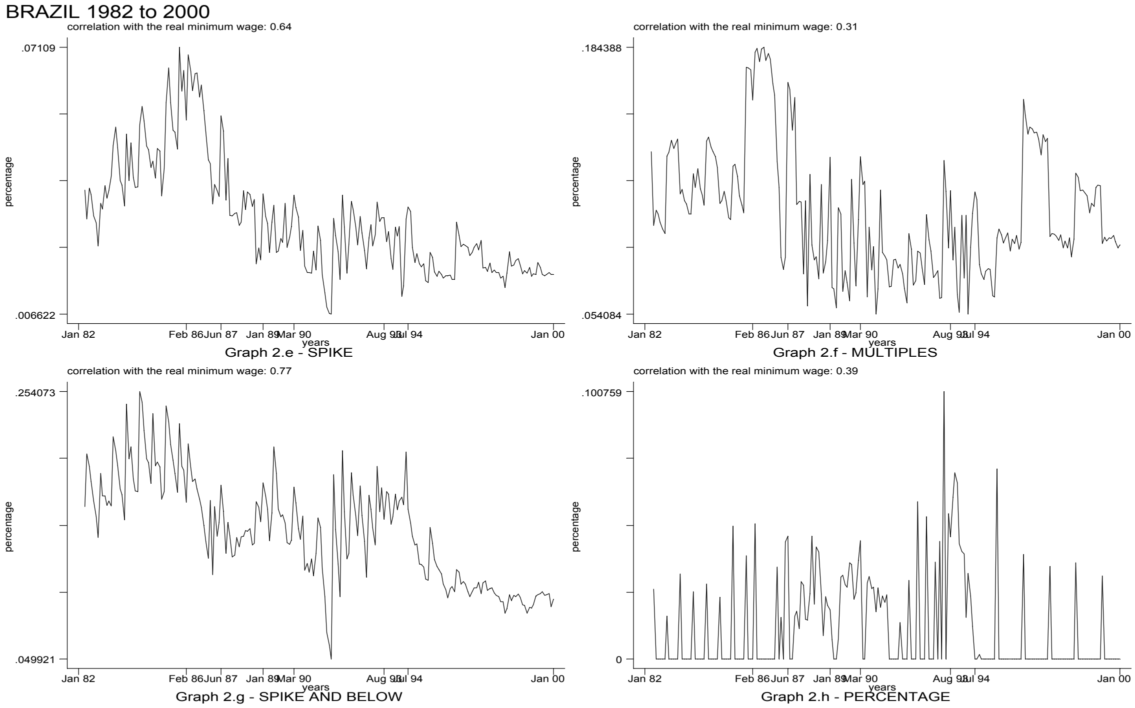


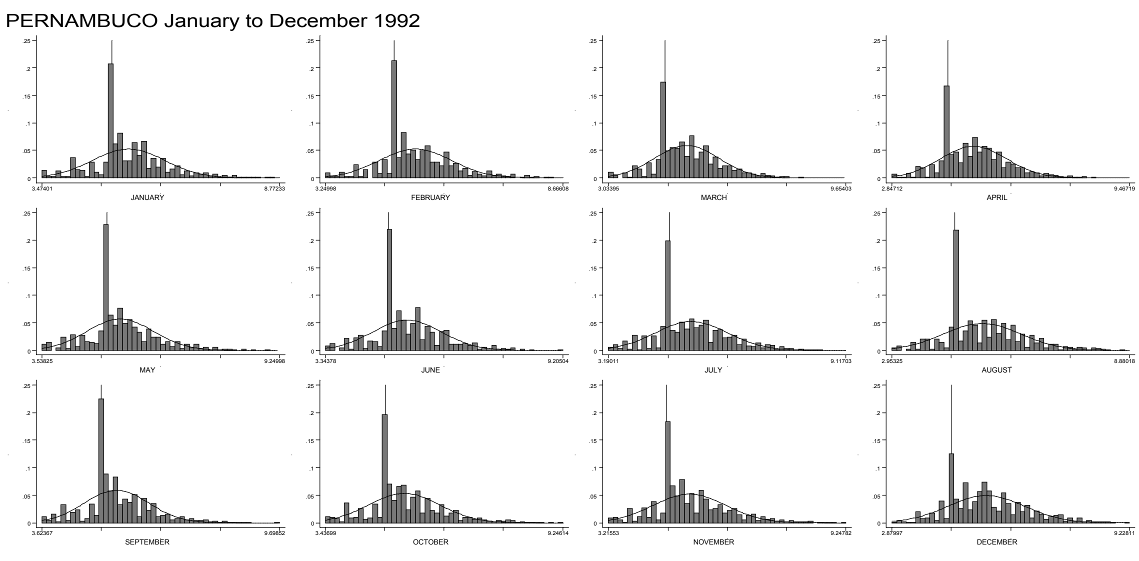
Graph 1 - MINIMUM WAGE AND WAGE DISTRIBUTION



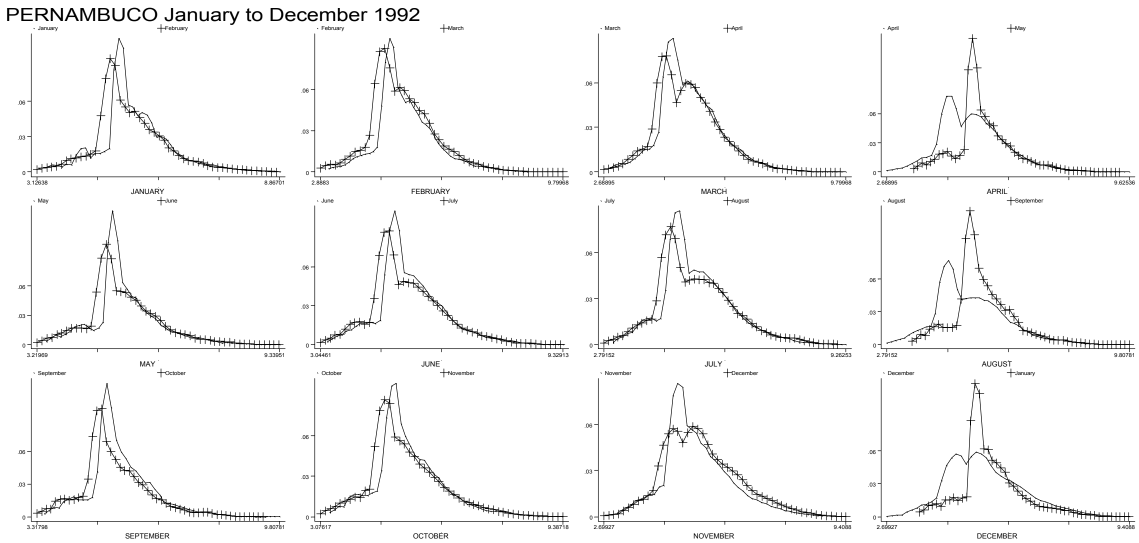
Graph 2 - MINIMUM WAGE VARIABLES - continues



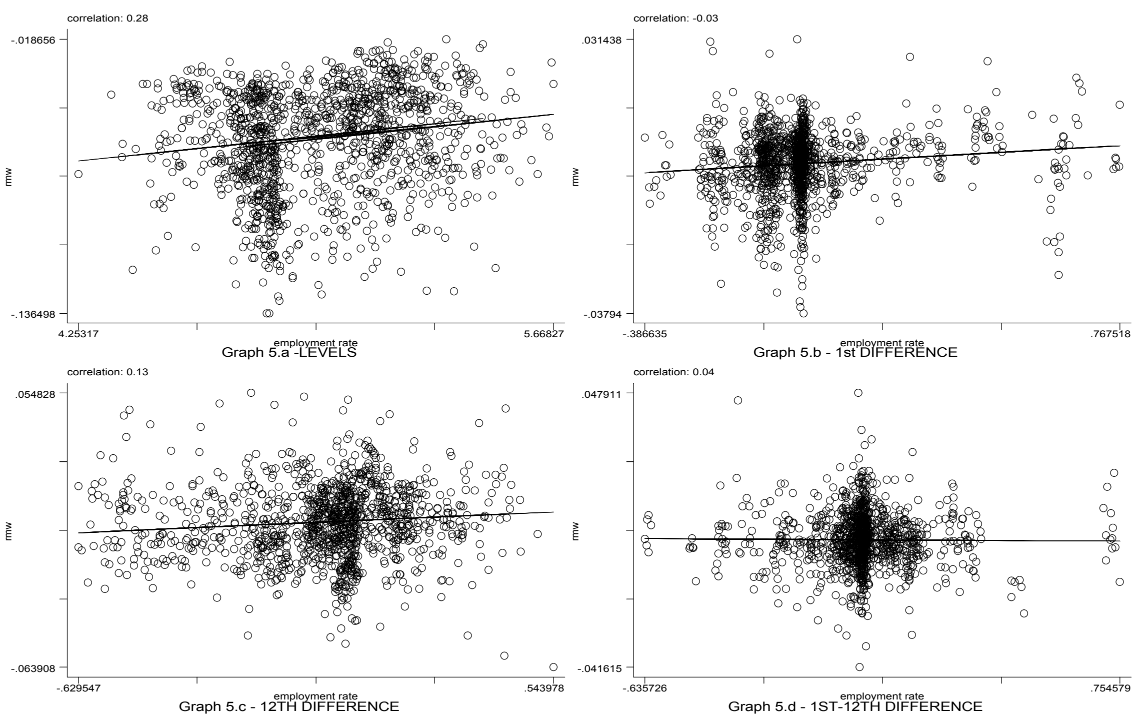
Graph 2 - MINIMUM WAGE VARIABLES - continued



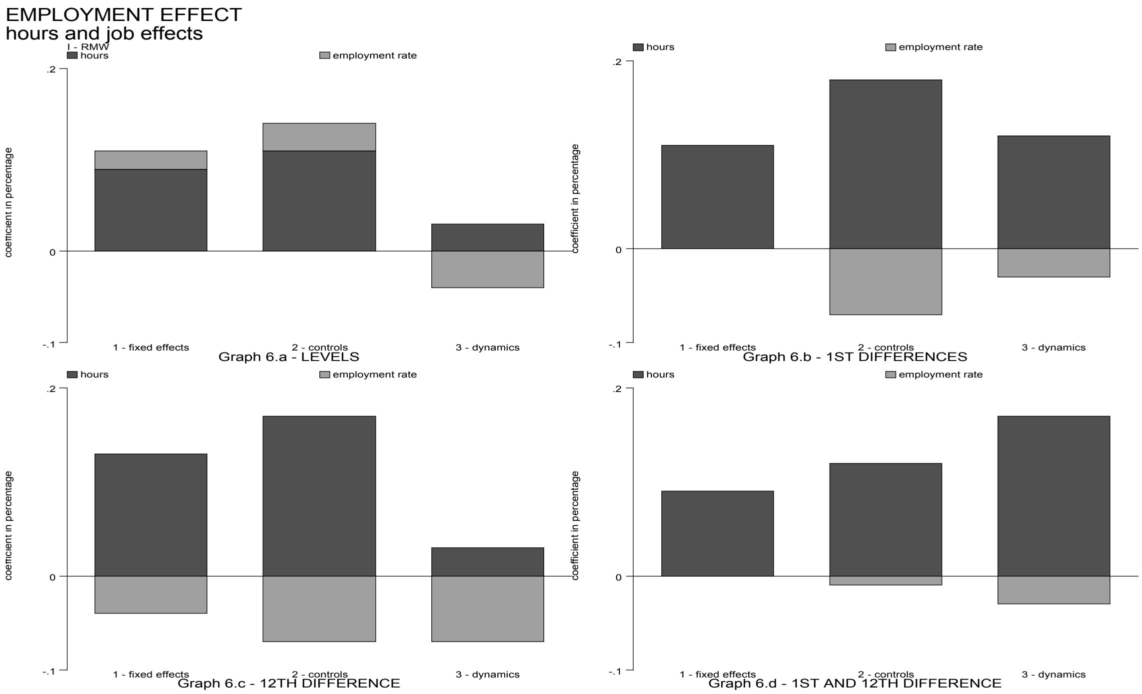
Graph 3 - DISTRIBUTION OF LOG REAL EARNINGS



Graph 4 - LOG REAL EARNINGS KERNEL DISTRIBUTIONS



Graph 5 - LOG EMPLOYMENT RATE AND LOG REAL HOURLY MINIMUM WAG



estimates from table B panel I

ph 6 - EFFECT OF A 10% INCREASE IN THE MINIMUM WAGE ON EMPLOYMI

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

percentiles	**interval**	
	min	max
5th	**0.22**	**5.72**
10th	**0.23**	**6.35**
15th	**0.20**	**6.02**
20th	**0.14**	**5.93**
25th	**0.09**	**5.18**
30th	**0.06**	**4.61**
35th	**0.03**	**4.04**
40th	**-0.02**	**3.64**
45th	**-0.17**	**3.22**
50th	**-0.16**	**2.93**
90th	**-1.19**	**1.36**
95th	**-1.20**	**1.15**
mean	**0.02**	**3.39**
50th/10th	***-3.48***	***-0.24***
90th/10th	***-5.10***	***-0.30***
90th/50th	***-1.62***	***-0.06***
standard deviation	***-1.56***	***-0.07***

1) For full estimates see Table A in the Appendix. To obtain the equivalent of a 10% increase in the minimum wage, the estimates of fraction were multiplied by 3.7, of fraction real by 1.4, of spike and below by 1.8, of spike by 0.3, of multiples by 0.4, and of percentage by 0.5 (see Section 3.4.2).
2) 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.
3) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors.

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

dependent variables	data filter	interval lower	interval upper
total employment	(1) levels	**-0.13**	**1.40**
hours worked		**0.00**	**1.13**
employment rate		**-0.39**	**0.28**
total employment	(2) first	**-0.01**	**1.15**
hours worked	difference	**-0.01**	**1.81**
employment rate		**-0.66**	**0.00**
total employment	(3) twelfth	**-0.95**	**1.05**
hours worked	difference	**0.01**	**1.75**
employment rate		**-0.73**	**0.03**
total employment	(4) first and	**0.00**	**1.27**
hours worked	twelfth	**0.00**	**1.69**
employment rate	difference	**-0.26**	**0.01**

1) For full estimates see Table B in the Appendix. To obtain the equivalent of a 10% increase in the minimum wage, the estimates of fraction were multiplied by 3.7, of fraction real by 1.4, of spike and below by 1.8, of spike by 0.3, of multiples by 0.4, and of percentage by 0.5 (see Section 3.4.2).
2) A 10% increase in the minimum wage decreases employment by less than 1% (lower end) across models and variables.
3) 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 for the static but not for the dynamic model.
4) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors.

Table 3 - ESTIMATES OF THE COEFFICIENT OF SPIKE - formal and informal, private and public sectors

dependent variables	coef	se	coef	se	Chow test
	1 - formal		**informal**		
total employment	**0.489**	0.108	**0.537**	0.146	0.172
hours worked	**0.427**	0.090	**0.420**	0.107	0.129
employment rate	**-0.044**	0.034	**-0.001**	0.098	0.093
	2 - private		**public**		
total employment	**0.446**	0.094	**0.517**	0.209	0.202
hours worked	**0.415**	0.085	**0.526**	0.208	0.195
employment rate	**-0.013**	0.035	**-0.021**	0.041	0.054
unemployment rate	**0.129**	0.183			

1) These estimates are to be compared with the dynamic model in first differences in column 3, row 2, panel V of Table A (in the appendix). That is the preferred specification as discussed in Section 4.3. Dynamics are modelled as 24 lags of the dependent variable.
2) The dependent variable is average hours worked for the working population, average hours worked for those employed and employment rate. Hours and Job elasticities do not add to Total elasticity for the dynamic model.
3) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors.

Table A - ESTIMATES OF THE COEFFICIENTS OF THE MINIMUM WAGE VARIABLES ON WAGES MODELS

percentiles	MW levels		MW difference		fraction		fraction real		spike and below		spike		multiples		percentage	
	coef (1)	se	coef (2)	se	coef (3)	se	coef (4)	se	coef (5)	se	coef (6)	se	coef (7)	se	coef (8)	se
without controls																
5th	**0.572**	0.014	**0.507**	0.024	**0.977**	0.053	**1.174**	0.094	**1.320**	0.160	**3.172**	0.464	**0.619**	0.121	**2.229**	0.280
10th	**0.635**	0.014	**0.578**	0.029	**1.202**	0.057	**1.401**	0.105	**1.821**	0.171	**3.659**	0.550	**0.657**	0.143	**2.868**	0.300
15th	**0.602**	0.014	**0.558**	0.029	**1.223**	0.050	**1.405**	0.102	**1.846**	0.153	**3.315**	0.495	**0.586**	0.130	**3.213**	0.272
20th	**0.593**	0.014	**0.547**	0.030	**1.212**	0.052	**1.368**	0.108	**1.732**	0.153	**2.588**	0.507	**0.444**	0.137	**3.099**	0.299
25th	**0.518**	0.015	**0.468**	0.029	**1.051**	0.052	**1.204**	0.104	**1.296**	0.149	**1.777**	0.461	**0.300**	0.119	**2.795**	0.265
30th	**0.461**	0.015	**0.400**	0.028	**0.908**	0.051	**1.072**	0.097	**0.954**	0.140	**1.034**	0.411	**0.220**	0.111	**2.391**	0.270
35th	**0.404**	0.014	**0.338**	0.025	**0.761**	0.048	**0.897**	0.089	**0.638**	0.127	**0.411**	0.360	**0.168**	0.095	**1.895**	0.236
40th	**0.364**	0.013	**0.295**	0.021	**0.654**	0.040	**0.779**	0.073	**0.476**	0.112	**0.202**	0.327	**0.102**	0.091	**1.693**	0.199
45th	**0.322**	0.013	**0.251**	0.019	**0.556**	0.038	**0.656**	0.066	**0.309**	0.105	**-0.339**	0.298	**-0.004**	0.085	**1.437**	0.186
50th	**0.293**	0.013	**0.223**	0.017	**0.485**	0.035	**0.591**	0.059	**0.197**	0.104	**-0.357**	0.287	**0.005**	0.082	**1.223**	0.166
90th	**0.136**	0.018	**0.062**	0.018	**0.126**	0.042	**0.192**	0.063	**-0.644**	0.109	**-1.626**	0.315	**-0.170**	0.097	**0.180**	0.166
95th	**0.115**	0.019	**0.047**	0.019	**0.093**	0.045	**0.158**	0.067	**-0.654**	0.119	**-1.622**	0.355	**-0.174**	0.102	**0.141**	0.168
mean	**0.339**	0.012	**0.270**	0.017	**0.586**	0.034	**0.700**	0.061	**0.386**	0.100	**0.282**	0.289	**0.106**	0.081	**1.449**	0.178
50th/10th	***-0.340***	*0.014*	***-0.348***	*0.023*	***-0.702***	*0.049*	***-0.796***	*0.082*	***-1.592***	*0.138*	***-4.034***	*0.401*	***-0.659***	*0.112*	***-1.638***	*0.221*
90th/10th	***-0.497***	*0.019*	***-0.510***	*0.028*	***-1.061***	*0.058*	***-1.200***	*0.101*	***-2.429***	*0.160*	***-5.349***	*0.548*	***-0.843***	*0.147*	***-2.686***	*0.271*
90th/50th	***-0.154***	*0.013*	***-0.162***	*0.015*	***-0.360***	*0.032*	***-0.404***	*0.052*	***-0.838***	*0.078*	***-1.315***	*0.285*	***-0.184***	*0.078*	***-1.047***	*0.131*
st.deviation	***-0.151***	*0.005*	***-0.156***	*0.008*	***-0.330***	*0.016*	***-0.372***	*0.030*	***-0.720***	*0.044*	***-1.464***	*0.153*	***-0.210***	*0.040*	***-0.864***	*0.078*
with controls																
5th	**0.559**	0.015	**0.479**	0.023	**0.898**	0.051	**1.016**	0.087	**1.208**	0.154	**2.818**	0.414	**0.541**	0.110	**1.921**	0.247
10th	**0.625**	0.015	**0.553**	0.029	**1.138**	0.059	**1.242**	0.104	**1.713**	0.169	**3.303**	0.504	**0.580**	0.133	**2.552**	0.273
15th	**0.586**	0.015	**0.530**	0.028	**1.155**	0.049	**1.245**	0.095	**1.734**	0.138	**2.943**	0.437	**0.502**	0.119	**2.904**	0.238
20th	**0.570**	0.015	**0.508**	0.029	**1.121**	0.049	**1.178**	0.097	**1.593**	0.137	**2.159**	0.442	**0.350**	0.123	**2.719**	0.251
25th	**0.494**	0.015	**0.426**	0.026	**0.955**	0.045	**1.010**	0.087	**1.173**	0.125	**1.397**	0.387	**0.218**	0.105	**2.452**	0.213
30th	**0.432**	0.014	**0.356**	0.025	**0.807**	0.043	**0.882**	0.078	**0.834**	0.113	**0.660**	0.347	**0.141**	0.097	**2.060**	0.218
35th	**0.382**	0.014	**0.300**	0.022	**0.672**	0.041	**0.730**	0.075	**0.540**	0.108	**0.106**	0.306	**0.111**	0.085	**1.609**	0.191
40th	**0.348**	0.014	**0.264**	0.019	**0.581**	0.037	**0.638**	0.065	**0.404**	0.096	**-0.055**	0.284	**0.058**	0.082	**1.459**	0.167
45th	**0.307**	0.014	**0.222**	0.017	**0.489**	0.036	**0.536**	0.060	**0.240**	0.093	**-0.557**	0.273	**-0.045**	0.079	**1.233**	0.162
50th	**0.280**	0.014	**0.200**	0.016	**0.429**	0.035	**0.487**	0.057	**0.151**	0.096	**-0.520**	0.265	**-0.020**	0.077	**1.053**	0.149
90th	**0.134**	0.018	**0.044**	0.017	**0.079**	0.043	**0.115**	0.064	**-0.662**	0.099	**-1.666**	0.305	**-0.160**	0.094	**0.082**	0.159
95th	**0.114**	0.019	**0.032**	0.019	**0.052**	0.047	**0.098**	0.069	**-0.666**	0.110	**-1.643**	0.338	**-0.179**	0.100	**0.050**	0.164
mean	**0.326**	0.012	**0.244**	0.015	**0.520**	0.032	**0.575**	0.055	**0.320**	0.087	**0.074**	0.255	**0.068**	0.073	**1.239**	0.151
50th/10th	***-0.341***	*0.014*	***-0.347***	*0.024*	***-0.694***	*0.052*	***-0.742***	*0.084*	***-1.527***	*0.139*	***-3.834***	*0.386*	***-0.602***	*0.109*	***-1.488***	*0.219*
90th/10th	***-0.487***	*0.019*	***-0.504***	*0.029*	***-1.045***	*0.062*	***-1.117***	*0.103*	***-2.338***	*0.158*	***-5.023***	*0.508*	***-0.757***	*0.140*	***-2.459***	*0.260*
90th/50th	***-0.143***	*0.013*	***-0.156***	*0.015*	***-0.351***	*0.034*	***-0.376***	*0.051*	***-0.810***	*0.074*	***-1.189***	*0.269*	***-0.155***	*0.076*	***-0.971***	*0.129*
st.deviation	***-0.144***	*0.005*	***-0.149***	*0.008*	***-0.314***	*0.016*	***-0.334***	*0.027*	***-0.680***	*0.040*	***-1.339***	*0.134*	***-0.179***	*0.038*	***-0.776***	*0.068*

1) Columns 1-8 show estimates for respectively: minimum wage in levels, minimum wage in differences, fraction, fraction real, spike and below, spike, multiples and percentage.
2) 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.
3) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies.
4) The top panel shows raw estimates and the bottom panel shows estimates after controlling for population and institutional factors.
5) To obtain the equivalent of a 10% increase in the minimum wage, the estimates of fraction were multiplied by 3.7, of fraction real by 1.4, of spike and below by 1.8, of spike by 0.3, of multiples by 0.4, and of percentage by 0.5 (see Section 3.4.2).

Table B - ESTIMATES OF THE COEFFICIENT OF THE MINIMUM WAGE ON EMPLOYMENT MODELS

		fixed effects		controls		dynamics		long run	fixed effects		controls		dynamics		long run
dependent	**data filter**	**coef**	se	**coef**	se	**coef**	se	**coef**	**coef**	se	**coef**	se	**coef**	se	**coef**
variables		(1)		(2)		(3)		(4)	(1)		(2)		(3)		(4)
		I - RMW							**VI - MULTIPLES**						
total employment	(1) levels	**0.011**	0.007	**0.014**	0.007	**0.001**	0.007	**0.001**	**-0.012**	0.035	**-0.008**	0.038	**-0.002**	0.032	**-0.001**
hours worked		**0.009**	0.006	**0.011**	0.006	**0.003**	0.006	**0.002**	**0.008**	0.031	**0.007**	0.033	**0.007**	0.028	**0.004**
employment rate		**0.002**	0.003	**0.003**	0.003	**-0.004**	0.002	**-0.002**	**-0.020**	0.017	**-0.015**	0.017	**-0.003**	0.008	**-0.001**
total employment	(2) first	**0.011**	0.006	**0.012**	0.007	**0.008**	0.006	**-0.002**	**-0.031**	0.031	**-0.025**	0.031	**0.011**	0.027	**-0.003**
hours worked	difference	**0.011**	0.006	**0.018**	0.007	**0.012**	0.006	**-0.001**	**-0.014**	0.030	**-0.010**	0.030	**0.015**	0.025	**-0.002**
employment rate		**0.000**	0.002	**-0.007**	0.002	**-0.003**	0.002	**0.004**	**-0.017**	0.009	**-0.015**	0.007	**-0.005**	0.007	**0.007**
total employment	(3) twelfth	**0.009**	0.008	**0.010**	0.008	**-0.009**	0.006	**-0.007**	**0.068**	0.027	**0.065**	0.027	**0.044**	0.020	**0.032**
hours worked	difference	**0.013**	0.007	**0.017**	0.007	**0.003**	0.005	**0.003**	**0.051**	0.025	**0.054**	0.025	**0.034**	0.018	**0.034**
employment rate		**-0.004**	0.003	**-0.007**	0.003	**-0.007**	0.002	**-0.005**	**0.017**	0.011	**0.011**	0.011	**0.002**	0.007	**0.001**
total employment	(4) first and	**0.009**	0.007	**0.011**	0.007	**0.013**	0.007	**-0.003**	**0.031**	0.031	**0.048**	0.031	**-0.003**	0.019	**0.001**
hours worked	twelfth	**0.009**	0.007	**0.012**	0.007	**0.017**	0.006	**-0.003**	**0.051**	0.030	**0.068**	0.030	**0.001**	0.018	**0.000**
employment rate	difference	**0.000**	0.002	**-0.001**	0.002	**-0.003**	0.002	**0.002**	**-0.020**	0.008	**-0.020**	0.008	**-0.011**	0.006	**0.008**
		II - FRACTION							**VII - PERCENTAGE**						
total employment	(1) levels														
hours worked															
employment rate															
total employment	(2) first	**0.027**	0.009	**0.030**	0.010	**0.014**	0.010	**-0.004**	**0.127**	0.035	**0.124**	0.039	**0.069**	0.033	**-0.017**
hours worked	difference	**0.026**	0.009	**0.038**	0.010	**0.020**	0.008	**-0.002**	**0.122**	0.035	**0.143**	0.038	**0.074**	0.029	**-0.008**
employment rate		**0.001**	0.003	**-0.008**	0.003	**-0.005**	0.003	**0.006**	**0.005**	0.012	**-0.019**	0.010	**-0.006**	0.010	**0.007**
total employment	(3) twelfth	**0.041**	0.015	**0.045**	0.015	**-0.005**	0.013	**-0.003**	**0.107**	0.050	**0.099**	0.051	**-0.008**	0.039	**-0.005**
hours worked	difference	**0.050**	0.012	**0.056**	0.012	**0.019**	0.011	**0.019**	**0.145**	0.043	**0.146**	0.043	**0.052**	0.031	**0.051**
employment rate		**-0.009**	0.007	**-0.012**	0.007	**-0.016**	0.005	**-0.011**	**-0.037**	0.025	**-0.047**	0.024	**-0.043**	0.016	**-0.028**
total employment	(4) first and	**0.031**	0.012	**0.034**	0.012	**0.006**	0.010	**-0.002**	**0.082**	0.043	**0.077**	0.043	**0.001**	0.030	**0.000**
hours worked	twelfth	**0.034**	0.012	**0.036**	0.011	**0.011**	0.008	**-0.002**	**0.092**	0.042	**0.094**	0.042	**0.022**	0.024	**-0.004**
employment rate	difference	**-0.003**	0.003	**-0.002**	0.003	**-0.006**	0.003	**0.005**	**-0.011**	0.012	**-0.017**	0.011	**-0.019**	0.012	**0.015**
		III - FRACTION REAL							**VIII - TOUGHNESS**						
total employment	(1) levels								**0.009**	0.008	**0.011**	0.008	**0.016**	0.008	**0.008**
hours worked									**0.031**	0.007	**0.033**	0.007	**0.022**	0.007	**0.012**
employment rate									**-0.022**	0.004	**-0.022**	0.004	**-0.005**	0.002	**-0.003**
total employment	(2) first	**0.022**	0.014	**0.028**	0.016	**0.012**	0.016	**-0.003**	**0.042**	0.008	**0.045**	0.009	**0.031**	0.007	**-0.008**
hours worked	difference	**0.018**	0.015	**0.040**	0.016	**0.022**	0.014	**-0.003**	**0.047**	0.009	**0.052**	0.009	**0.033**	0.007	**-0.004**
employment rate		**0.003**	0.005	**-0.011**	0.005	**-0.002**	0.006	**0.002**	**-0.004**	0.003	**-0.006**	0.002	**-0.003**	0.002	**0.004**
total employment	(3) twelfth	**0.016**	0.023	**0.021**	0.024	**0.008**	0.018	**0.006**	**0.024**	0.011	**0.027**	0.011	**0.013**	0.008	**0.009**
hours worked	difference	**0.015**	0.019	**0.024**	0.019	**0.018**	0.015	**0.017**	**0.042**	0.009	**0.044**	0.009	**0.029**	0.007	**0.029**
employment rate		**0.001**	0.011	**-0.003**	0.012	**-0.008**	0.008	**-0.006**	**-0.017**	0.004	**-0.017**	0.004	**-0.009**	0.003	**-0.006**
total employment	(4) first and	**0.038**	0.016	**0.041**	0.016	**0.023**	0.013	**-0.006**	**0.060**	0.011	**0.066**	0.010	**0.036**	0.007	**-0.010**
hours worked	twelfth	**0.040**	0.015	**0.041**	0.015	**0.030**	0.011	**-0.005**	**0.065**	0.011	**0.069**	0.010	**0.037**	0.006	**-0.007**
employment rate	difference	**-0.002**	0.006	**0.000**	0.006	**-0.006**	0.006	**0.005**	**-0.005**	0.003	**-0.003**	0.002	**-0.003**	0.002	**0.002**
		IV - SPIKE AND BELOW							**IX - TOUGHNESS 50**						
total employment	(1) levels	**-0.074**	0.028	**-0.067**	0.030	**0.079**	0.029	**0.042**	**0.005**	0.007	**0.006**	0.008	**0.013**	0.008	**0.007**
hours worked		**0.090**	0.023	**0.103**	0.024	**0.114**	0.024	**0.062**	**0.025**	0.006	**0.027**	0.007	**0.019**	0.007	**0.010**
employment rate		**-0.164**	0.014	**-0.170**	0.014	**-0.026**	0.011	**-0.014**	**-0.020**	0.004	**-0.021**	0.004	**-0.005**	0.002	**-0.003**
total employment	(2) first	**0.260**	0.038	**0.273**	0.040	**0.185**	0.036	**-0.050**	**0.037**	0.008	**0.040**	0.008	**0.028**	0.007	**-0.007**
hours worked	difference	**0.280**	0.040	**0.296**	0.039	**0.188**	0.031	**-0.023**	**0.041**	0.008	**0.047**	0.008	**0.030**	0.006	**-0.004**
employment rate		**-0.020**	0.013	**-0.024**	0.009	**-0.010**	0.010	**0.013**	**-0.004**	0.002	**-0.006**	0.002	**-0.003**	0.002	**0.004**
total employment	(3) twelfth	**0.144**	0.038	**0.163**	0.039	**0.078**	0.028	**0.056**	**0.022**	0.010	**0.024**	0.010	**0.010**	0.008	**0.008**
hours worked	difference	**0.210**	0.031	**0.230**	0.031	**0.134**	0.023	**0.134**	**0.037**	0.009	**0.040**	0.009	**0.026**	0.007	**0.026**
employment rate		**-0.066**	0.018	**-0.067**	0.019	**-0.028**	0.012	**-0.019**	**-0.016**	0.004	**-0.015**	0.004	**-0.009**	0.002	**-0.006**
total employment	(4) first and	**0.326**	0.042	**0.347**	0.042	**0.156**	0.030	**-0.042**	**0.050**	0.010	**0.055**	0.010	**0.031**	0.007	**-0.008**
hours worked	twelfth	**0.348**	0.043	**0.359**	0.043	**0.156**	0.024	**-0.030**	**0.055**	0.010	**0.058**	0.009	**0.033**	0.006	**-0.006**
employment rate	difference	**-0.022**	0.012	**-0.012**	0.011	**-0.011**	0.010	**0.008**	**-0.005**	0.002	**-0.003**	0.002	**-0.003**	0.002	**0.002**
		V - SPIKE							**X - TOUGHNESS 25**						
total employment	(1) levels	**-0.022**	0.095	**-0.036**	0.099	**0.203**	0.090	**0.108**	**0.016**	0.008	**0.018**	0.008	**0.019**	0.008	**0.010**
hours worked		**0.210**	0.080	**0.193**	0.084	**0.200**	0.080	**0.109**	**0.027**	0.007	**0.029**	0.007	**0.021**	0.007	**0.012**
employment rate		**-0.232**	0.042	**-0.230**	0.043	**-0.024**	0.025	**-0.013**	**-0.011**	0.004	**-0.011**	0.004	**-0.002**	0.002	**-0.001**
total employment	(2) first	**0.625**	0.111	**0.663**	0.111	**0.441**	0.098	**-0.117**	**0.050**	0.011	**0.055**	0.011	**0.036**	0.008	**-0.009**
hours worked	difference	**0.704**	0.110	**0.737**	0.109	**0.422**	0.090	**-0.051**	**0.056**	0.012	**0.058**	0.011	**0.034**	0.008	**-0.004**
employment rate		**-0.079**	0.034	**-0.074**	0.027	**-0.013**	0.030	**0.016**	**-0.005**	0.003	**-0.003**	0.002	**0.000**	0.002	**0.000**
total employment	(3) twelfth	**0.570**	0.102	**0.551**	0.103	**0.347**	0.083	**0.250**	**0.028**	0.012	**0.032**	0.012	**0.018**	0.008	**0.013**
hours worked	difference	**0.466**	0.095	**0.454**	0.096	**0.328**	0.074	**0.326**	**0.040**	0.011	**0.042**	0.011	**0.030**	0.008	**0.031**
employment rate		**0.104**	0.044	**0.097**	0.043	**-0.012**	0.031	**-0.008**	**-0.011**	0.004	**-0.010**	0.004	**-0.005**	0.003	**-0.003**
total employment	(4) first and	**0.747**	0.117	**0.779**	0.116	**0.317**	0.079	**-0.084**	**0.066**	0.014	**0.072**	0.013	**0.037**	0.008	**-0.010**
hours worked	twelfth	**0.823**	0.116	**0.844**	0.115	**0.317**	0.071	**-0.059**	**0.069**	0.014	**0.072**	0.013	**0.034**	0.007	**-0.006**
employment rate	difference	**-0.076**	0.032	**-0.065**	0.030	**-0.031**	0.027	**0.024**	**-0.003**	0.003	**0.000**	0.002	**0.000**	0.002	**0.000**

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 for the static but not for the dynamic model.
2) Column 1 shows the base specification with region and time fixed (and past inflation); column 2 adds controls to the base specification; and column 3 adds controls and dynamics (24 lags of the independent variable). Column 4 shows the long run coefficient associated to the model in column 3. Each comun shows Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies. Controls are population and institutional factors.
3) Panels I-X show respectively estimates of the coefficients of the real minimum wage, fraction, fraction real, spike and below, spike, multiples, percentage, toughness, toughness 50 and toughness 25. Each panel has four rows: (1) within groups (levels), (2) first differences, (3) twefth differences, and (4) first and twelfth differences.
4) Because fraction, fraction real, and percentage are variables already in differences, the models in levels were not estimated.
5) To obtain the equivalent of a 10% increase in the minimum wage, the estimates of fraction were multiplied by 3.7, of fraction real by 1.4, of spike and below by 1.8, of spike by 0.3, of multiples by 0.4, and of percentage by 0.5 (see Section 3.4.2).