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THE EFFECTS OF THE MINIMUM WAGE ON WAGES AND EMPLOYMENT IN BRAZIL – A MENU OF MINIUM WAGE VARIABLES

by

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The Effects Of The Minimum Wage On Wages And Employment In Brazil - A Menu Of Minimum Wage Variables

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The international literature on minimum wage strongly lacks empirical evidence from developing countries. In Brazil, not only are increases in the minimum wage large and frequent - unlike the typically small increases focused upon in most of the existing literature - but also the minimum wage plays a central and complex role. In addition to its social role the minimum wage has been used as anti-inflationary policy, confirming its importance to the Brazilian Economy. This paper analyzes the effects of the minimum wage on both wages and employment using monthly household-level data (similar to the US CPS) over a reasonably long time period. A number of conceptual and identification questions is here discussed. Various strategies on how to best measure the effect of a constant (national) minimum wage are summarized in a "menu" of minimum wage variables. Also, an employment decomposition that separately estimates the hours worked and the number of jobs effects is used. 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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I. Introduction

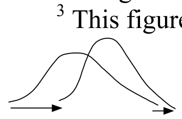
Increasing the level of employment and wages is always a goal in modern societies. Such a goal can be achieved by increases in the minimum wage depending on how these variables respond to the increase - i.e. depending on wage and employment elasticities with respect to the minimum wage. These elasticities depend on the minimum wage level and enforcement, and on the particularities of the labour market where it is imposed (Freeman, 1996 and Dolado et al., 1997). Generally, according to economic theory, their expected directions and magnitudes are as follows.

If the minimum wage is large enough and binding, the wage effect is positive because workers bargain to maintain their relative wages. Further, its magnitude is likely to vary across the wages distribution because different occupations have different comparison groups (Grossman, 1983;[2] Akerlof, 1982 and 1984; and Foguel, 1997 for Brazil). If the minimum wage is binding, its increase has two effects: (a) it shifts the distribution to the right, increasing its mean, and (b) it changes the shape of the distribution, reducing its variance. This is because larger elasticities are expected at lower percentiles, compressing the distribution. Other things being equal, (a) plus (b) implies a non-parallel shift of the distribution to the right,[3] reducing inequality.

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), Katz and Krueger (1992), Machin et al. (1993), Machin and Manning (1994), Bernstein and Schmitt (1998) and Dickens et

[2] According to Grossman (1983) a firm increases wages in response to a minimum wage increase because: workers' effort is a function of relative wage and firms demand more skilled workers. Grossman (1983) finds evidence that the wage distribution becomes more compressed immediately after an increase (relative wage effects), but that the wage structure gradually returns to its original state (substitution wage effects).

[3] This figure illustrates a non-parallel shift to the right:



The market power of the above minimum wage workers might offset (parallel shift) the redistributive impact of the increase (Freeman, 1996). Carneiro and Henley (1998) argue that in the 80s the Brazilian industrial labour unions had substantial insider power.

al. (1999) challenge such a prediction, unable to find disemployment effects of the minimum wage.

Some authors have attempted to theorize on non-negative employment effects (Brown, 1999; Card and Krueger, 1995). The idea is that the minimum wage increases employment if wages are lower than productivity. In a monopsony framework, for example, the minimum wage at first increases employment, but will eventually decrease it.[4] The point at which the sign switches depends on the elasticity of the labour supply (Brown, 1999).[5] 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).[6]

Assuming wage effects are present, the use of the minimum wage against inequality relies on its employment effects.[7] The aim is to change the shape of the wages distribution but not to destroy jobs - a compromise if wages and employment elasticities have opposite signs. On the one hand, if the employment elasticity is non-negative or non-significant (identifying restriction), the effects on inequality depend on the effect on the wage distribution (Dinardo et al., 1996). In other words, in the absence of employment losses, minimum wage increases just transfer money from one group to another (Freeman, 1994 and 1996; Deere et al., 1996). On the other hand, if the employment elasticity is negative, such an effect has to be accounted for by the effects on inequality.[8]

In this paper, adverse effects on employment are not consistently found across specifications, although the effects on the wage distribution are in the expected direction and magnitude. Such effects are here estimated for Brazil. This is important in this context for a number of reasons. First, the international literature on minimum wage strongly lacks evidence

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[4] Some are skeptical that firms that hire minimum wage workers have monopsony power (Brown et al., 1982; Card and Krueger, 1995; Brown, 1999).

[5] Using two stages estimators, different from the standard conditional mean labour supply function estimation, Ribeiro (2001) estimates a conditional quantile labour supply function for prime age urban males in Brazil. The author finds that labour supply elasticities significantly vary across hours of work, but at the standard workweek they are zero. This suggests that the labour supply elasticity at the minimum wage is basically zero.

[6] For large enough minimum wage increases the theory is unambiguous in that it predicts negative employment effects.

[7] See the original article by Stigler (1946). Also, see Burkhauser and Finegan (1989), Horrigan and Mincy (1993), Dinardo et al. (1994), Card and Krueger (1995), Teulings (1998), Lee (1999) and Neumark et al. (2000). For a survey, see Brown (1999).

from developing countries. Second, minimum wage increases in Brazil are large and frequent, unlike the typically small increases focused upon in most of the existing (mainly US) literature.[9] Studying such large increases ought to correspond more closely to standard economic models of the minimum wage, and allow a better possibility of observing its economic effects. Third, the minimum wage is a very important economic phenomenon in Brazil. It plays a central and complex role as an anti-inflation policy in addition to its traditional social role (Macedo, 1976; Macedo and Garcia, 1978 and 1979; Camargo, 1984; Foguel, 1997).

In Brazil, the minimum wage affects inflation in two ways. On the one hand, benefits, pensions, and earnings for a large proportion of civil servants are linked to it. As a result, minimum wage increases affect the public deficit, which ultimately affects inflation. On the other hand, it affects production costs, not only through its direct effect on minimum wage workers, but also through indirect spillover effects (Brown, 1999). As a result, minimum wage increases affect prices and, therefore, inflation. 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 an indexor).

The real minimum wage was then decreased to control both prices and the public deficit - ultimately, to control inflation. The perverse side of this is that increases in the minimum wage severely affected inflation; this effect was perpetuated into an inflation spiral. First, inflation eroded the minimum wage and triggered minimum wage bargains. The subsequent minimum wage increase: (a) increased the public deficit, and (b) was a signal for price and wage bargains. Both these increased inflation, which in turn triggered new minimum wage bargains. The anti-inflationary policy became inflationary itself; the remedy became the disease.

Thus, the minimum wage has been alternately used as social and anti-inflationary policy in Brazil. 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. Whether in its social or anti-inflationary role, the use of the minimum wage as a policy requires the study of its effect on both wages and employment.

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[8] In the case of a negative elasticity, the speed and magnitude of the increase play an important role. For example, a more desirable effect might be reached with successive small increases rather than a single large increase that could lead to lay offs (Card and Krueger, 1995; Dickens et al., 1997; and Machin and Manning, 1994, 1996).

[9] A parallel can be drawn with the Puerto Rico study of Castillo-Freeman and Freeman (1992).

This paper estimates such effects. It is organized as follows. Section II presents the data, Section III discusses wage effects, and Section IV employment effects. Section III describes the minimum wage in Brazil (Section III.1), presents descriptive statistics (Section III.2), and wage models (Section III.3). The wage effect is estimated by non-parametric Kernel densities and formalized by percentile wage models. This motivates a discussion on identification (Section III.4.1) because the minimum wage is constant (national) and therefore cannot explain variation in wages across regions. The wages models are then re-specified using various alternative minimum wage variables suggested in the literature (Section III.4.2) and here collected into a "menu" which establishes the relationship among them. Section IV presents the employment decomposition (Section IV.1), used to separately estimate the hours worked and number of jobs effects, and employment models (Section IV.2). Once more, alternative minimum wage variables are used as robustness checks (Section IV.3). The last Section comments on results robust to various alternative specifications and minimum wage variables. An increase in the minimum wage compresses the wages distribution with moderately small adverse effects on employment.

II. Data

The data used is from PME (Monthly Employment Survey), 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 period occurred annually, bi-annually, quarterly and even monthly, depending on the inflation level and indexation rules.

Each metropolitan region, composed of towns and cities, is divided into Census sectors. A panel is defined as a set of households within a Census sector, and divided into four subsets: P1, P2, P3, and P4. A second and third panel of the same length are defined, with no coincident households, and also divided into four subsets (Q1, Q2, Q3, Q4 and R1, R2, R3, R4). The rotating scheme consists of substituting one subset each month, in such a way that in the 13th month, panels P1, P2, P3, and P4 are back in the survey before they are definitely excluded.[10] In

[10] The Table illustrates the rotating panels scheme:

this way, every household is interviewed in the first 4 months, not interviewed in the next 8, and again interviewed in the next 4 months. This guarantees (a) that 75% of the households are the same in any two consecutive months, and (b) that every two years 100% of the sample is repeated.[11] This scheme allows monthly, yearly, and seasonal comparisons (IBGE, 1983 and 1991). To perform such comparisons at an individual level, and because it was unavailable in the data, a panel identifier had to be constructed. The identifier is necessary because there is no guarantee that the same individual will live in the same house for 16 consecutive months or answer the 8 waves.[12] 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 (IPC) to reduce measurement error.[13]

III. Wages Effects

III.1 Minimum Wage In Brazil

The minimum wage was introduced in 1940 as a social policy to provide the minimum diet, transport, clothing, and hygiene for an adult worker. The price of this minimum basket varied across regions which was reflected in 14 minimum wages - the highest (lowest) for the Southeast (Northeast) (Foguel, 1997). Wells (1983, p. 305) believes they were "generous relative to existing standards" since about 60% to 70% of workers earned below them. In contrast, Saboia (1984) and Oliveira (1981) believe they legitimated the low wages of the unskilled.

year/month	**weeks**			
1988	1	2	3	4
May	P1	P2	P3	P4
June	P1	P2	P3	Q4
July	P1	P2	Q3	Q4
August	P1	Q2	Q3	Q4
September	Q1	Q2	Q3	Q4
October	Q1	Q2	Q3	R4
November	Q1	Q2	R3	R4
December	Q1	R2	R3	R4
1989				
January	R1	R2	R3	R4
February	R1	R2	R3	P4
March	R1	R2	P3	P4
April	R1	P2	P3	P4
May	P1	P2	P3	P4

[11] The flow was twice interrupted: in August 1988, the sample was reduced by 20%, and in October 1993, the Census selected a new sample, fully implemented by January 1994. Thus, the panels are 100% different in January 1993 and January 1994. Furthermore, new sectors were selected whenever panels were exhausted and households within sectors were substituted in areas of extreme violence.

[12] Using the identifier, around 40% of the data was lost when first-differencing wages because individuals not observed in subsequent periods were dropped (either because of unemployment or because the rotating scheme).

The minimum basket price was the criteria for the introduction of the minimum wage, but not for its adjustments. The main reason for the erosion of the real minimum wage over time has been the failure in adjustments to keep pace with inflation. After a steep decrease, the real minimum wage was adjusted and reached its historical peak during the economic 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. Its social role changed when the dictatorship installed in 1964 associated high inflation with wage adjustments. The dictatorship limited labour organization, reduced wage militancy, and implemented a centralized wage policy. One of the strategies of this policy was to control nominal increases (Macedo and Garcia, 1978). The minimum wage was transformed "from a social policy designed to protect the worker's living standard into an instrument for stabilization policy" (Camargo, 1984, p.19). According to Carneiro and Faria (1998), the minimum wage was used not only as a stabilization policy but also as a co-ordinator of the wage policy. One example of this role 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. The minimum wage then became an indexor; its effects were no longer limited to the bottom of the distribution as when it plays a social role. Even after law forbade its indexor role in 1987, it was still used as a signal in price and wage bargains.[14]

Another reason for the erosion 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 its impact on benefits, pensions, and the Government wage bill (comprising a large proportion of minimum wage civil servants).[15] This has often been the criteria for the affordable increase in the minimum wage.

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[13] Because IPC is centered on the 15th, and wages are usually paid on the 5th of the month, a geometric mean was used to center the IPC on 1st. See Neri (1995) and Azzoni et al. (1998) for choices on deflator and deflation method in the presence of high inflation in Brazil (from 1982 to 2000, inflation was approximately 5,000,000,000,000%).

[14] Carneiro and Henley (1998) argue that the minimum wage co-ordinator role was weakened in the 80s (also see Soares, 1998). This debate started with the increase in inequality revealed in the 1970 Census being associated with the decreases in the minimum wage - the so called "Teoria do Farol" (Souza and Baltar, 1979, 1980a and 1980b; Wells; 1983, Bacha, 1979; Camargo, 1984; Saboia, 1983), although some disagreed (Macedo and Garcia, 1978).

[15] The Netherlands and Spain have benefits linked to the minimum wage (Dolado et. al, 1997).

Graph 3.1a summarizes the hourly real minimum wage between 1982 and 2000.[16] The highest level of the real minimum wage was in November 1982, before the acceleration of inflation, and the lowest level in August 1991.[17] 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 minimum basket as the minimum diet, accommodation, education, health, leisure, clothing, hygiene, transport, and retirement for an adult worker and his family - even though such a basket 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, 1983). 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 erratically adjusted - systematically decreasing - the minimum wage, depending on their indexation rules and on the inflation level. Since then, under reasonably stable inflation, the minimum wage has not been explicitly used as an anti-inflationary policy.

III.2 Descriptive Analysis And Minimum Wage Variables

The relationship between minimum wage and other wages in Brazil is now described empirically. Graphs 3.1 plot the real minimum wage and the average, 25th, 50th, and 90th 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 correlations (on the top of each graph) of 0.71 and 0.63 for the 25th and 90th percentiles. Lee (1999) found little minimum wage effect on the wage distribution above the 25th percentile for the USA.

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 wages adjusted for coverage - the Kaitz index (Kaitz, 1970). The index also received the intuitive name of "toughness" of the minimum wage if coverage is 100% (Machin and Manning, 1994). Graph 3.2a shows log toughness, whose correlation with the log real minimum wage of 0.80 suggests that the minimum wage is tough,

[16] The hourly minimum wage (wage) rate is the monthly minimum wage (earnings) divided by 44*4.3 after, and 48*4.3 before, the Constitution of 1988 (which shortened the working week from 48 to 44 hours).

i.e. it drives 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 USA.

Graph 3.2b 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, as suggested by Lee (1999) among others, log toughness 50 is a more suitable measure if wages inequality is substantial as in Brazil (Bacha, 1979; Fernandes and Menezes, 2000). The average fails to be representative of most people (who are at the bottom), and the median is a better central description of the distribution (insensitive to top outliers).[18] The correlation with the log real minimum wage is a tough 0.81. On the other hand, the minimum wage affects the low, not the average or median, wage worker (Deere et al., 1996). This motivates log toughness 25, whose correlation with log real minimum wage is again a tough 0.79.[19]

In addition to the typically used toughness, Graphs 3.2 plot over time other minimum wage variables suggested in the literature. Graph 3.2c 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 is 0.56. Regular spikes as big as 30% are observed at the beginning and end of the sample period (when minimum wage increases were bi-yearly and yearly). Fraction was also defined using real data (Graph 3.2d). The path is similar to that of fraction (correlation with the log real minimum wage is 0.46), 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 3.e shows “spike”, i.e. the proportion of people earning one minimum wage (Dolado at al., 1997),[20] whose correlation with

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[17] At that time, there were two currencies in the country: Cruzeiros Reais and Real (URV). Inflation was much higher if measured in Cruzeiros Reais, as was the idea behind the Plan. Here, the inflation in Reais was corrected (by 21.99%) to account for the inflation in Cruzeiros Reais in July 1994.

[18] Trimming is an alternative to eliminate to top outliers (Lee, 1999 for USA; Green and Arbashe, 2001 for Brazil); it is, furthermore, effective against measurement error in the top of the distribution.

[19] Toughness 25 has no variability if all workers in the 25th percentile earn a minimum wage. To a lesser extent, toughness also suffers from such (upward) bias if average wages are affected by a minimum wage increase (if many earn a minimum wage) (Castillo-Freeman and Freeman, 1992).

[20] Neri (1997) also used spike as a minimum wage variable, but not as a regressor on employment models as in Dolado et al. (1997). Later, Neri et al. (1999) described spike as a corner solution imposed in the wage distribution by the minimum wage and specified an empirical model for it. Many used spike as a measure of the importance of the minimum wage in Brazil (Drobny and Wells, 1983; Camargo, 1984; Macedo, 1976 and 1981; Macedo and

the log real minimum wage is 0.61.[21] Spike moves in response to the minimum wage, being bigger after an increase and smaller as different categories have their salaries negotiated and are pulled out of the minimum wage (Card and Krueger, 1995). As expected, this is particularly the case if inflation is high and the minimum wage is constant (Carmargo, 1984) - note the saw-toothed pattern on the real minimum wage (Graph 3.1a), also documented by Brown (1999) for the USA. Whereas Graph 3.2e shows spike over time, Graphs 3.3 show the actual spike in the earnings distribution for each month of 1992 (the vertical line is the minimum wage).[22]

Because of the minimum wage indexor role in Brazil (Section 3.2), Neri (1997) expanded spike to embrace those earning not only one, but also 0.5, 1, 1.5, 2, 2.5 and 3 minimum wages. Graph 3.2f shows "multiples", whose correlation with the log real minimum wage is 0.28. Figures almost as large as 20% and 15% are observed when Plano Cruzado and Plano Real were implemented (spike and fraction are also large in both events).

A related measure to multiples is the proportion of people earning the minimum wage or below (Dolado et al., 1997).[23] Graph 3.2g shows "spike and below", whose correlation with log real minimum wage is a high 0.78. Note the resemblance with the minimum wage itself (Graph 3.a). A remarkable figure of 28% is observed in the early 80s, which decreased over time but remained fairly significant.[24]

Once more, because of the indexor role - in the tradition of the "Teoria do Farol" (Section 3.1) - Neri (1997) and Foguel (1997) defined a measure of the effect of a minimum wage increase across the wage distribution. Graph 3.2h 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 is 0.40.[25] Considerable spikes are once more observed at Plano Cruzado and Plano Real. Percentage and multiples measure spillover effects.

Garcia, 1979; Souza and Baltar, 1979; Saboia, 1983; Barros, Foguel and Mendonca, 1997; Ramos and Reis, 1993 and 1995).

[21] From March to June 1994 the minimum wage was fixed at 64.79 URV and converted into Cruzeiros Reais on the day of payment. To capture the spike, the MW_t is here converted by the average URV of the first 7 days of $month_{t+1}$, since by law it must be paid at the latest on the 5th working day of $month_{t+1}$ (CLT, art. 459, law 7855/89).

[22] For a detailed comparison of toughness, fraction and spike, see Lemos (2002).

[23] See Ashenfelter and Smith (1979) and Card and Krueger (1995) for non-compliance.

[24] See Barros, Foguel and Mendonca (1997) and Ramos e Reis (1993 and 1995) for descriptives on spike and below, toughness, and toughness50 using another Brazilian household survey (PNAD).

[25] Percentage suffers from the same drawback as fraction (Brown, 1999) - it is zero when the minimum wage is constant.

III.2.1 Relationship Among Minimum Wage Variables

Fraction, spike, spike and below, multiples, and percentage are "degree of impact" measures (Brown, 1999), i.e. they focus on the proportion of workers directly affected by increases in the minimum wage. This suggests not only an intuitive but also an empirical and a mathematical relationship among them.

Empirically, their correlations are: (a) spike and fraction: 0.10; (b) spike and spike and below: 0.74; (c) spike and multiples: 0.75; (d) spike and percentage: 0.04; (e) spike and log toughness: 0.67; (f) fraction and spike and below: 0.44; and (g) fraction and log toughness: 0.45.

Mathematically, their definitions over intervals of the wage distribution can be formalized in terms of integrals having the general form $Z = \int_a^b g(x)dx$ for some choice of function $g(x)$ and limits *a* and *b*. Let ε be some appropriate "small" constant (say, 0.02MW, for rounding approximations, called ε here) and let $f_t(x)$ denote the probability density function of wages in time t. Consider the following choices of $g(x)$, a and *b*.

1) MINIMUM WAGE: $a = MW_{t-1}$, $b = MW_t$ and $g(x) = 1$ will give: $Z = \int_{MW_{t-1}}^{MW_t} 1dx = MW_t - MW_{t-1} = \Delta MW_t$

2) TOUGHNESS: $a = 0$, $b = \infty$ and $g(x) = f_t(x)$ will give: $Z = \frac{MW_t}{\int_0^\infty x f_t(x)dx}$ - $\frac{MW_{t-1}}{\int_0^\infty x f_{t-1}(x)dx} = \frac{MW_t}{average(wages_t)}$ - $\frac{MW_{t-1}}{average(wages_{t-1})}$ $= tough_t - tough_{t-1} = \Delta tough_t$

3) FRACTION: $a = MW_{t-1} - \varepsilon$, $b = MW_t + \varepsilon$ and $g(x) = f_{t-1}(x)$ will give: $Z = \int_{MW_{t-1}-\varepsilon}^{MW_t+\varepsilon} f_{t-1}(x)dx = fraction_{t-1}$

4) SPIKE AND BELOW: $a = -\infty$, $b = MW_t$ and $b = MW_{t-1}$ respectively; and $g(x) = f_t(x)$ respectively; will give: $Z = \int_{-\infty}^{MW_t} f_t(x)dx$ - $\int_{-\infty}^{MW_{t-1}} f_{t-1}(x)dx$ $= spikeandbelow_t - spikeandbelow_{t-1}$ $= \Delta spikeandbelow_t$

5) SPIKE: $a = MW_t - \varepsilon$, $b = MW_t + \varepsilon$ and $g(x) = f_t(x)$ will give: $Z = \int_{MW_t - \varepsilon}^{MW_t + \varepsilon} f_t(x)dx$ - $\int_{MW_{t-1} - \varepsilon}^{MW_{t+1} + \varepsilon} f_{t-1}(x)dx$ $= spike_t - spike_{t-1} = \Delta spike_t$

6) MULTIPLES: $a = mMW_t - \varepsilon$, $b = mMW_t + \varepsilon$ and $g(x) = f_t(x)$ will give: $Z = \sum_{i=1}^{6} Z_i$, where $Z_i = \int_{mMW_t - \varepsilon}^{mMW_t + \varepsilon} f_t(x)dx$ - $\int_{mMW_{t-1} - \varepsilon}^{mMW_{t-1} + \varepsilon} f_{t-1}(x)dx$ $= multiples_{it} - multiples_{it-1}$ $= \Delta multiples_{it}$, where m = 0.5, 1, 1.5, 2, 2.5 and 3.

7) PERCENTAGE: Let $f_{t,t-1}(x, y)$ denote the joint probability density function of $x = wages_{t-1}$ and $y = wages_t$. Let also $p_t = \frac{MW_t - MW_{t-1}}{MW_{t-1}}$ and $a = x[1 + (1 - \varepsilon) p_t]$, and $b = x[1 + (1 + \varepsilon) p_t]$, then $Z = \int_0^{\infty} \{ \int_{x[1+(1-\varepsilon)p_t]}^{x[1+(1+\varepsilon)p_t]} f_{t,t-1}(x, y)dy \} dx = percentage_t$

Intuitively $fraction_{t-1}$ relates to $\Delta spike_t$. It also relates to $\Delta spikeandbelow_t$ depending on how $f_t(x)$ approximates $f_{t-1}(x)$; both variables would be the same if the probability density function of wages did not change between two time periods. It is then easy to see that $fraction_{t-1}$ is already a variable in differences. The same is true for $percentage_t$. Table 3.1 summarizes the main aspects of the minimum wage variables.

III.3 Descriptive Models

Graphs 3.4 show non-parametric Kernel estimation of the earnings distribution for each month of 1992. Graphs 3.4d, 3.4h and 3.4l show the change in the shape of the distribution after each minimum wage increase (January, May and September). As expected (see Introduction), the distribution becomes less dispersed due to compression in the lower tail. In the remaining months, when the high inflation erodes the real minimum wage, the distributions become more dispersed. This is because if an increase shifts the distribution in a non-parallel shift to the right, a decrease (relative to other wages) is expected to shift it to the left.

If, in the absence of a minimum wage increase, the wage distribution remained stable over time (if individuals did not change positions within or dropped out of the distribution), then the simple comparison of Kernels before and after an increase would estimate the effect of the minimum wage on the wage distribution. However, shifts in the distribution might be due to the shifts to the minimum wage or to other variables, and it is not possible to distinguish between them (Meyer and Wise, 1983; Dinardo et. al, 1996; Lee, 1999). Thus, regression models were estimated to control for such variables.

The simplest model of wages as a function of the minimum wage is:

$$lrwage_{irt} = \alpha + \beta\, lrmw_t + u_{irt}, \qquad i = 1,..,8millions,\ t = 1,...,214$$

where $lrwage_{it}$ is the log real wages for individual i in region r in time t and $lrmw_t$ is the log real minimum wage in time t and u_{irt} is the error term. The month data goes from May of 1984 to January of 2000 (214 time periods). Aggregating over regions:

$$\overline{lrwage}_{rt} = \alpha + \beta\, lrmw_t + \bar{u}_{rt}, \qquad r = 1,..,6,\ t = 1,...,214$$

where $\overline{lrwage}_{rt}$ is the mean of log real wages of individuals in region r in time t.

However, a more complete picture of the effect of the minimum wage on the wages distribution is obtained by aggregating the data not only for the mean, but also for the 5th, 10th, 15th, 20th, 25th, 30th, 35th, 40th, 45th, 50th, 90th, and 95th percentiles of the wage distribution, and running a regression for each one of them. In this fashion, not only the effect of the minimum wage at the mean, but also at various points across the distribution is estimated (Dickens et al., 1999).[26] 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, time dummies separate other macro variable effects, from the effect of the minimum wage on wages (Section 3.4). 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 stabilizing the inflation; thus, inflation is driving other variables. On the other hand, the minimum wage was used as indexor (Section 3.1); thus, past inflation captures the portion of the minimum wage increase that merely compensates inflation.

Population and institutional control variables account for groups whose wages are linked to the minimum wage. Some examples are: 1) pensions and benefits; 2) young people, women, illiterates, etc.; 3) because of the particularities of the Brazilian labour market, municipal and estate civil servants, workers in the building industry, maids, etc.; and 4) informal sector wages (Carneiro and Henley, 1998 and Foguel, 1997). Thus, 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, were included as controls. These variables control for region specific characteristics that might be correlated with the minimum wage. Also, the unemployment rate, typically used as a measure of demand for labour, controls for region specific macro shocks that might be correlated with the minimum wage (Brown et al., 1982; Card and Krueger, 1995; Brown, 1999).[27]

The model was estimated in levels and in first-differences - conceptually the interest is on how changes in the minimum wage changes wages (Card, 1992; Card and Krueger, 1994; Dickens et al. 1999).[28] Dummies, past inflation, controls and constant were included after differencing.[29] The models were weighted and White-corrected for heteroskedasticity,[30] as well

[26] While Dickens et al. (1999) use the conditional distribution of averages across regions, Quantile Regression uses the conditional distribution of wages across individuals. A different procedure is to define a dummy for each percentile (rather than a regression for each percentile), as Neumark et al. (2000).

[27] 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. Nevertheless, even if employment is demand determined, truly exogenous supply side variables do not bias the coefficient, although they do bring in inefficiency (Brown et al., 1982 and 1983). Typically, employment equations in the literature have been interpreted as demand equations, even though many include supply side variables (Card and Krueger, 1995).

Of particular concern is the inclusion of a variable measuring enrolment rates in school, which is jointly determined with - rather than an exogenous determinant of - employment, since schooling and working are alternative opportunities (Card and Krueger, 1995). Neumark and Wascher (1992) report results both excluding (omitted variable bias) and including (simultaneity bias) enrolment rate as a strategy to bracket the true minimum wage effect. Card and Krueger (1995) argue that if year and region effects are modeled, then excluding enrolment rate does not matter much. 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. If the minimum wage reduces school enrolment, this might be more important than adverse employment effects.

In Brazil, a large number of minimum wage workers are adults no longer at school. Also, schooling is largely available in the evenings, and therefore working and schooling need not be exclusive alternatives; if present, the simultaneity bias will not be as strong. Due to these particularities and the unresolved debate, enrolment rate was not here included (Williams, 1993; Baker, 1999).

[28] In addition, first-differencing reduces variables to stationarity, preventing spurius regression.

[29] The constant is the base dummy (not a trend from the model in levels), and the regional dummies model region specific trends. The latter is because regions are expected to differ not only in their business cycles but also in their macroeconomic performance pace over time.

[30] Two sources of heteroskedasticity were identified: at a disaggregated level because of the nature of the conditional distribution of wages, and at an aggregated level because of the aggregation (Burkhauser et al., 1999; Castillo-Freemand and Freeman, 1992; Card and Krueger, 1995). This is because averages computed over a larger sample size have smaller variance (even if wages were homoskedastic), i.e. are more reliable. The appropriate correction is formalized by WLS, which incidentally captures the relative importance of each region to the (regional weighted) average coefficient if the sample size is proportional to the regional labour market (Card and Krueger

as for serial correlation within panels (model in levels), assuming an autoregressive process of order 1 specific to each region (Dolado et al., 1997; Burkhauser, 2000; Zavodny, 2000).

Graph 3.5a (and the corresponding first two columns of Table 3.A in the Appendix) shows robust and significant OLS estimates of the coefficients of the minimum wage. They are robust to levels or differences and to controlling; they are strongly significant for lower percentiles and for models in levels.[31] An increase in the minimum wage affects the 10th percentile almost 10 times more than the 90th percentile of the wages distribution (model in differences). Dickens et al. (1999) also found a compression effect when estimating a similar specification for the UK.[32]

Larger estimates for lower percentiles are the counterpart of the compression effect shown by the Kernel densities (Graph 3.4). The same compression effect can also be documented by regressing percentile ratios on the same regressors as above. The results in Table 3.A show that an increase of 10% in the minimum wage significantly decreases the gap between the 50th and the 10th percentile by 30%, between the 90th and the 10th by 40%, and between the 90th and the 50th by 15%. Dickens et al. (1993, 1998 and 1999), Lee (1999), Teulings (1998), and Card and Krueger (1995) found the same effect for the UK and the USA. 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 3.A are reassuring regarding the compression effect, also found by Machin and Manning (1994) and Dolado et al. (1997).

III.4 Identification And Robustness Check

III.4.1 Identification

III.4.1.1 Identifying Variation Across Regions

The nominal minimum wage in Brazil is national, i.e. constant across regions and individuals on a given month. The real minimum wage varies across regions though because the nominal (constant) minimum wage has been deflated with regional deflators. However, had a national deflator deflated the data, the real minimum wage would be a constant, just like the nominal minimum wage (on a given cross section). Consequently, such regional variation

1995; Neumark and Wascher 1992; Baker at all. 1999). Note that PME is sometimes weighted by projections of population size.

[31] They were also robust to (a) using INPC rather than the regional IPC as a deflator, (b) using regional IPCA rather than regional INPC as a deflator, (c) omitting past inflation, and (d) omitting the stabilization plan dummies.

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.

Thus, within a month, the minimum wage is a constant and therefore cannot explain variations in wages across regions. Lacking regional variation, identification relies on time variation, which depends on restrictions on time effects - the so-called *ad hoc* identification, predominant in the early time series literature. On the one hand, no restriction means to model time defining one dummy for each time period; the minimum wage effect is not identified at all because of perfect multicolinearity (Brown et al., 1982; Card and Krueger, 1995; Burkhauser et al., 2000; Dolado et al., 1997; Lee, 1999). On the other hand, full restriction means to model time defining a linear trend; the minimum wage effect is not identified because its effect cannot be distinguished from the effect of other variables.

Therefore, identification of the effect of the minimum wage separately from the effect of other regional macro variables on wages 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, of which the most used has been toughness and its alternative versions (toughness 50 and toughness 25). Other variables were also suggested: fraction, spike and below, spike, multiples, and percentage, as defined above.[33] The idea here is to collect all these variables in a "menu" of minimum wage variables and to compare their estimates. If consistent results across (such different but related minimum wage variables) specifications can be obtained, greater confidence can be placed in the results.

III.4.1.2 Identifying Variation Over Time

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). Intuitively, the month data version 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 employment in each month - including the discrete minimum wage increases. As a result, there would be no variation

[32] Many found wage effects in Brazil: Bacha, 1979; Wells and Drobny, 1982; Drobny and Wells, 1983; Camargo, 1984; Cacciamali et al., 1994; Velloso, 1988; Foguel, 1997; Barros and Lemos, 1998; Soares, 1998; Carneiro, 2000.

but noise left to identify the minimum wage effect (Burkhauser et al., 2000). An alternative is to expect a relationship between both models. It is possible to show that the aggregated version of the month model is the typical annual model found in the literature[34] - and therefore their parameters are related. In this sense, the month is no worse than the annual model. However, some might argue that despite the mathematical correspondence, year dummies alone are not sufficient to model time in a month model. In response, in addition to the year dummies, seasonal-month dummies to control for unobserved fixed effects across months are included as in Burkhauser et al. (2000). It is possible to include both (year and seasonal month dummies) because of the month-to-month variation in the minimum wage in most of the sample period in Brazil, rather than the typical annual increase elsewhere. Also, stabilization plan dummies are included to capture common macro shocks under each stabilization plan.[35] All these time dummies, namely year, seasonal-month, and stabilization plan dummies,[36] attempt to separate out the effect of other regional macro variables from the effect of the minimum wage on wages.[37]

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[33] Also, Lee (1999) and Green and Arbasche (2001) suggested trimmed toughness and Deere et al. (1996) costs of the increase on the firm's side (Deere et al., 1996).

[34] Consider the model for month data with year dummies: $y_{my} = a + bx_{my} + c_{84}Y84_{my} + ... + c_{99}Y99_{my} + u_{my}$, where m and y indexes months and years. Its aggregated version over months is:

$$\frac{1}{12}\sum_{m=1}^{12} y_{my} = \frac{1}{12}\sum_{m=1}^{12} a + \frac{1}{12}\sum_{m=1}^{12} bx_{my} + \frac{1}{12}\sum_{m=1}^{12} c_{84}Y84_{my} + ... + \frac{1}{12}\sum_{m=1}^{12} c_{99}Y99_{my} + \frac{1}{12}\sum_{m=1}^{12} u_{my} \quad \therefore \; \bar{y}_y = a + b\bar{x}_y + c_{84}Y84_y + ... + c_{99}Y99_y + \bar{u}_y$$

[35] Each had very particular rules (Abreu, 1992): in the Cruzado Plan, prices were frozen by law; in the Collor Plan, savings were confiscated for two years, etc. Thus, macro shocks were similar within, and different across, plans.

[36] A dummy was defined in October 1988, when the new Constitution: (a) shortened the working week from 48 to 44 hours; and (b) made available an alternative working day of 6 consecutive hours instead of 8 with 2 hours break.

[37] An F test was implemented to test whether these time dummies capture the relevant month variation. Consider two versions of the month model: (1) restricted - time is modeled by year, seasonal-month, stabilization plan, and structural break dummies; and (2) unrestricted - time is modeled by one dummy for each time period. Test F tests whether the restricted model is a good approximation of the fully saturated model; if most of the month variation is not being captured, the F test will fail the restricted model. Also, a more general Wald test (where the restricted is nested into the unrestricted model) is proposed to account for non iid errors. Both F and Wald tests rejected the restricted model; in the unrestricted model, the September dummies of each year were significant, even though a seasonal September dummy was included - it was the same for the January, May and November dummies of most years. Also, dummies coinciding with the implementation of the stabilization plan were significant, even though stabilization plan dummies were included. A hybrid model might be a compromise, adding dummies for January, May, September and November as well as for the month of implementation of each stabilization plan to the restricted model. However, before rejecting the restricted model, a Schwarz (likelihood) test for long T and short N panel data should be performed; Schwarz could be bigger for the restricted model even if restrictions are rejected on conventional tests. Despite these results the restricted version of the model is here reported, as the fully saturated model is not identified. Note the robustness of estimates to alternative specifications.

III.4.2 Model Specification And Results

To ensure identification, $\Delta lrmw_t$ in the models of Section 3.1 is replaced by the minimum wage variables discussed above (fraction and percentage are variables already in differences). Graphs 3.5 (and corresponding Table 3.A in the Appendix) show weighted and White-corrected OLS estimates. The results are in line with the above: the estimates of the coefficients of the minimum wage variables are significant and larger at lower percentiles. At higher percentiles, they are not only smaller but sometimes not significant, suggesting no spillover higher in the distribution. Limited spillover was also found by Gramlich (1976), Grossman (1983), Card and Krueger (1995), Machin and Manning (1994), Dinardo et al. (1996), Lee (1999), and Dickens et al. (1999).[38]

The estimates show a very similar pattern whatever the minimum wage variable used - even their order of magnitude is similar. The fraction estimate, before the inclusion of controls, is 1.086% (0.891%) for those in the 10^{th} (30^{th}) percentile of the wages distribution. In other words, an increase in the minimum wage sufficient to increase fraction by 10 percentage points is associated with an increase in the wages of those in the 10^{th} (30^{th}) percentile of the wages distribution by 10.86% (8.91%).[39] Controlling for population and institutional factors marginally the magnitude of the estimates, and does not affect their sign or significance. These figures are respectively 1.524% and 1.277% for fraction real; 1.590% and 1.138% for spike and below; 2.782% and 1.097% for spike; 0.398% and 0.139% for multiples; 3.159% and 2.729% for percentage. Table 3.A also shows percentile ratios and standard deviation regressions, which are supportive of the compression effect found in Section 3.2.[40]

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 made 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,

[38] Spillover effects are expected to extend higher up in the distribution because of the minimum wage indexor role in Brazil. Maning's (1993) model predicts a right shift of the whole distribution.

[39] Card and Krueger (1995) found an estimate of 0.28 (mean of log wages as independent variable). They present an alternative interpretation of the estimates (also, see Brown, 1999).

[40] 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, and the results for both fraction and fraction real do not differ qualitatively. The same holds for the employment models below.

below and above the minimum wage, as well as across the distribution. Spike measures this effect on those workers at the minimum wage; spike and below on those at and below; multiples on those above; fraction on those between the old and the new minimum wage; and percentage on those across the wage distribution. It is therefore very reassuring that such a variety of specifications and variables produce robust results - including those for the minimum wage itself. A preferred specification is not chosen; instead, the range of estimates produced across all specifications is expected to embrace the true coefficient. Table 3.1 presents summary estimates of the coefficients of the wages models: the interval that brackets the estimates as well as the average coefficient across variables. All the above pieces of evidence consistently suggest that the minimum wage compress the wage distribution.

IV. Employment Effects

IV.1 Decomposition

As discussed in the introduction, the use of the minimum wage against inequality depends on the other wages and employment responses. Having established the expected effect on the wages distribution, its policy potential lies on its effect on employment.

The minimum wage effect on employment can be decomposed into changes in the number of jobs and changes in hours of work. Let average hours in the population ($\bar{T}$) be equal to the product of average hours for those working ($\bar{H}$) and the employment rate (E). Then, assuming that each of these three variables is a function of the minimum wage, total employment elasticity is equal to the hours plus job elasticities.[41]

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 $\bar{T}$ and $\bar{H}$ as dependent

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[41] More formally, $\bar{T} = \bar{H}E$ is $\frac{\sum_{i=1}^{N} hour_i}{N} = \frac{\sum_{i=1}^{N_e} hour_i}{N_e}\frac{N_e}{N}$, where N_e and N are sample sizes of the employed and of the labour force and $hour$ is hours worked. Re-writing this equation as a function of the minimum wage, $\bar{T}(mw) = \bar{H}(mw)E(mw)$, differentiating with respect to the minimum wage and multiplying through by $\frac{mw}{\bar{H}E}$, the total employment elasticity is equal to the hours plus job elasticities: $\frac{\partial \bar{T}}{\partial mw}\frac{mw}{\bar{H}E} = \frac{\partial \bar{H}}{\partial mw}E\frac{mw}{\bar{H}E} + \frac{\partial E}{\partial mw}\bar{H}\frac{mw}{\bar{H}E}$ $\frac{\partial \bar{T}}{\partial mw}\frac{mw}{\bar{T}} = \frac{\partial \bar{H}}{\partial mw}\frac{mw}{\bar{H}} + \frac{\partial E}{\partial mw}\frac{mw}{E}$ $\varepsilon_{\bar{T}} = \varepsilon_H + \varepsilon_E$.

variables. Thus, three specifications for the employment equation naturally arise. If a log-log functional form is assumed (Brown, 1999) 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.[42] Although this procedure has not received much attention in the literature (Barzel, 1973; Gramlich, 1976; Linneman, 1982; Brown et al., 1982; Brown, 1999),[43] more recent research (Michl, 2000; Zavodny, 2000; Card and Krueger, 1999; Neumark and Wascher, 1998) explains non-negative effects on jobs as a sub-product of adjustments in hours.[44] Zavodny (2000) estimates job and hours effects, but does not formalize it as decomposition.

IV.2 Model Specification And Results

Each of the three specifications in Section 4.1 was estimated for four alternative data filters, to account for Baker et al.'s (1999) criticism:[45] Within Groups (WG), OLS on the first (OLS Δ), twelfth (OLS Δ^{12}), and on both first and twelfth differences (OLS $\Delta\Delta^{12}$). For each of these initially just the raw correlation including past inflation was estimated (see Section 3.3). Then regional and time dummies were added, as well as controls (see Section 3.4). Next, dynamics were added because an increase in the minimum wage might not affect employment contemporaneously but in future periods. This is because the inability to adjust other inputs instantaneously creates lagged responses in employment (Brown, 1982; Neumark and Wascher, 1992; Hamermesh, 1995). Thus, dynamic models with 12 and 24 lags were estimated, once such large T on monthly data allowed for long dynamics.

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[42] That is $\beta_T = \beta_H + \beta_E$ coincides with $\varepsilon_T = \varepsilon_H + \varepsilon_E$ (this additivity property does not hold for dynamic models).

[43] Some prefer to measure employment changes in Full Time Equivalent Employment (FTE). However, the same 4 hours reduction that simply means transition to part-time employment for a full-timer actually means transition to unemployment for a part-timer - this cannot be captured by FTE.

[44] Other attempts to reconcile the debate are (Brown, 1999): inappropriate econometric techniques (difference-in-difference, time series, cross-section, etc.), inappropriate empirical modeling (regional and time effects, serial correlation, spurious regression, endogeneity, poor instrumental variables, etc.), data flaws, data filtering, unidentification of structural model, inadequacy of competitive model, offsets and as claimed by Heckman and MaCurdy (1988) "a soft protective belt of plausible omitted variables can always be erected to rationalize any empirical outcome".

[45] Baker et al. (1999) attempt to reconcile the debate from the frequency domain approach. The appropriate data filter (short or long differencing) matters because the minimum wage effect is not constant across frequencies; negative or positive results are found depending on whether low or high frequency data is used. Card and Krueger (1995) found positive results using one and two-year-differencing (high frequency) whereas Neumark and Wascher (1992) found negative results using long differencing. Baker et al. (1999) argue that such conflicting results are a clear sign of mis-specification. In addition, differencing reduces variables to stationarity preventing spurius regression.

By modeling regional and time fixed effects, including controls and lags, and differencing the data, the errors are no longer expected to be serially correlated. Neumark and Wascher (1992) also assume errors to be serially uncorrelated; few authors (Brown et al., 1983; Dolado et al., 1997; Burkhauser, 2000; Zavodny, 2000) worry about it (Brown, 1999). This variety of specifications embraces the typical specifications in the literature (Brown, 1999; Burkhauser et al., 1997; Card and Krueger, 1995; Neumark and Wascher, 1994).

Graph 4.1 plots log employment rate against log real minimum wage. The suggested positive raw correlation in levels fades as the data is differenced, with no support for a negative effect of the minimum wage on employment - if anything, the correlation is weakly positive. (The plot of log hours worked against log real minimum wage, not reported, follows a similar pattern.) Nonetheless, such raw correlations need to be proved robust when the effect of other variables (demand and supply shocks) on employment is controlled for. The specifications in Panel I - RMW of Graph 4.2 (and corresponding panel I - RMW of Table 4.A in the Appendix) begin with raw correlations and then add fixed effects, controls, and dynamics (as discussed above). In line with the plots, such estimates also give little support for a negative effect: they are mostly positive, statistically significant, but small. The coefficient of real minimum wage in the total employment model ranges from -0.007 to 0.064, decomposed into (a) the hours coefficient ranging from -0.009 to 0.040 (darker bars); and (b) the jobs coefficient ranging from -0.006 to 0.024 (lighter bars). Decreases on employment come mainly from decreases in the number of hours worked rather than from the destruction of jobs (Brown, 1999). A 10% increase in the minimum wage is associated with a decrease in total employment of 0.07% at the most. Finally, the last two columns of Table 4.A show a decrease in total employment no bigger than 0.20% in the long run.[46]

IV.3 Robustness Check

Although the real minimum wage was used in Section 4.2, such models are not identified (Section 3.3); 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.

[46] The long run coefficient is defined as $b_{lr} = b/\{1-(\sum^{M} c_l)\}$, where b and c_l are the coefficients of the minimum wage and independent variable and l is the number of lags (12 or 24).

Graph 4.2 (and corresponding Table 4.A in the Appendix) shows estimates mostly statistically different from zero. Panel II - FRACTION shows that the total employment elasticity ranges from -0.006 to 0.051,[47] whereas panel III - FRACTION REAL shows -0.027 to 0.053, panel IV - SPIKE AND BELOW shows -0.102 to 0.292, panel V - SPIKE shows 0.057 to 0.621, panel VI -MULTIPLES shows -0.058 to 0.194, panel VII - PERCENTAGE shows -0.013 to 0.164, panel VIII- TOUGHNESS shows -0.008 to 0.063, panel IX - TOUGHNESS 50 shows -0.011 to 0.050, and panel X - TOUGHNESS 25 shows -0.010 to 0.057. The largest and most robust estimates are for spike and spike and below.

Across models, the coefficient of the ten minimum wage variables in the total employment model ranges from -0.102 to 0.621, decomposed into (a) the hours coefficient ranging from -0.048 to 0.609 (darker bars); and (b) the jobs coefficient ranging from -0.160 to 0.159 (lighter bars). Once more, decreases in employment come mainly from decreases in the number of hours worked rather than from the destruction of jobs (Brown, 1999). On the one hand, an increase in the minimum wage sufficient to increase the degree of impact measures in 10 percentage points is associated with a decrease in employment of typically less than 1% (on average across regions). On the other hand, an increase of 10% in any of the toughness measures is associated with a decrease in employment of 0.1%, at the most (on average across regions). Finally, the last two columns of Table 4.A show a decrease in total employment no bigger than 2%, on average in the long run.

Bracketing the employment elasticity below 1% across such a variety of models is reassuring: the results were fairly robust to changes in the specification and to various alternative minimum wage variables. The worst picture seems to be the one where an increase in the minimum wage might cause a small number of people to lose their jobs and those remaining employed to work longer hours. A preferred specification is not chosen; instead, the range of estimates produced across all specifications and variables is expected to embrace the true coefficient. Table 4.1 presents summary estimates of the coefficients of all the employment models: the interval that brackets the estimates as well as the average coefficient across variables. Camargo (1984), Velloso (1988), Neri (1997), Foguel (1997), Carneiro (2000) and Lemos (2002), among others, also found small (non-significant) adverse employment effects for Brazil. All the above pieces of evidence suggest consistently that an increase in the minimum

[47] Card and Krueger (1995) found an estimate of 0.01.

wage does not always have a significant effect on employment and it is not always negative but if anything, it is small. Regarding the above as demand equations, this is consistent with a fairly inelastic demand curve: minimum wage increases translate into wage gains and no employment losses.

V. Conclusion

This paper provides evidence – strongly lacking in the international literature - on the effects of the minimum wage on wages and employment for a developing country. In Brazil, not only are increases in the minimum wage large and frequent, unlike the typically small increases focused upon in the existing literature, but also the minimum wage plays a central and complex role. It affects employment directly and indirectly, through wages, pensions, benefits, inflation, the informal sector, and the public deficit. As a result, in addition to its social role, it has been used as an anti-inflationary policy.

The effect of the minimum wage on the wage distribution was exhaustively measured using a variety of specifications and variables. Yet evidence of a compression effect was robust and in line with the international and Brazilian empirical literature. This is also in line with the predictions of standard theory.

Having established the expected effect on the wages distribution, the minimum wage policy potential lies on its effect on employment. Again, this effect was exhaustively measured using a variety of specifications, variables and estimation techniques. Yet, evidence of a moderately small adverse effect was uncovered and shown to be robust to many specification changes and tests. This is in line with more recent international and Brazilian empirical literature. Although not in line with the predicted standard theory, this small (non-significant) effect may be the best information about the employment effect so far.

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 (but not of high) paid workers and does not destroy too many jobs. This suggests that – at least up to a point - the minimum wage can be used as a policy against inequality and poverty in Brazil.

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table 3.1 - SUMMARY ESTIMATES OF THE COEFFICIENTS - WAGES MODELS

percentiles	interval		average	standard deviation
	minimum	maximum	(across variables)	
percentile 5	**0.190**	**2.253**	1.058	0.750
percentile 10	**0.363**	**2.815**	1.309	0.939
percentile 15	**0.227**	**3.117**	1.279	0.956
percentile 20	**0.205**	**3.012**	1.225	0.917
percentile 25	**0.101**	**2.772**	0.976	0.816
percentile 30	**0.106**	**2.351**	0.846	0.685
percentile 35	**0.004**	**1.855**	0.585	0.586
percentile 40	**0.088**	**1.683**	0.554	0.505
percentile 45	**-0.359**	**1.361**	0.356	0.506
percentile 50	**-0.339**	**1.134**	0.302	0.427
percentile 90	**-1.553**	**0.137**	-0.227	0.574
percentile 95	**-1.631**	**0.109**	-0.276	0.589
mean	**0.009**	**1.362**	0.436	0.426
percentile ratio 50/10	***-2.854***	***-0.285***	*-0.986*	*0.894*
percentile ratio 90/10	***-4.158***	***-0.415***	*-1.529*	*1.352*
percentile ratio 90/50	***-1.304***	***-0.133***	*-0.544*	*0.471*
standard deviation	***-1.166***	***-0.130***	*-0.471*	*0.398*

1) for full estimates see table 3.A in the Appendix (bottom panel - with controls).
2) percentile regressions are shown for selected percentiles, followed by percentile ratio and standard deviation regressions
3) the dependent variable is the various percentiles, ratios of percentiles and standard deviation of the wages distribution
4) time effects are modelled with year , seasonal-month, stabilization and 1988 structural break dummies
5) multiply estimates by 10 to obtain the percentual effect on wages of a 10% increase in the minimum wage variable

table 4.1 - SUMMARY ESTIMATES OF THE COEFFICIENTS – EMPLOYMENT MODELS

		interval		average	standard deviation
		minimum	maximum	(across models and variables)	
β_T		**-0.102**	**0.456**	0.027	0.092
β_H	**WG**	**-0.034**	**0.453**	0.052	0.094
β_E	**WITHIN GROUPS**	**-0.160**	**0.024**	-0.025	0.049
β_T		**-0.048**	**0.558**	0.086	0.134
β_H	Δ	**-0.034**	**0.609**	0.092	0.144
β_E	**FIRST DIFFERENCE**	**-0.060**	**0.025**	-0.006	0.013
β_T		**-0.027**	**0.580**	0.073	0.135
β_H	Δ^{12}	**0.003**	**0.421**	0.083	0.107
β_E	**TWELVETH DIFFERENCE**	**-0.117**	**0.159**	-0.008	0.042
β_T		**-0.020**	**0.621**	0.100	0.154
β_H	$\Delta\Delta^{12}$	**-0.014**	**0.678**	0.111	0.167
β_E	**FIRST AND TWELVETH DIFFERENCE**	**-0.059**	**-0.001**	-0.011	0.014

1) For full estimates see table 4.A in the Appendix.
2) Dependent variable is average hours worked for the working population, average hours worked for those employed and employment rate.
3) Total employment coefficient estimate equals hours plus jobs coefficient estimates.
4) Models estimated are Within Groups and OLS on 1st, 12th and 1st and 12th differences.
5) Hours and Job elasticities add to Total elasticity for the static but not for the dynamic models.
6) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies.
7) Controls are population and instituional factors.
8) Multiply estimates by 10 to obtain the percentual effect on employment of a 10% increase on the minimum wage variable.

table 3.A - ESTIMATES OF THE COEFFICIENTS OF THE MW VARIABLES - WAGES MODELS

pctiles	MW l	se	MW d	se	frn	se	frr	se	spkab	se	spk	se	mu1	se	per	se
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
without controls																
p5	0.525	0.013	0.457	0.019	0.945	0.046	1.165	0.085	1.375	0.130	2.239	0.464	0.233	0.107	2.635	0.300
p10	0.573	0.014	0.480	0.024	1.086	0.055	1.330	0.097	1.590	0.149	2.782	0.506	0.398	0.120	3.159	0.335
p15	0.552	0.013	0.464	0.025	1.137	0.048	1.380	0.092	1.744	0.135	2.261	0.486	0.275	0.115	3.492	0.304
p20	0.538	0.014	0.449	0.026	1.131	0.048	1.332	0.097	1.703	0.134	2.075	0.501	0.239	0.122	3.392	0.328
p25	0.486	0.014	0.382	0.024	1.018	0.050	1.195	0.102	1.366	0.134	1.258	0.471	0.146	0.110	3.195	0.321
p30	0.443	0.014	0.334	0.022	0.891	0.048	1.076	0.091	1.138	0.126	1.097	0.428	0.139	0.100	2.729	0.301
p35	0.398	0.014	0.282	0.020	0.771	0.047	0.963	0.087	0.802	0.121	0.291	0.385	0.035	0.092	2.231	0.288
p40	0.360	0.013	0.256	0.018	0.680	0.041	0.856	0.074	0.693	0.105	0.355	0.345	0.110	0.087	1.992	0.250
p45	0.313	0.013	0.210	0.017	0.566	0.039	0.708	0.065	0.455	0.101	-0.244	0.309	-0.059	0.080	1.614	0.230
p50	0.288	0.013	0.185	0.016	0.493	0.035	0.627	0.059	0.356	0.097	-0.242	0.298	-0.016	0.079	1.382	0.205
p90	0.142	0.017	0.042	0.016	0.140	0.041	0.232	0.060	-0.438	0.095	-1.584	0.311	-0.161	0.085	0.132	0.204
p95	0.114	0.018	0.019	0.019	0.093	0.042	0.199	0.062	-0.503	0.103	-1.655	0.341	-0.185	0.090	0.009	0.195
mean	0.328	0.011	0.226	0.014	0.582	0.034	0.738	0.059	0.511	0.093	0.168	0.298	0.021	0.075	1.624	0.215
p50/10	*-0.281*	*0.013*	*-0.289*	*0.020*	*-0.577*	*0.048*	*-0.685*	*0.077*	*-1.185*	*0.121*	*-2.966*	*0.366*	*-0.416*	*0.092*	*-1.777*	*0.236*
p90/10	*-0.422*	*0.017*	*-0.433*	*0.024*	*-0.932*	*0.052*	*-1.088*	*0.088*	*-1.976*	*0.130*	*-4.411*	*0.487*	*-0.584*	*0.122*	*-3.035*	*0.291*
p90/50	*-0.140*	*0.012*	*-0.144*	*0.014*	*-0.355*	*0.031*	*-0.403*	*0.051*	*-0.791*	*0.070*	*-1.444*	*0.270*	*-0.168*	*0.070*	*-1.258*	*0.143*
sd	*-0.138*	*0.005*	*-0.142*	*0.007*	*-0.322*	*0.014*	*-0.366*	*0.028*	*-0.687*	*0.037*	*-1.256*	*0.151*	*-0.148*	*0.035*	*-1.026*	*0.085*
with controls																
p5	0.509	0.014	0.421	0.018	0.848	0.042	0.975	0.075	1.226	0.115	2.041	0.384	0.190	0.092	2.253	0.258
p10	0.564	0.014	0.480	0.024	1.023	0.056	1.176	0.095	1.464	0.144	2.590	0.458	0.363	0.110	2.815	0.305
p15	0.534	0.014	0.464	0.025	1.059	0.047	1.214	0.086	1.599	0.123	2.015	0.427	0.227	0.104	3.117	0.263
p20	0.518	0.014	0.449	0.026	1.049	0.046	1.147	0.088	1.563	0.115	1.856	0.431	0.205	0.110	3.012	0.276
p25	0.461	0.014	0.382	0.024	0.914	0.043	0.990	0.085	1.203	0.111	0.984	0.389	0.101	0.095	2.772	0.256
p30	0.419	0.014	0.334	0.022	0.795	0.041	0.891	0.076	0.994	0.100	0.876	0.351	0.106	0.089	2.351	0.242
p35	0.374	0.014	0.282	0.020	0.666	0.040	0.776	0.070	0.655	0.097	0.065	0.319	0.004	0.081	1.855	0.229
p40	0.340	0.013	0.256	0.018	0.596	0.037	0.707	0.065	0.577	0.090	0.189	0.295	0.088	0.079	1.683	0.205
p45	0.296	0.013	0.210	0.017	0.489	0.036	0.566	0.059	0.355	0.085	-0.359	0.272	-0.069	0.075	1.361	0.196
p50	0.273	0.013	0.185	0.016	0.421	0.035	0.499	0.056	0.263	0.087	-0.339	0.269	-0.024	0.074	1.134	0.178
p90	0.137	0.017	0.042	0.016	0.077	0.042	0.130	0.061	-0.494	0.085	-1.553	0.291	-0.141	0.082	-0.016	0.191
p95	0.109	0.018	0.019	0.019	0.033	0.045	0.108	0.064	-0.556	0.097	-1.631	0.325	-0.179	0.087	-0.112	0.193
mean	0.314	0.012	0.226	0.014	0.506	0.032	0.597	0.053	0.411	0.078	0.062	0.253	0.009	0.067	1.362	0.179
p50/10	*-0.285*	*0.013*	*-0.289*	*0.020*	*-0.585*	*0.050*	*-0.660*	*0.081*	*-1.148*	*0.123*	*-2.854*	*0.356*	*-0.384*	*0.089*	*-1.678*	*0.239*
p90/10	*-0.415*	*0.017*	*-0.433*	*0.024*	*-0.932*	*0.056*	*-1.036*	*0.092*	*-1.903*	*0.130*	*-4.158*	*0.457*	*-0.525*	*0.117*	*-2.830*	*0.287*
p90/50	*-0.133*	*0.012*	*-0.144*	*0.014*	*-0.346*	*0.032*	*-0.376*	*0.051*	*-0.754*	*0.068*	*-1.304*	*0.257*	*-0.141*	*0.069*	*-1.152*	*0.139*
sd	*-0.132*	*0.005*	*-0.136*	*0.007*	*-0.306*	*0.014*	*-0.329*	*0.025*	*-0.643*	*0.034*	*-1.166*	*0.132*	*-0.130*	*0.032*	*-0.925*	*0.074*

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
3) the dependent variable is the various percentiles, ratios of percentiles and standard deviation of the wages distribution
4) time effects are modelled with year , seasonal-month, stabilization and 1988 structural break dummies
5) the top panel shows raw estimates and the bottom panel shows estimates after controlling for population and institutional factors
6) multiply estimates by 10 to obtain the percentual effect on wages of a 10% increase in the minimum wage variable

table 4.A - ESTIMATES OF THE COEFFICIENTS OF THE MW VARIABLES - EMPLOYMENT MODELS - continues

		raw		fi + ft		controls		12 lags		24 lags		12	24
		coef	se	coef	se	coef	se	coef	se	coef	se	long run coef	
	I - RMW												
β_T		0.064	0.006	0.015	0.007	0.017	0.007	0.003	0.006	0.006	0.007	0.002	0.003
β_H	WG	0.040	0.005	0.014	0.006	0.015	0.006	0.007	0.006	0.008	0.006	0.004	0.005
β_E		0.024	0.003	0.001	0.003	0.002	0.003	-0.005	0.001	-0.004	0.002	-0.003	-0.002
β_T		-0.005	0.005	0.014	0.005	0.014	0.006	0.012	0.006	0.009	0.006	-0.004	-0.003
β_H	Δ	-0.009	0.005	0.015	0.005	0.020	0.006	0.015	0.006	0.013	0.005	-0.003	-0.002
β_E		0.004	0.002	-0.001	0.002	-0.005	0.001	-0.004	0.001	-0.003	0.002	0.019	0.003
β_T		0.027	0.006	0.014	0.007	0.015	0.007	-0.001	0.006	-0.007	0.005	-0.001	-0.005
β_H	Δ^{12}	0.022	0.004	0.017	0.007	0.019	0.007	0.008	0.006	0.003	0.005	0.010	0.003
β_E		0.005	0.002	-0.004	0.002	-0.005	0.002	-0.006	0.001	-0.006	0.001	-0.004	-0.004
β_T		0.011	0.007	0.011	0.007	0.010	0.008	0.025	0.006	0.010	0.007	-0.014	-0.003
β_H	$\Delta\Delta^{12}$	0.012	0.006	0.012	0.007	0.012	0.008	0.027	0.006	0.015	0.006	-0.013	-0.004
β_E		-0.001	0.002	-0.001	0.002	-0.002	0.002	-0.002	0.002	-0.003	0.002	0.017	0.002
	II - FRACTION												
β_T		-0.006	0.009	0.030	0.009	0.033	0.010	0.020	0.009	0.016	0.010	-0.006	-0.005
β_H	Δ	-0.013	0.008	0.030	0.009	0.039	0.010	0.023	0.009	0.021	0.009	-0.005	-0.004
β_E		0.008	0.003	0.000	0.002	-0.006	0.002	-0.005	0.002	-0.004	0.002	0.024	0.004
β_T		0.025	0.014	0.049	0.015	0.051	0.015	0.022	0.013	-0.001	0.013	0.020	-0.001
β_H	Δ^{12}	0.039	0.011	0.057	0.013	0.060	0.013	0.035	0.012	0.020	0.012	0.041	0.017
β_E		-0.014	0.006	-0.008	0.005	-0.009	0.006	-0.012	0.004	-0.015	0.004	-0.008	-0.010
β_T		0.033	0.011	0.034	0.012	0.034	0.012	0.031	0.010	0.004	0.010	-0.017	-0.001
β_H	$\Delta\Delta^{12}$	0.036	0.011	0.037	0.012	0.038	0.012	0.032	0.009	0.011	0.009	-0.015	-0.003
β_E		-0.003	0.003	-0.003	0.003	-0.004	0.002	-0.002	0.002	-0.006	0.003	0.019	0.004
	III - FRACTION REAL												
β_T		0.018	0.015	0.031	0.015	0.037	0.016	0.025	0.016	0.018	0.017	-0.007	-0.005
β_H	Δ	0.006	0.015	0.030	0.015	0.046	0.016	0.029	0.015	0.026	0.015	-0.006	-0.004
β_E		0.012	0.005	0.002	0.004	-0.009	0.004	-0.005	0.004	-0.002	0.005	0.023	0.002
β_T		-0.027	0.023	0.021	0.023	0.026	0.024	0.005	0.019	0.014	0.018	0.005	0.009
β_H	Δ^{12}	0.013	0.019	0.019	0.020	0.028	0.021	0.017	0.017	0.021	0.016	0.020	0.017
β_E		-0.040	0.010	0.001	0.009	-0.002	0.009	-0.012	0.006	-0.009	0.006	-0.008	-0.006
β_T		0.044	0.015	0.047	0.016	0.048	0.016	0.053	0.014	0.025	0.013	-0.029	-0.007
β_H	$\Delta\Delta^{12}$	0.047	0.015	0.050	0.015	0.051	0.016	0.055	0.013	0.032	0.012	-0.025	-0.008
β_E		-0.003	0.005	-0.004	0.005	-0.003	0.005	-0.001	0.004	-0.007	0.005	0.010	0.005
	IV - SPIKE AND BELOW												
β_T		-0.038	0.014	-0.101	0.028	-0.102	0.030	0.070	0.027	0.060	0.029	0.038	0.032
β_H	WG	0.035	0.012	0.036	0.024	0.041	0.025	0.090	0.023	0.085	0.025	0.051	0.046
β_E		-0.073	0.008	-0.137	0.011	-0.142	0.011	-0.028	0.008	-0.025	0.008	-0.015	-0.013
β_T		0.127	0.030	0.231	0.033	0.240	0.034	0.175	0.032	0.160	0.032	-0.052	-0.049
β_H	Δ	0.124	0.031	0.248	0.033	0.262	0.034	0.184	0.029	0.171	0.029	-0.041	-0.031
β_E		0.003	0.010	-0.017	0.009	-0.023	0.007	-0.019	0.007	-0.013	0.008	0.090	0.015
β_T		-0.016	0.029	0.125	0.035	0.143	0.037	0.078	0.030	0.062	0.026	0.069	0.043
β_H	Δ^{12}	0.101	0.024	0.187	0.030	0.206	0.031	0.132	0.027	0.110	0.023	0.155	0.092
β_E		-0.117	0.012	-0.062	0.013	-0.064	0.014	-0.031	0.009	-0.029	0.009	-0.021	-0.020
β_T		0.271	0.038	0.286	0.039	0.292	0.040	0.200	0.031	0.126	0.027	-0.110	-0.038
	$\Delta\Delta^{12}$	0.297	0.038	0.310	0.039	0.311	0.039	0.212	0.028	0.142	0.024	-0.099	-0.037
β_E		-0.026	0.009	-0.024	0.009	-0.019	0.008	-0.018	0.008	-0.017	0.008	0.155	0.012
	V - SPIKE												
β_T		0.456	0.075	0.083	0.098	0.057	0.102	0.158	0.085	0.172	0.091	0.086	0.092
	WG	0.453	0.067	0.242	0.086	0.208	0.090	0.139	0.083	0.160	0.084	0.081	0.088
β		0.003	0.040	-0.160	0.036	-0.151	0.036	-0.003	0.020	-0.001	0.022	-0.002	0.000
		0.368	0.120	0.538	0.109	0.558	0.110	0.440	0.095	0.391	0.096	-0.130	-0.119
		0.372	0.122	0.599	0.109	0.609	0.109	0.450	0.090	0.386	0.091	-0.100	-0.067
		-0.004	0.030	-0.060	0.026	-0.051	0.022	-0.033	0.021	-0.003	0.024	0.149	0.003
		0.580	0.086	0.513	0.096	0.489	0.097	0.289	0.090	0.357	0.075	0.260	0.249
	Δ^{12}	0.421	0.072	0.404	0.091	0.392	0.093	0.273	0.083	0.320	0.069	0.327	0.272
		0.159	0.040	0.109	0.031	0.097	0.030	0.013	0.022	0.015	0.025	0.009	0.010
		0.606	0.112	0.616	0.113	0.621	0.113	0.363	0.090	0.220	0.075	-0.200	-0.064
	$\Delta\Delta^{12}$	0.658	0.112	0.675	0.112	0.678	0.112	0.368	0.086	0.238	0.071	-0.174	-0.058
		-0.052	0.024	-0.059	0.024	-0.058	0.023	-0.005	0.022	-0.021	0.022	0.042	0.015

1) Dependent variable is average hours worked for the working population, average hours worked for those employed and employment rate.
2) Hours and Job elasticities add to Total elasticity for the static but not for the dynamic models.
3) Colum 1 shows raw correlations, and columns 2-5 add time and region fixed effects, controls, 12 and 24 lags of dependent variable, respectively.
4) Columns 6 and 7 are long run coefficients related to the dynamic models in columns 4 and 5.
5) Panels I to V show estimates of MW, FRACTION, FRACTION REAL, SPIKE AND BELOW, AND SPIKE.
6) Each panel has Within Groups and OLS on 1st, 12th and 12th differences.
7) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies.
8) Controls are population and instituional factors.
9) Multiply estimates by 10 to obtain the percentual effect on employment of a 10% increase on the minimum wage variable.
10) Because FRACTION, FRACTION REAL AND PERCENTAGE are variables already in differences, WG was not computed.

table 4.A - ESTIMATES OF THE COEFFICIENTS OF THE MW VARIABLES - EMPLOYMENT MODELS - continued

		raw		fi + ft		controls		12 lags		24 lags		12	24
		coef	se	coef	se	coef	se	coef	se	coef	se	long run coef	
	VI - MULTIPLES												
β_T		**0.194**	0.034	**0.016**	0.032	**0.016**	0.035	**-0.033**	0.029	**-0.008**	0.028	**-0.018**	**-0.004**
β_H	**WG**	**0.178**	0.029	**0.018**	0.029	**0.011**	0.031	**-0.034**	0.028	**-0.009**	0.026	**-0.020**	**-0.005**
β_E		**0.017**	0.016	**-0.002**	0.012	**0.005**	0.012	**0.003**	0.006	**0.004**	0.006	**0.001**	**0.002**
β_T		**-0.058**	0.032	**-0.048**	0.027	**-0.044**	0.027	**0.016**	0.025	**-0.002**	0.024	**-0.005**	**0.001**
β_H	Δ	**-0.048**	0.032	**-0.033**	0.027	**-0.034**	0.027	**0.024**	0.024	**0.002**	0.023	**-0.005**	**0.000**
β_E		**-0.010**	0.007	**-0.015**	0.006	**-0.011**	0.005	**-0.008**	0.005	**-0.004**	0.005	**0.039**	**0.004**
β_T		**0.069**	0.020	**0.058**	0.024	**0.054**	0.024	**0.021**	0.022	**0.036**	0.017	**0.019**	**0.025**
β_H	Δ^{12}	**0.031**	0.016	**0.037**	0.022	**0.037**	0.022	**0.022**	0.020	**0.027**	0.016	**0.026**	**0.023**
β_E		**0.038**	0.009	**0.021**	0.007	**0.018**	0.007	**0.004**	0.005	**0.004**	0.005	**0.003**	**0.003**
β_T		**0.012**	0.027	**0.007**	0.027	**0.010**	0.027	**-0.001**	0.020	**-0.020**	0.018	**0.001**	**0.006**
β_H	$\Delta\Delta^{12}$	**0.026**	0.026	**0.024**	0.026	**0.028**	0.027	**0.008**	0.020	**-0.014**	0.017	**-0.004**	**0.003**
β_E		**-0.015**	0.006	**-0.017**	0.006	**-0.018**	0.005	**-0.005**	0.005	**-0.009**	0.004	**0.045**	**0.006**
	VII - PERCENTAGE												
β_T		**0.022**	0.036	**0.164**	0.043	**0.160**	0.047	**0.127**	0.038	**0.098**	0.040	**-0.036**	**-0.028**
β_H	Δ	**-0.004**	0.034	**0.167**	0.043	**0.182**	0.047	**0.127**	0.036	**0.106**	0.037	**-0.028**	**-0.017**
β_E		**0.025**	0.010	**-0.003**	0.011	**-0.022**	0.009	**-0.016**	0.009	**-0.008**	0.010	**0.075**	**0.008**
β_T		**0.049**	0.050	**0.151**	0.059	**0.138**	0.060	**0.100**	0.050	**-0.013**	0.044	**0.089**	**-0.009**
β_H	Δ^{12}	**0.099**	0.041	**0.189**	0.054	**0.183**	0.055	**0.147**	0.046	**0.056**	0.039	**0.173**	**0.047**
β_E		**-0.050**	0.021	**-0.038**	0.021	**-0.045**	0.021	**-0.039**	0.014	**-0.046**	0.015	**-0.025**	**-0.031**
β_T		**0.096**	0.049	**0.101**	0.051	**0.092**	0.053	**0.117**	0.041	**0.000**	0.033	**-0.058**	**0.000**
β_H	$\Delta\Delta^{12}$	**0.116**	0.048	**0.118**	0.051	**0.116**	0.052	**0.114**	0.038	**0.026**	0.029	**-0.050**	**-0.006**
β_E		**-0.020**	0.011	**-0.016**	0.011	**-0.023**	0.010	**-0.011**	0.010	**-0.021**	0.011	**0.116**	**0.015**
	VIII - TOUGHNESS												
β_T		**-0.008**	0.004	**0.009**	0.008	**0.009**	0.008	**0.019**	0.007	**0.017**	0.008	**0.010**	**0.009**
β_H	**WG**	**0.009**	0.004	**0.025**	0.007	**0.025**	0.007	**0.024**	0.007	**0.021**	0.007	**0.014**	**0.012**
β_E		**-0.017**	0.002	**-0.016**	0.003	**-0.016**	0.003	**-0.005**	0.002	**-0.004**	0.002	**-0.003**	**-0.002**
β_T		**0.028**	0.008	**0.045**	0.008	**0.048**	0.009	**0.035**	0.007	**0.031**	0.007	**-0.011**	**-0.010**
β_H	Δ	**0.027**	0.008	**0.049**	0.008	**0.053**	0.009	**0.037**	0.007	**0.034**	0.007	**-0.008**	**-0.006**
β_E		**0.001**	0.002	**-0.004**	0.002	**-0.005**	0.001	**-0.004**	0.001	**-0.003**	0.002	**0.018**	**0.003**
β_T		**0.001**	0.009	**0.029**	0.010	**0.031**	0.010	**0.019**	0.008	**0.015**	0.007	**0.017**	**0.011**
β_H	Δ^{12}	**0.029**	0.007	**0.042**	0.009	**0.044**	0.009	**0.031**	0.008	**0.028**	0.007	**0.036**	**0.023**
β_E		**-0.028**	0.003	**-0.013**	0.003	**-0.013**	0.003	**-0.008**	0.002	**-0.007**	0.002	**-0.005**	**-0.005**
β_T		**0.057**	0.010	**0.061**	0.010	**0.063**	0.010	**0.051**	0.008	**0.032**	0.007	**-0.028**	**-0.009**
β_H	$\Delta\Delta^{12}$	**0.062**	0.010	**0.066**	0.010	**0.066**	0.010	**0.053**	0.007	**0.035**	0.006	**-0.025**	**-0.009**
β_E		**-0.005**	0.002	**-0.005**	0.002	**-0.004**	0.002	**-0.004**	0.002	**-0.003**	0.002	**0.030**	**0.002**
	IX - TOUGHNESS 50												
β_T		**-0.011**	0.004	**0.003**	0.007	**0.003**	0.007	**0.015**	0.007	**0.013**	0.007	**0.008**	**0.007**
β_H	**WG**	**0.005**	0.003	**0.018**	0.006	**0.018**	0.006	**0.019**	0.006	**0.017**	0.007	**0.011**	**0.009**
β_E		**-0.016**	0.002	**-0.015**	0.003	**-0.015**	0.003	**-0.005**	0.001	**-0.004**	0.002	**-0.002**	**-0.002**
β_T		**0.024**	0.007	**0.040**	0.007	**0.042**	0.008	**0.031**	0.007	**0.027**	0.007	**-0.009**	**-0.008**
β_H	Δ	**0.022**	0.007	**0.043**	0.008	**0.047**	0.008	**0.032**	0.006	**0.028**	0.006	**-0.007**	**-0.005**
β_E		**0.002**	0.002	**-0.003**	0.002	**-0.005**	0.001	**-0.003**	0.001	**-0.002**	0.001	**0.015**	**0.002**
β_T		**0.003**	0.008	**0.024**	0.009	**0.026**	0.009	**0.014**	0.008	**0.012**	0.007	**0.013**	**0.008**
	Δ^{12}	**0.025**	0.007	**0.035**	0.008	**0.037**	0.008	**0.025**	0.007	**0.023**	0.006	**0.030**	**0.020**
β_E		**-0.022**	0.003	**-0.011**	0.003	**-0.011**	0.003	**-0.007**	0.002	**-0.007**	0.002	**-0.005**	**-0.004**
β_T		**0.046**	0.009	**0.050**	0.009	**0.051**	0.010	**0.042**	0.007	**0.027**	0.006	**-0.024**	**-0.008**
	$\Delta\Delta^{12}$	**0.050**	0.009	**0.054**	0.009	**0.054**	0.009	**0.044**	0.007	**0.029**	0.006	**-0.021**	**-0.007**
β_E		**-0.004**	0.002	**-0.003**	0.002	**-0.003**	0.002	**-0.003**	0.001	**-0.002**	0.001	**0.022**	**0.001**
	X - TOUGHNESS 25												
		-0.010	0.004	**0.006**	0.008	**0.008**	0.008	**0.017**	0.007	**0.015**	0.008	**0.009**	**0.008**
	WG	**0.001**	0.003	**0.017**	0.007	**0.017**	0.007	**0.019**	0.007	**0.017**	0.007	**0.011**	**0.010**
		-0.011	0.002	**-0.010**	0.003	**-0.010**	0.003	**-0.003**	0.002	**-0.002**	0.002	**-0.001**	**-0.001**
		0.028	0.009	**0.044**	0.010	**0.047**	0.010	**0.035**	0.008	**0.030**	0.008	**-0.010**	**-0.009**
		0.027	0.010	**0.049**	0.010	**0.050**	0.010	**0.035**	0.008	**0.031**	0.007	**-0.008**	**-0.005**
		0.001	0.002	**-0.004**	0.002	**-0.003**	0.002	**-0.002**	0.001	**-0.001**	0.002	**0.009**	**0.001**
		-0.004	0.009	**0.024**	0.010	**0.027**	0.011	**0.019**	0.009	**0.017**	0.007	**0.017**	**0.012**
	12	**0.021**	0.008	**0.034**	0.010	**0.037**	0.010	**0.028**	0.008	**0.027**	0.007	**0.033**	**0.024**
		-0.025	0.003	**-0.011**	0.003	**-0.010**	0.003	**-0.005**	0.002	**-0.005**	0.002	**-0.003**	**-0.003**
		0.051	0.012	**0.055**	0.012	**0.057**	0.012	**0.047**	0.009	**0.029**	0.008	**-0.026**	**-0.008**
	$\Delta\Delta^{12}$	**0.055**	0.012	**0.059**	0.012	**0.059**	0.012	**0.048**	0.008	**0.030**	0.007	**-0.023**	**-0.008**
		-0.004	0.002	**-0.004**	0.002	**-0.002**	0.002	**-0.003**	0.002	**-0.001**	0.002	**0.022**	**0.001**

1) Dependent variable is average hours worked for the working population, average hours worked for those employed and employment rate.
2) Hours and Job elasticities add to Total elasticity for the static but not for the dynamic models.
3) Colum 1 shows raw correlations, and columns 2-5 add time and region fixed effects, controls, 12 and 24 lags of dependent variable, respectively.
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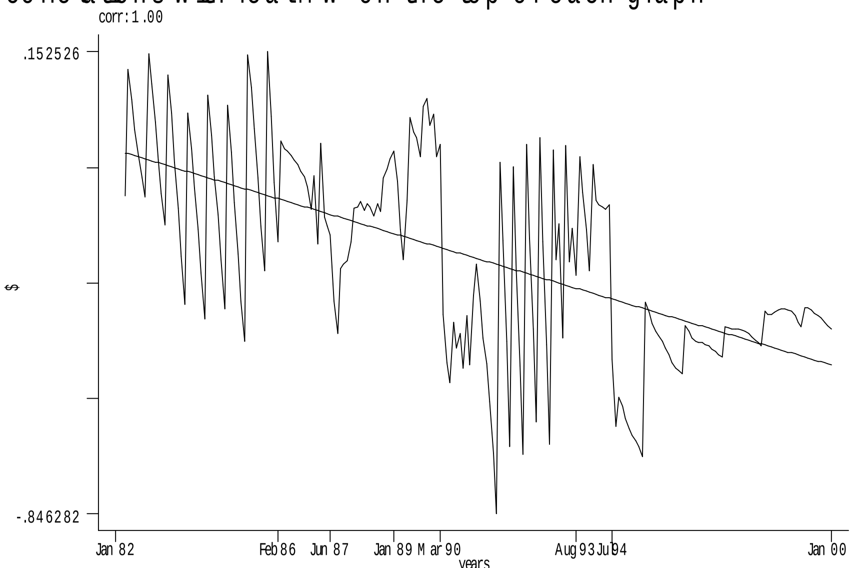
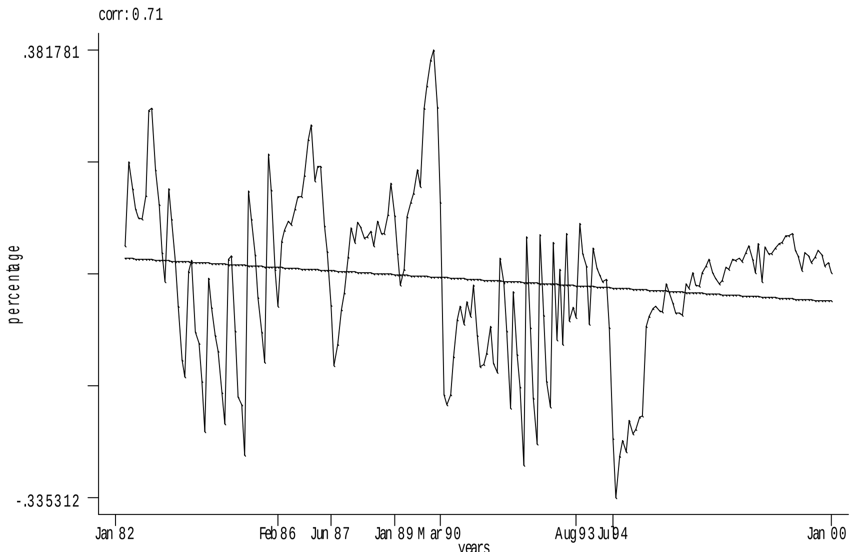
6) Each panel has Within Groups and OLS on 1st, 12th and 1st and 12th differences.
7) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies.
8) Controls are population and instituional factors.
9) Multiply estimates by 10 to obtain the percentual effect on employment of a 10% increase on the minimum wage variable.
10) Because FRACTION, FRACTION REAL AND PERCENTAGE are variables already in differences, WG was not computed.

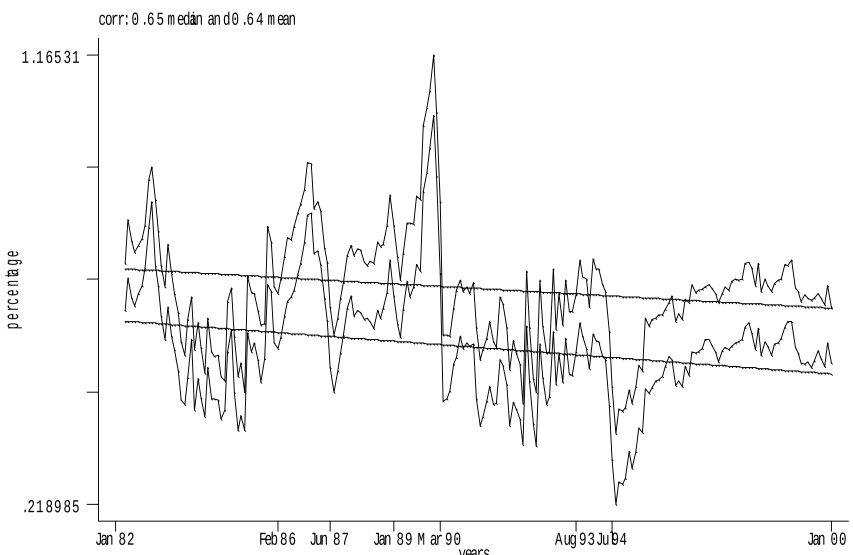
BRAZIL from 1982 to 2000
correlations with real MW on the top of each graph



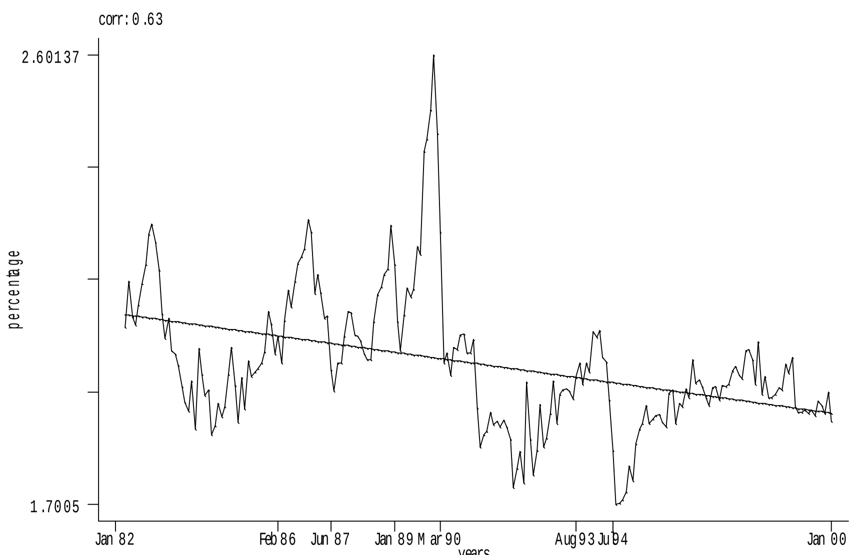
graph 3.1a - log REAL HOURLY MW



graph 3.1c - log 25th WAGE DISTRIBUTION PCTILE



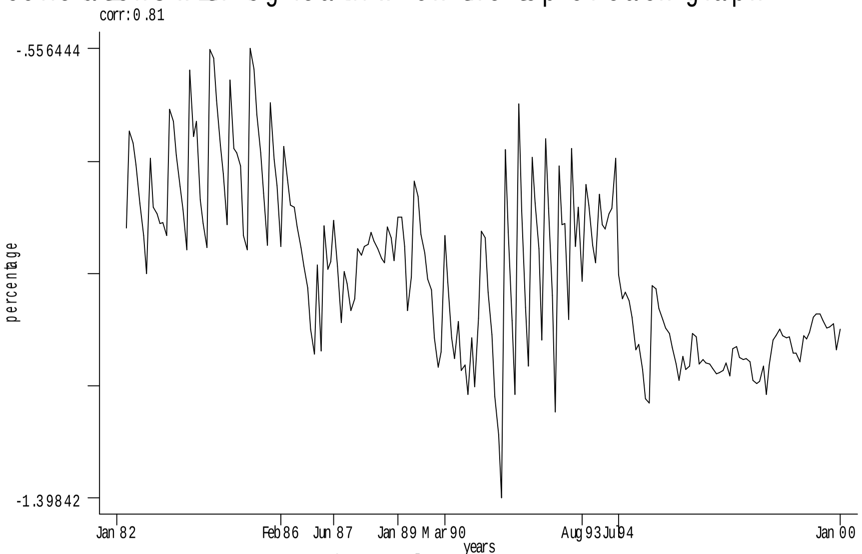
graph 3.1c - log MEDIAN AND MEAN WAGE



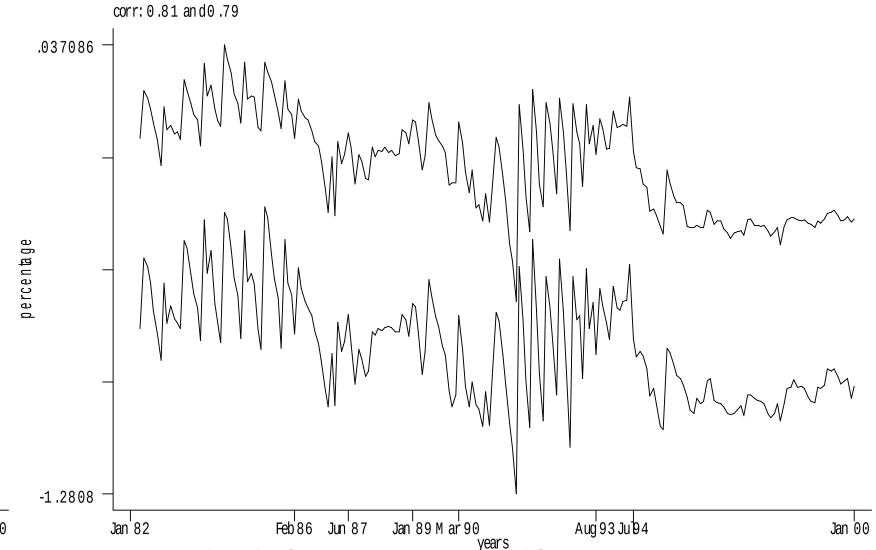
graph 3.1d - log 90th WAGE DISTRIBUTION PCTILE

graph 3.1 - log WAGE DISTRIBUTION PCTILES

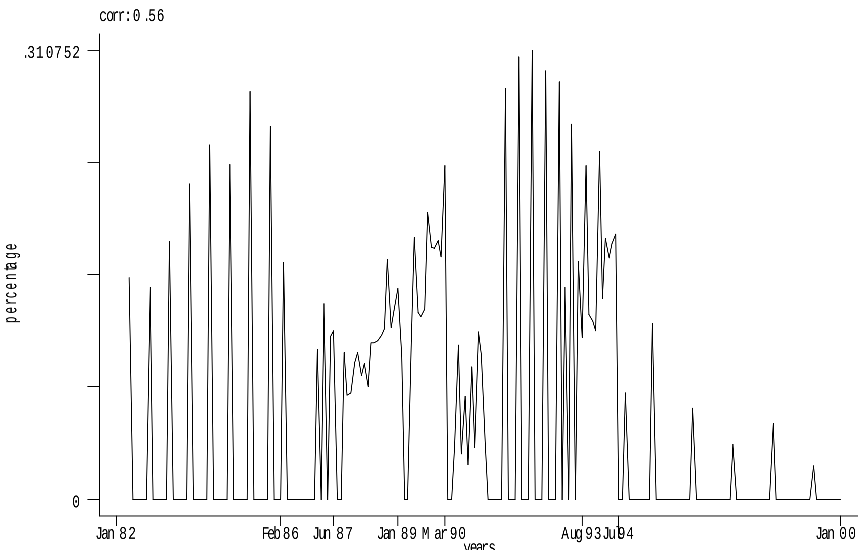
BRAZIL from 1982 to 2000
correlations with log real MW on the top of each graph



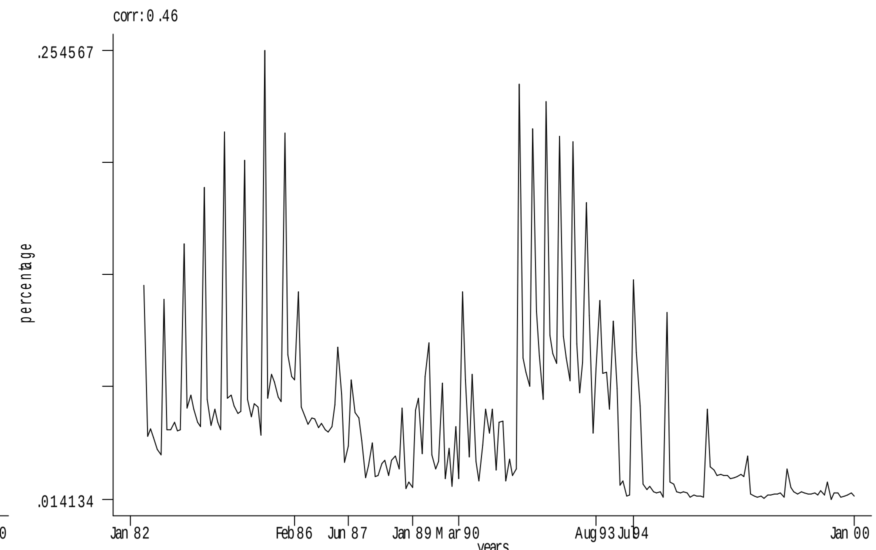
graph 3.2a - log TOUGHNESS



graph 3.2b - log TOUGHNESS 25 and log TOUGHNESS 50



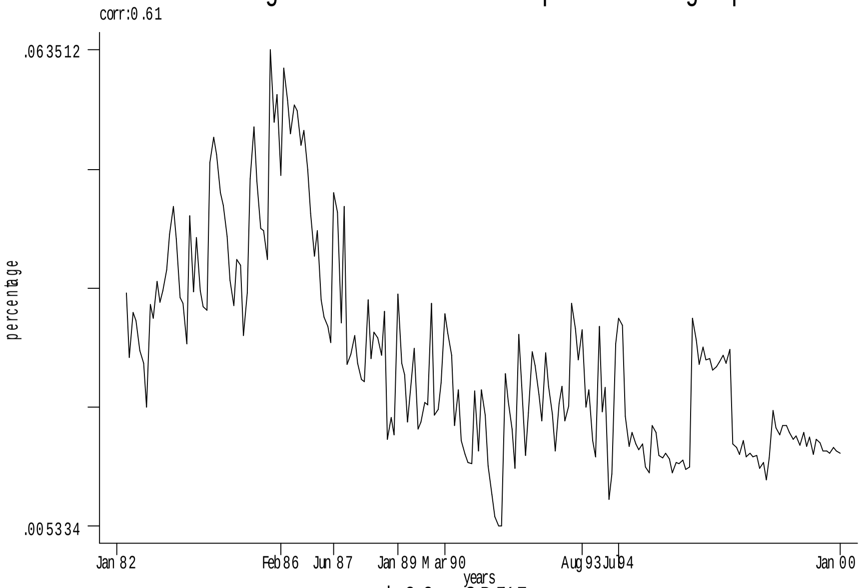
graph 3.2c - FRACTION



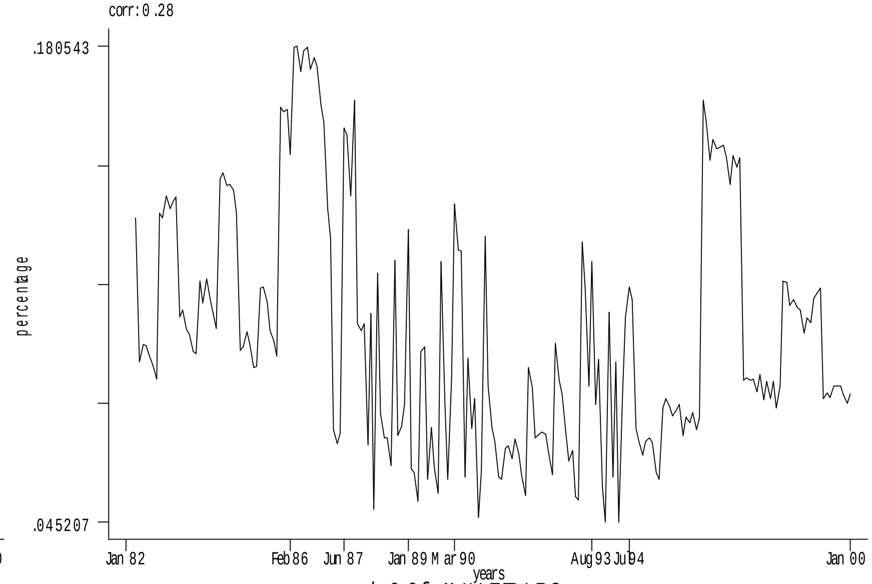
graph 3.2d - FRACTION REAL

graph 3.2 - MINIMUM WAGE VARIABLES - continues

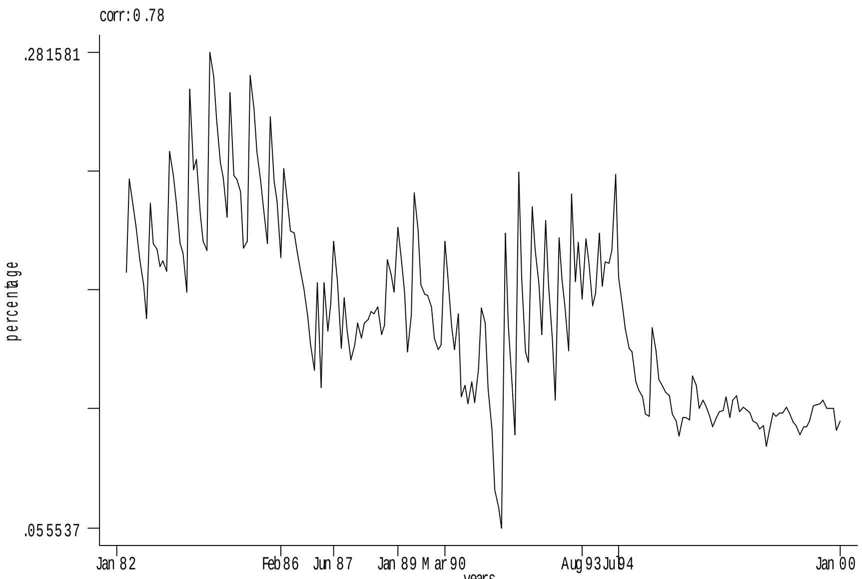
BRAZIL from 1982 to 2000
correlations with log real MW on the top of each graph



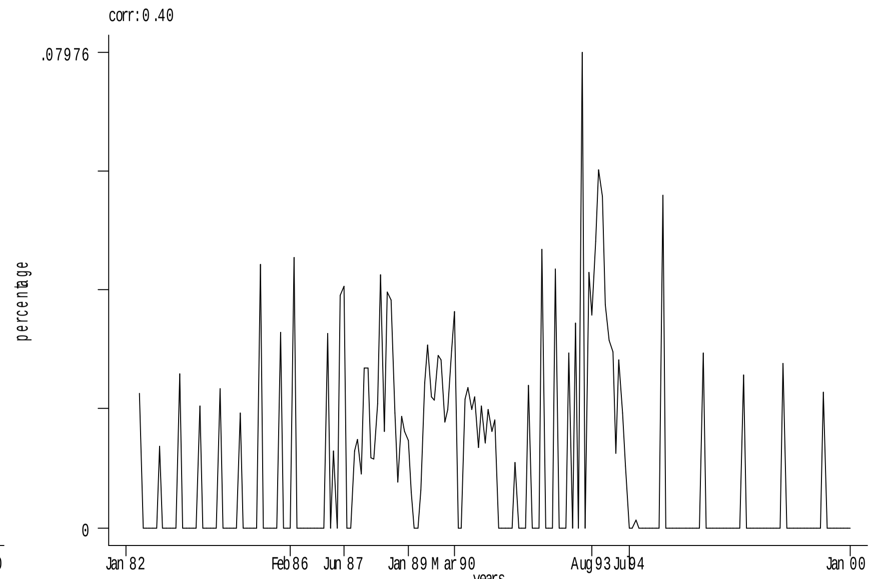
graph 3.2e - SPIKE



graph 3.2f - MULTIPLES



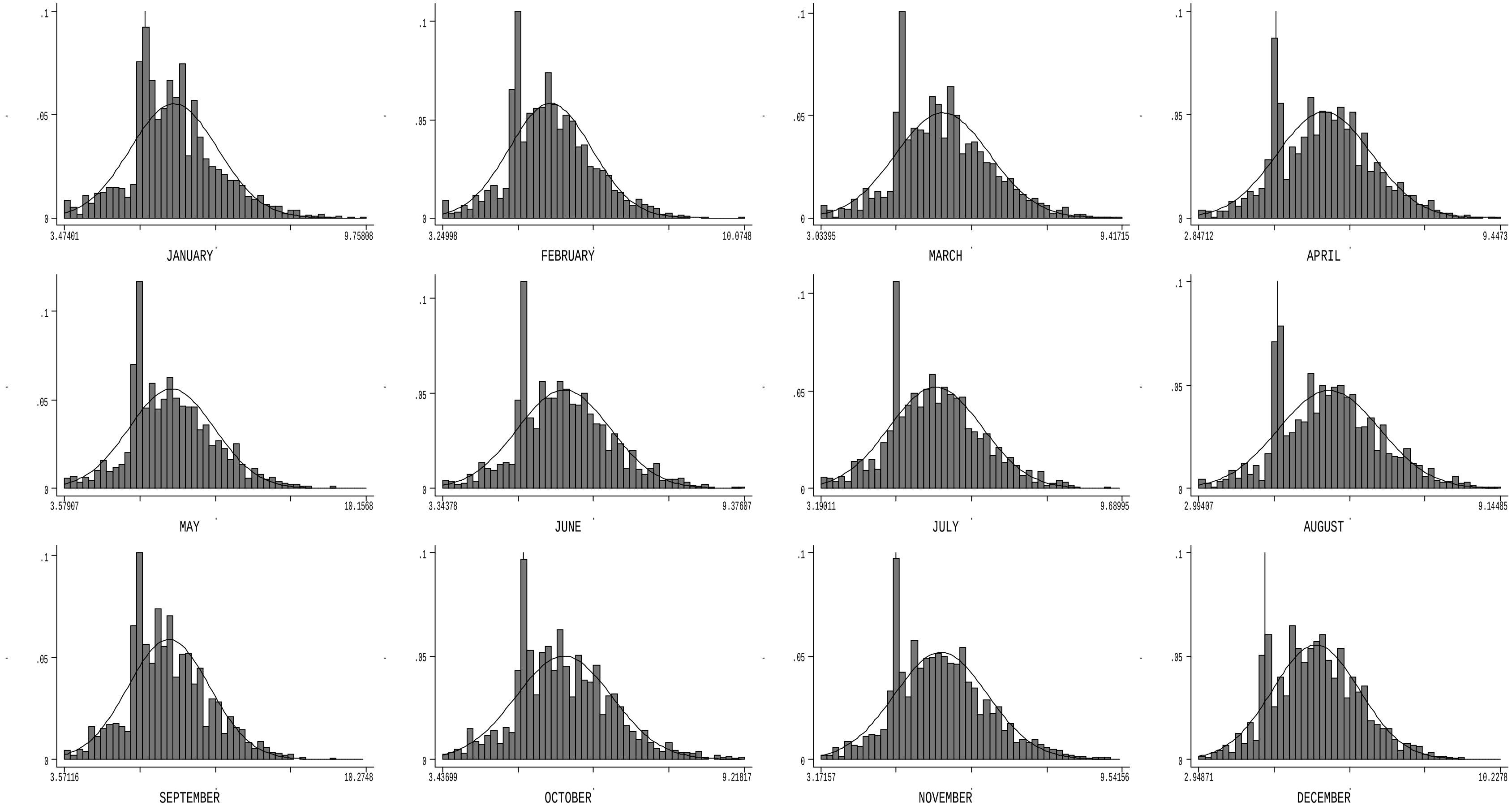
graph 3.2g - SPIKE AND BELOW



graph 3.2h - PERCENTAGE

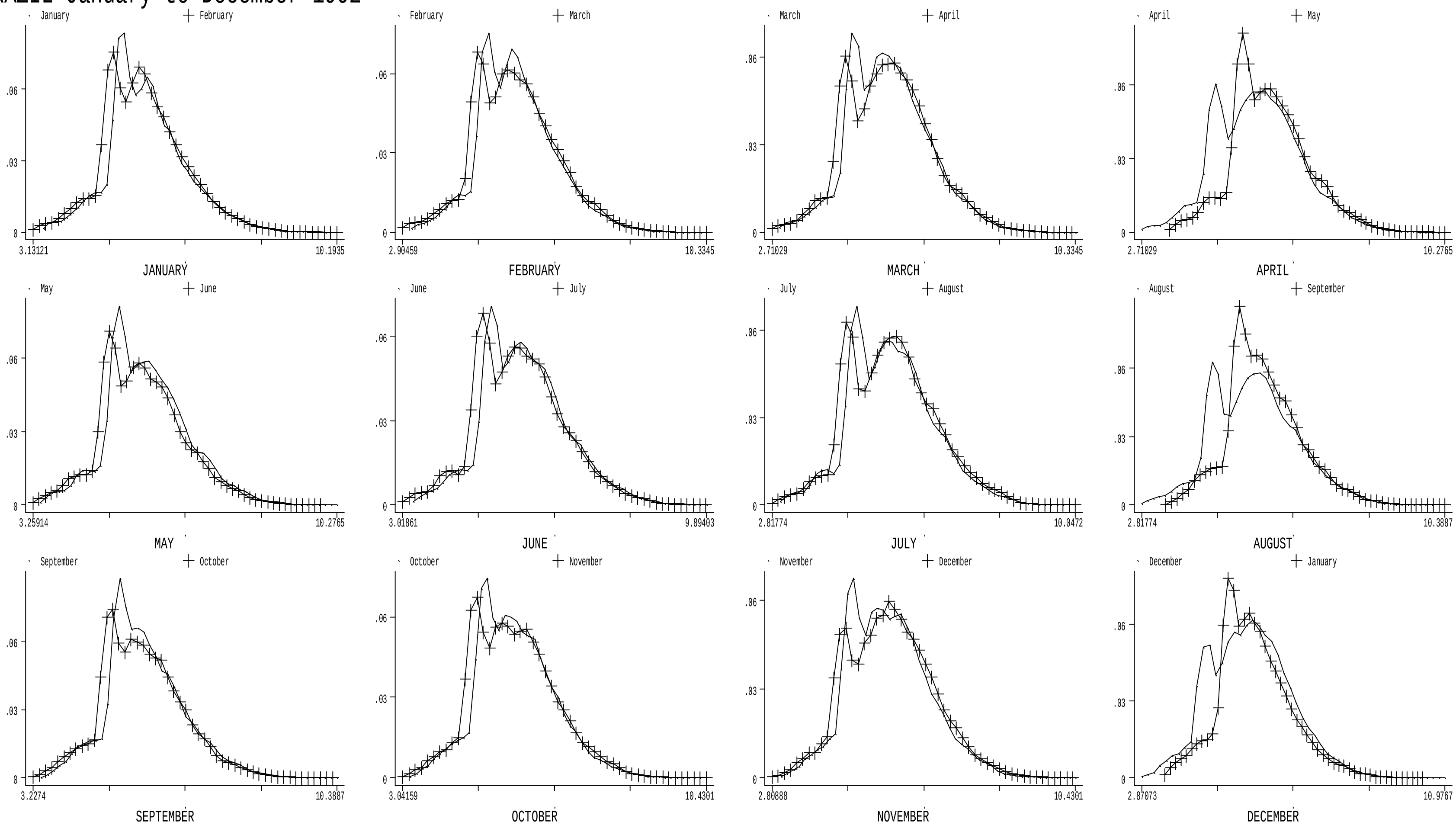
graph 3.2 - MINIMUM WAGE VARIABLES - continued

BRAZIL January to December 1992

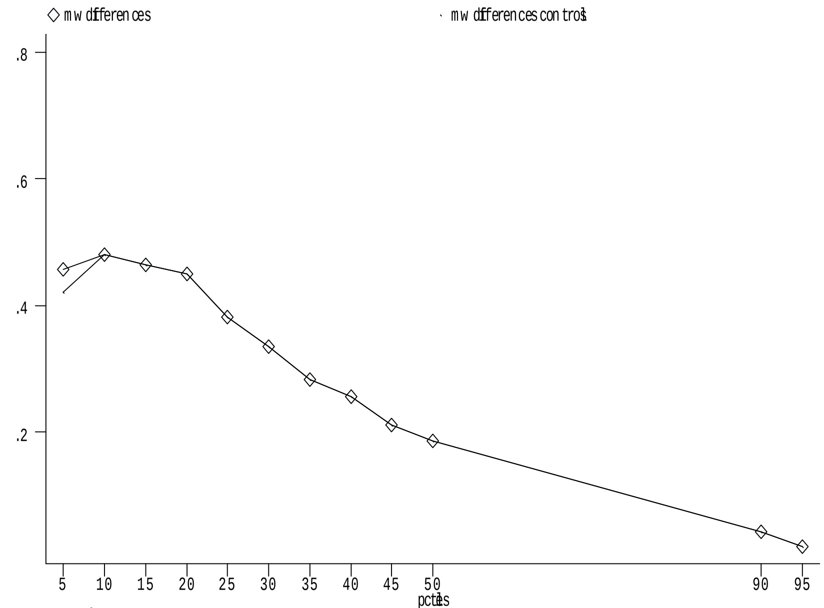


graph 3.3 - DISTRIBUTION OF LOG REAL EARNINGS

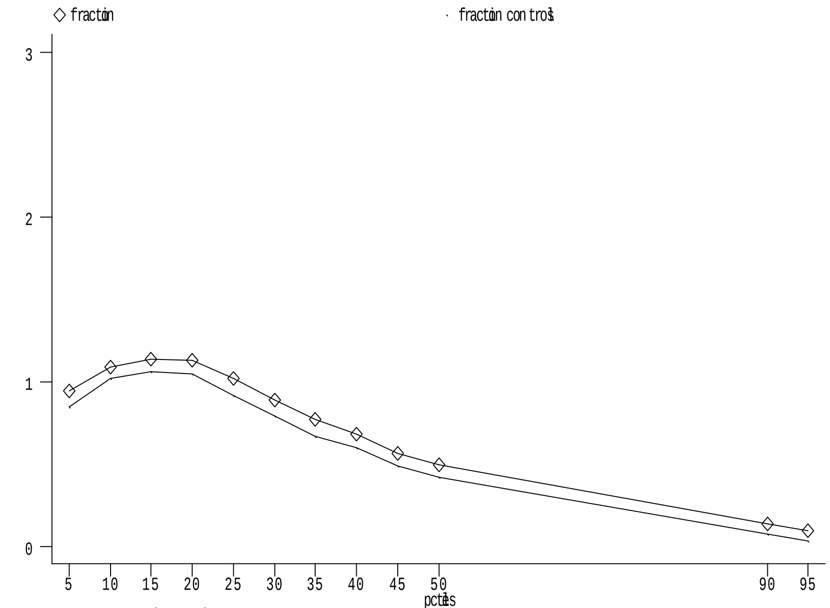
BRAZIL January to December 1992



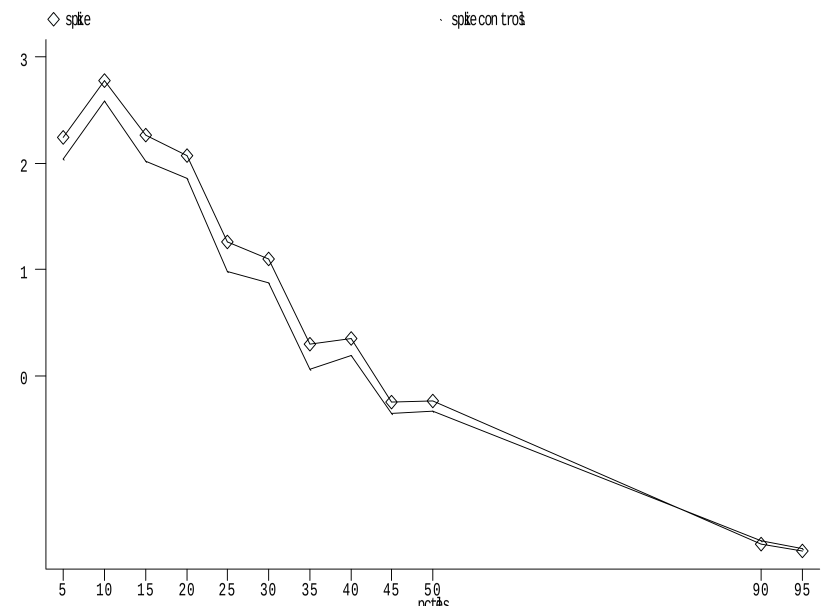
graph 3.4 - LOG REAL EARNINGS KERNEL DISTRIBUTIONS



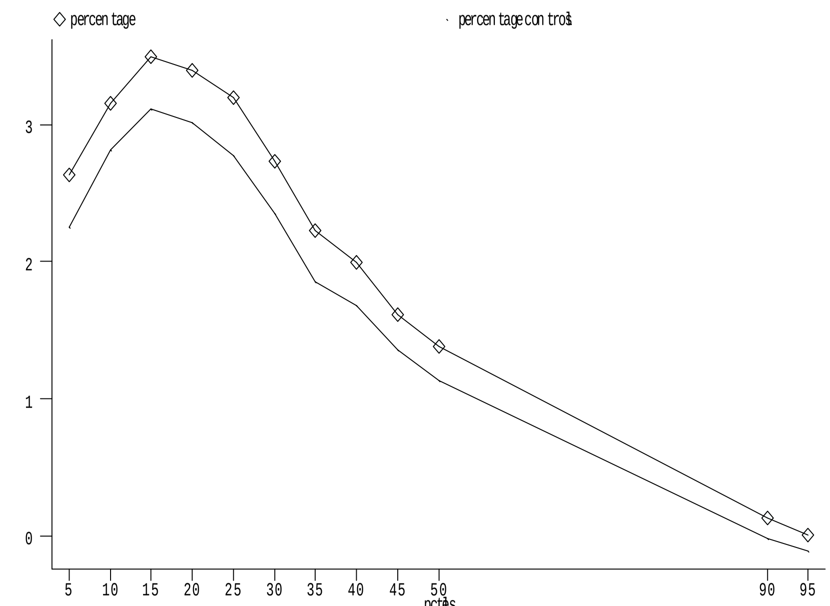
graph 3.5a - ESTIMATES OF THE COEF OF THE MW IN DIFFERENCES



graph 3.5b - ESTIMATES OF THE COEF OF THE FRACTION



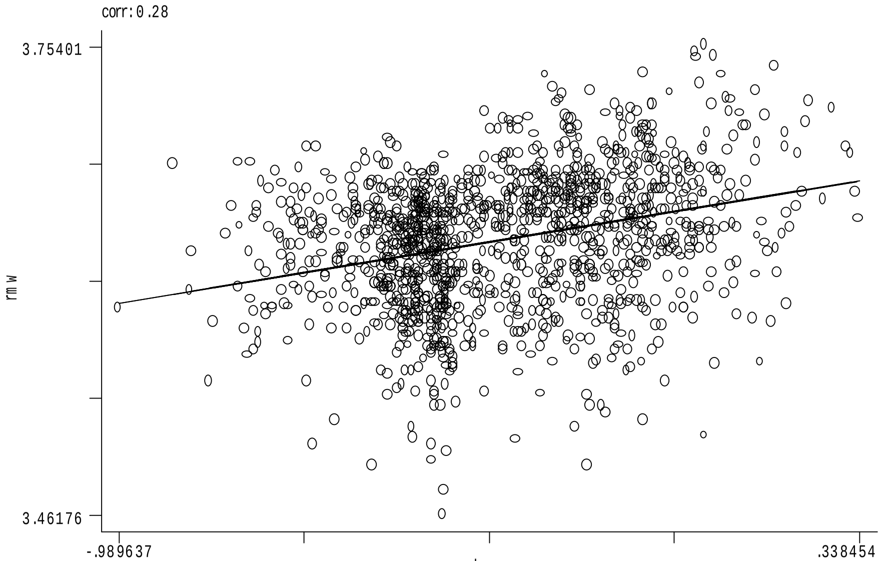
graph 3.5c - ESTIMATES OF THE COEF OF THE SPIKE



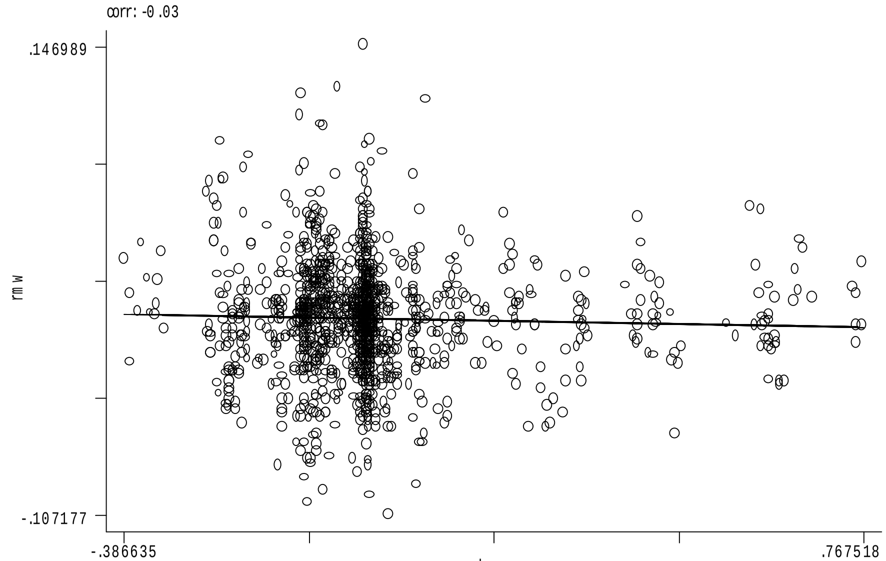
graph 3.5d - ESTIMATES OF THE COEF OF THE PERCENTAGE

graph 3.5 - ESTIMATES OF THE COEFFICIENTS OF THE MW VARIABLES

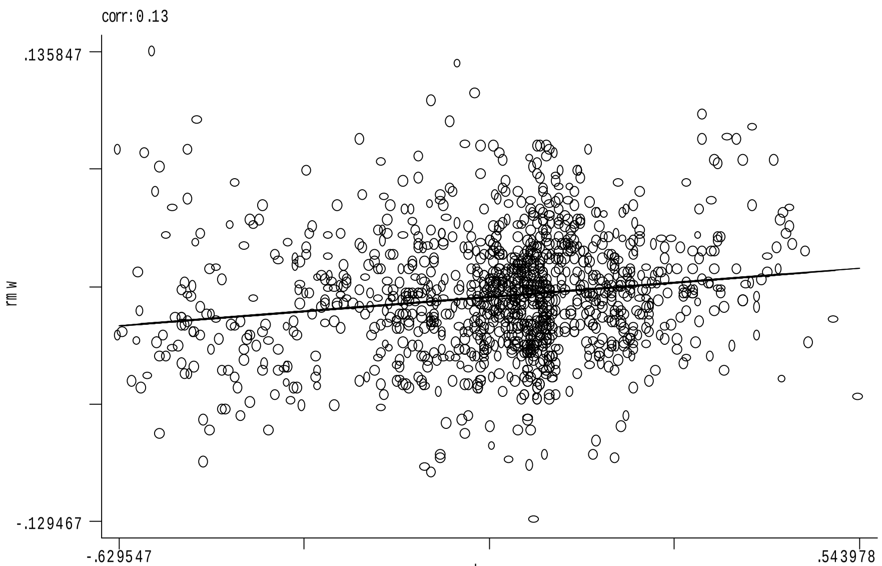
BRAZIL from 1984 to 2000



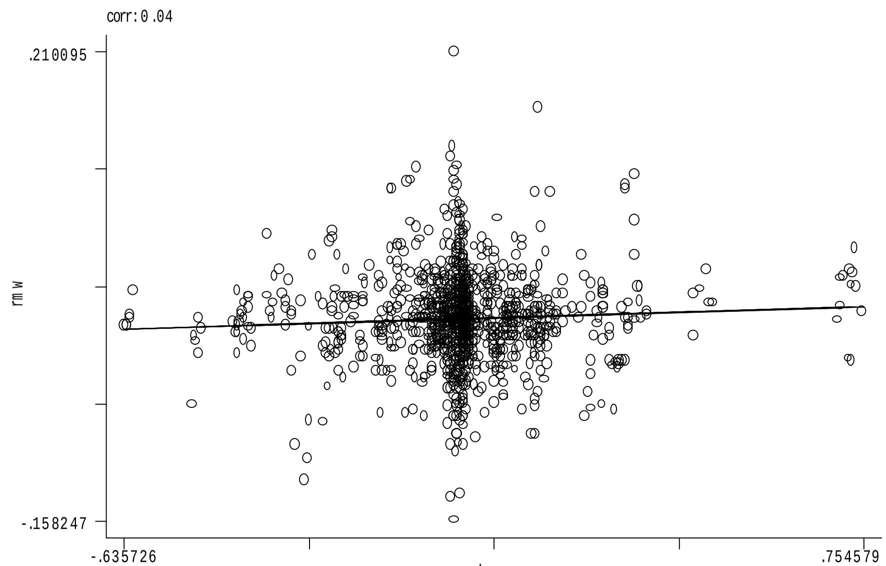
graph 4.1a - LOG HOURS WORKED AND REAL HOURLY MW



graph 4.1b - 1st DIFFERENCE LOG HOURS AND REAL HOURLY MW

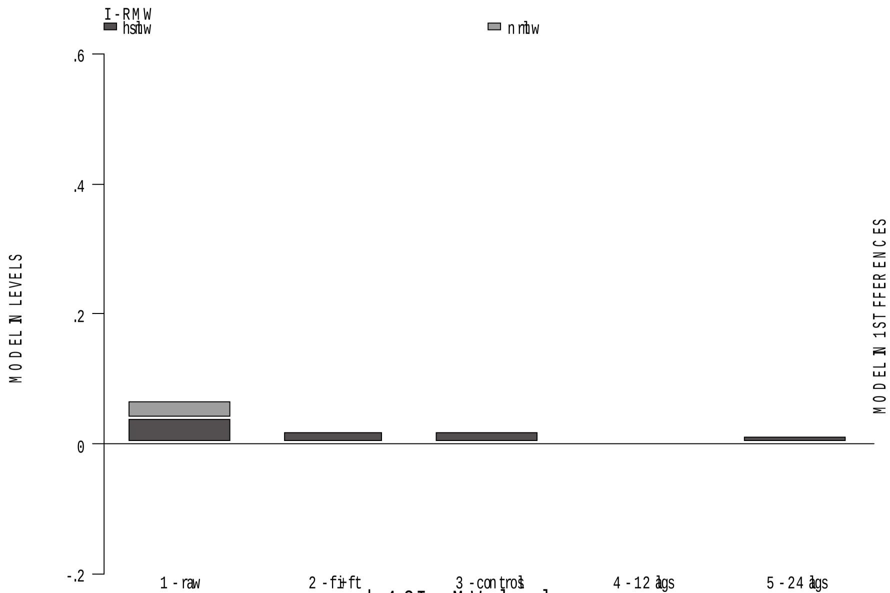


graph 4.1c - 12TH DIFFERENCE LOG HOURS AND REAL HOURLY MW

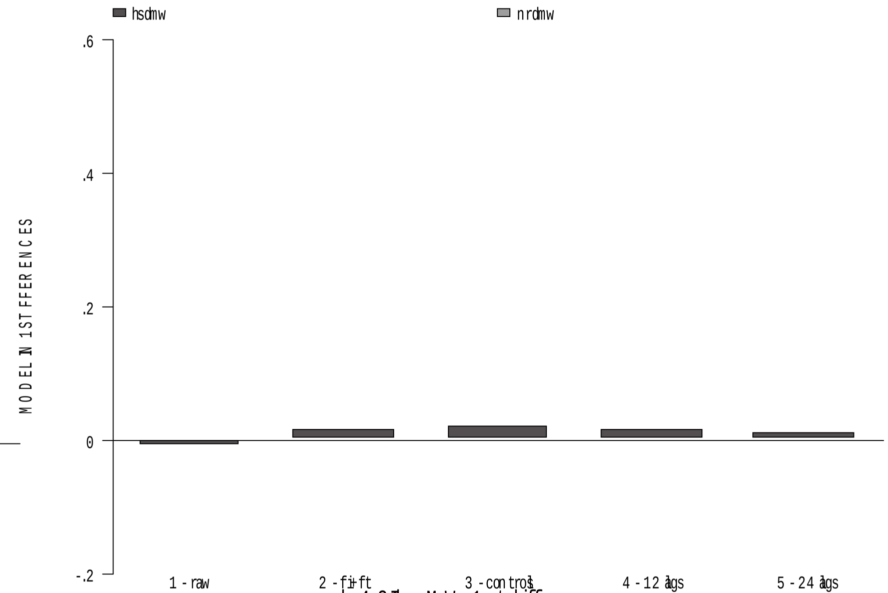


graph 4.1d - 1ST-12TH DIFFERENCE LOG HOURS AND REAL HOURLY MW

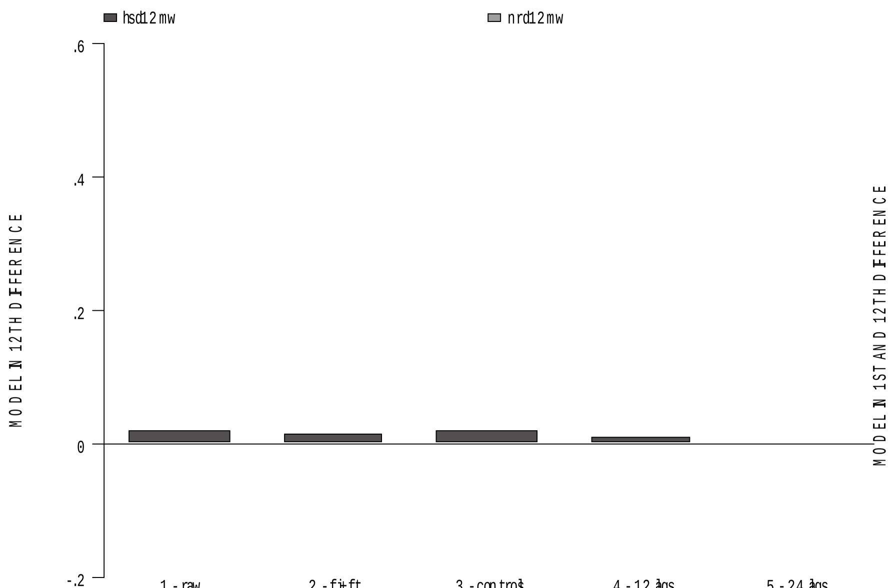
4.1 - LOG HOURS WORKED AND LOG REAL HOURLY MW



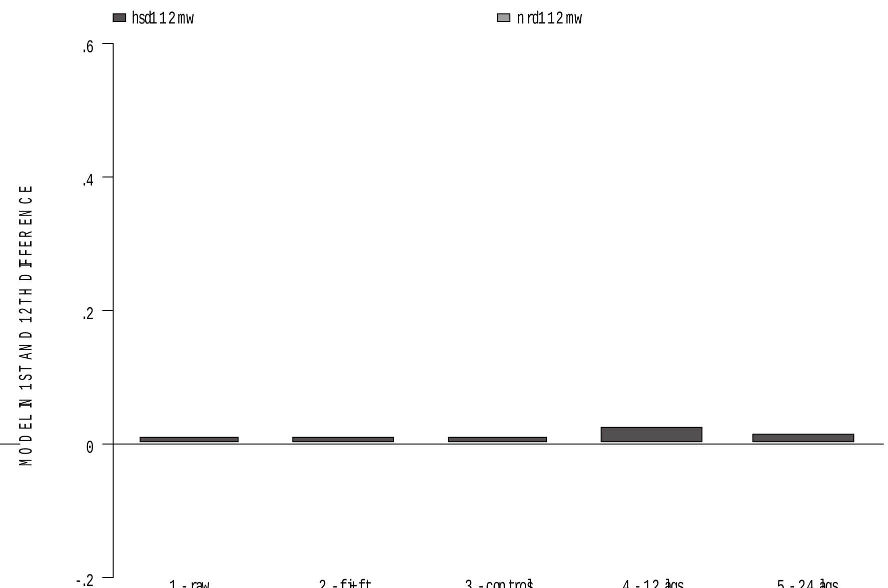
graph 4.2Ia - MW levels



graph 4.2Ib - MW 1st difference

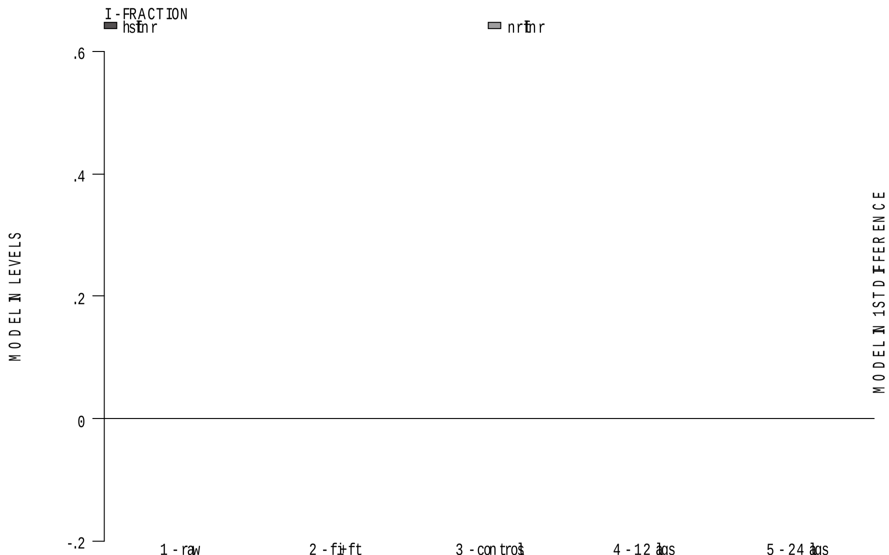


graph 4.2Ic - MW 12th difference

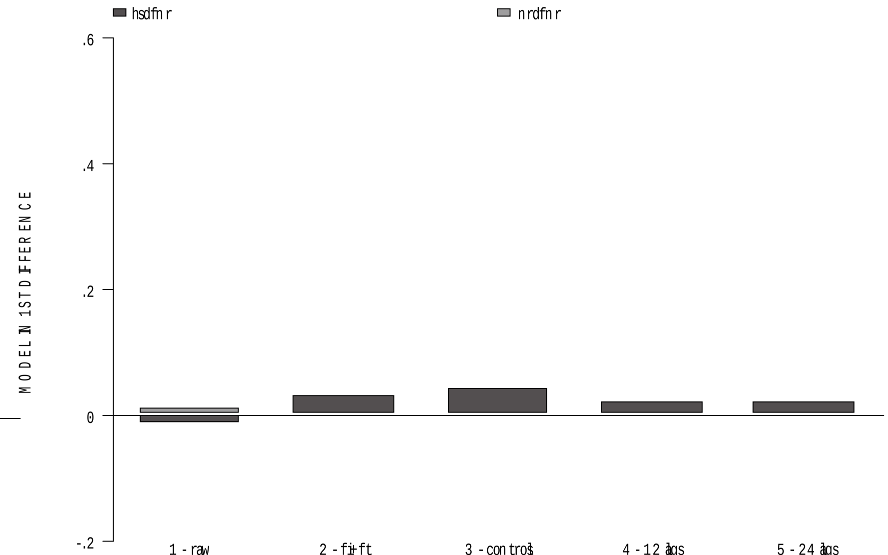


graph 4.2Id - MW 1st and 12th difference

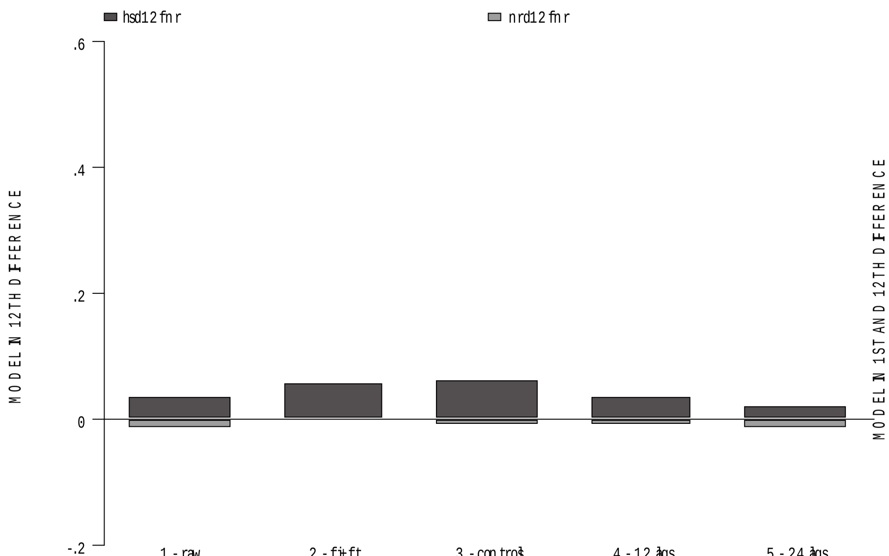
graph 4.2I - ESTIMATES OF THE COEFFICIENTS OF MW



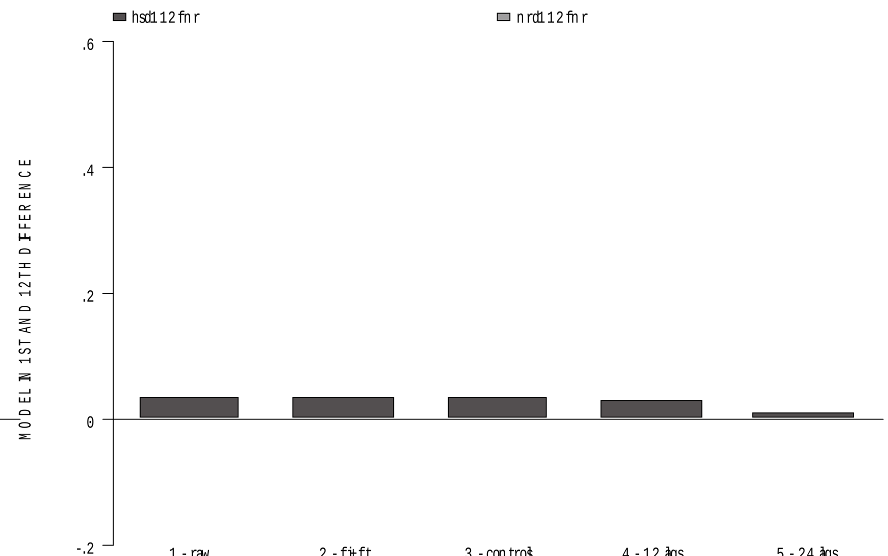
graph 4.2IIa - FRACTION levels



graph 4.2IIb - FRACTION 1st difference

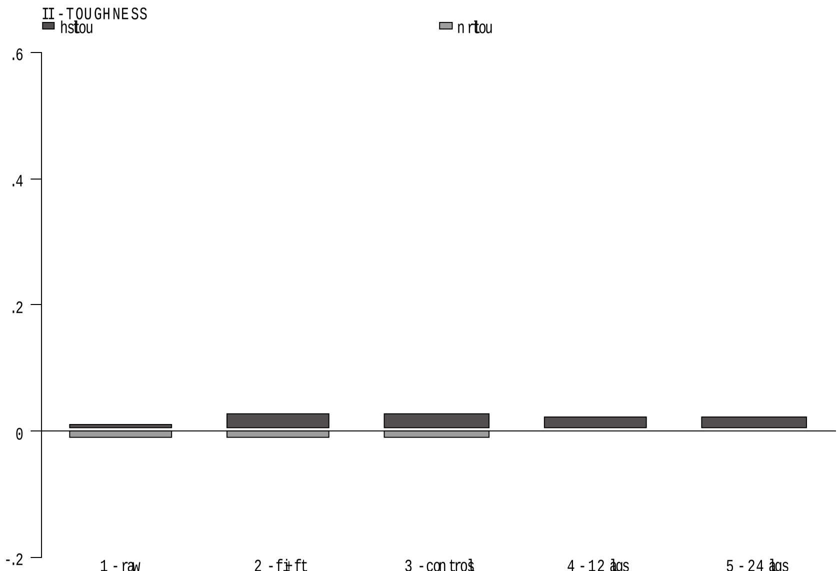


graph 4.2IIc - FRACTION 12th difference

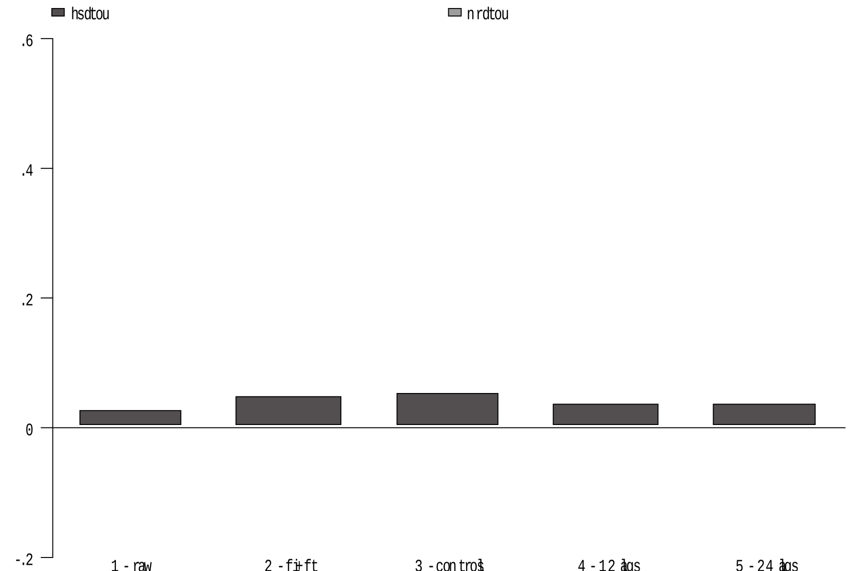


graph 4.2IId - FRACTION 1st and 12th difference

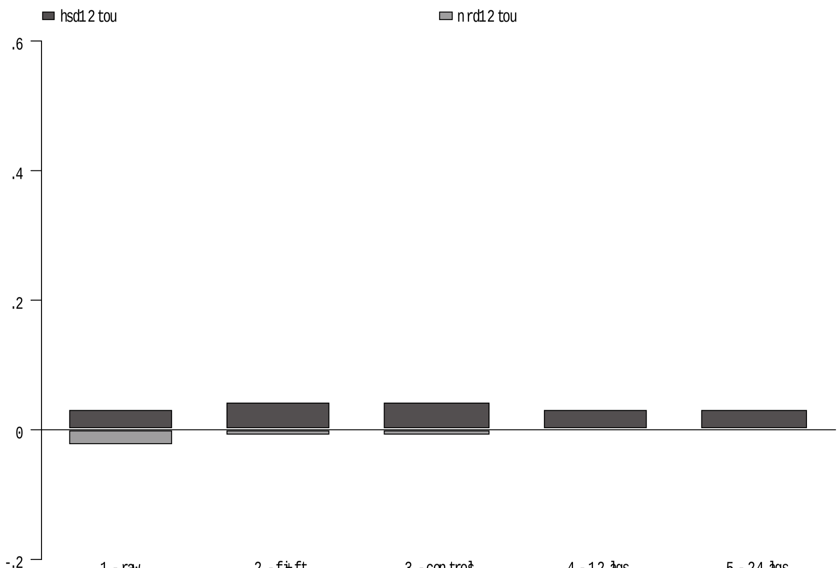
graph 4.2II - ESTIMATES OF THE COEFFICIENTS OF FRACTION



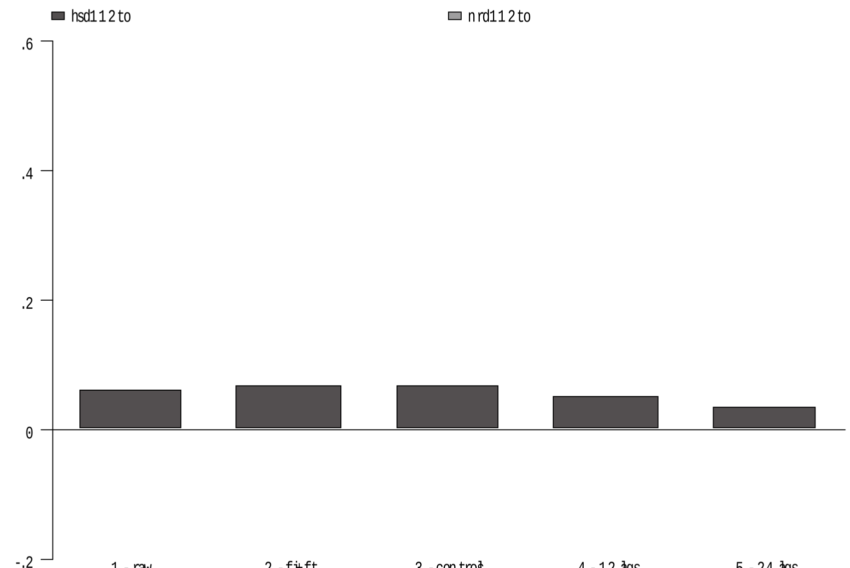
graph 4.2IIIa - TOUGHNESS levels



graph 4.2IIIb - TOUGHNESS 1st difference



graph 4.2IIIc - TOUGHNESS 12th difference



graph 4.2IIId - TOUGHNESS 1st and 12th difference

graph 4.2III - ESTIMATES OF THE COEFFICIENTS OF TOUGHNESS

table 3.1 - MINIMUM WAGE VARIABLES

NAME/DEFINITION	INTERVAL	GENERAL FORM $Z = \int_a^b g(x)dx$	FUNCTION $g(x)$	LIMITS a b	CORR MW
MINIMUM WAGE	mw_t	$Z = \int_{MW_{t-1}}^{MW_t} 1dx$	1	$a = MW_{t-1}$ $b = MW_t$	1.00
TOUGHNESS mw as % of average wage	$\frac{mw_t}{avwage_t}$	$Z = \frac{MW_t}{\int_0^\infty xf_t(x)dx} - \frac{MW_{t-1}}{\int_0^\infty xf_{t-1}(x)dx}$	$f_t(x)$	$a = 0$ $b = \infty$	0.81
TOUGHNESS 50 mw as % of median wage	$\frac{mw_t}{mdwage_t}$				0.81
TOUGHNESS 25 mw as % of median wage	$\frac{mw_t}{25pwage_t}$				0.79
FRACTION % between old and new mw	$0.98 * mw_t \leq wage_t \leq 1.02 * mw_{t+1}$	$Z = \int_{MW_{t-1}-\varepsilon}^{MW_t+\varepsilon} f_{t-1}(x)dx$	$f_{t-1}(x)$	$a = MW_{t-1} - \varepsilon$ $b = MW_t + \varepsilon$	0.56
FRACTION REAL % between old an new real mw	$0.98 * mw_t \leq rwage_t \leq 1.02 * mw_{t+1}$				0.46
SPIKE % at the mw	$0.98 * mw_t \leq wage_t \leq 1.02 * mw_t$	$Z = \int_{MW_t-\varepsilon}^{MW_t+\varepsilon} f_t(x)dx - \int_{MW_t-\varepsilon}^{MW_t+\varepsilon} f_{t-1}(x)dx$	$f_t(x)$	$a = MW_t - \varepsilon$ $b = MW_t + \varepsilon$	0.61
MULTIPLES % at 0.5, 1, 1.5, 2, 2.5 and 3 mw	$0.98 * 0.5 * mw_t \leq wage_t \leq 1.02 * 0.5 * mw_t$ $+ \ldots +$ $0.98 * 0.5 * mw_t \leq wage_t \leq 1.02 * 0.5 * mw_t$	$Z = \sum_{i=1}^{6} Z_i$ $Z_i = \int_{mMW_t-\varepsilon}^{mMW_t+\varepsilon} f_t(x)dx - \int_{mMW_t-\varepsilon}^{mMW_t+\varepsilon} f_{t-1}(x)dx$ $m = 0.5, 1.0, 1.5, 2.0, 2.5$	$f_t(x)$	$a = mMW_t - \varepsilon$ $b = mMW_t + \varepsilon$	0.28
SPIKE AND BELOW % at or below mw	$wage_t \leq 1.02 * mw_t$	$Z = \int_{-\infty}^{MW_t} f_t(x)dx - \int_{-\infty}^{MW_{t-1}} f_{t-1}(x)dx$	$f_t(x)$	$a = -\infty$ $b = mMW_t + \varepsilon$	0.78
PERCENTAGE % whose wage increase = mw increase	$\frac{wage_t - wage_{t-1}}{wage_{t-1}} = \frac{mw_t - mw_{t-1}}{mw_{t-1}}$	$Z = \int_0^\infty \{ \int_{x[1+(1-\varepsilon)p_t]}^{x[1+(1+\varepsilon)p_t]} f_{t,t-1}(x,y)dy \} dx$ $p_t = \frac{MW_t - MW_{t-1}}{MW_{t-1}}$	$f_{t,t-1}(x,y)$	$a = x[1+(1-\varepsilon)p_t]$ $b = x[1+(1+\varepsilon)p_t]$	0.40

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