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## MINIMUM WAGE EFFECTS UNDER ENDOGENOUS COMPLIANCE: EVIDENCE FROM PERU<sup>1,2</sup>

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### 1. Introduction

Minimum wage setting is a well established labor market policy in Latin American countries. Its rationality is associated with redistribution objectives (Freeman, 1996), on the one hand, and to solving informational problems in the labor market, on the other (Card and Krueger, 1995). Under the former objective, policy intervention is justified as a means to improve the situation of the poorest among wage earners. This may be a response to problems of demand concentration (monopsony) or unequal distribution of power between employers and workers. In the latter case, the idea is to produce signals for a market in which information asymmetry problems or difficulties in measuring worker productivity may be significant.

Under perfect competition and full compliance a binding minimum wage raises average employed worker earnings, but lowers employment. This is an important consideration for policy, though not all empirical results validate it. Full compliance with labor regulations, or anything near that, however, is unknown of in Latin America. All Latin American countries, to a greater or lesser degree, feature informal sectors of a significant size. This makes theoretical predictions less certain. Why would informal firms comply with minimum wage laws? Are they not by definition out of the reach of labor legislation? In practice, the simple duality formal-informal has many different shades: firms are more formal in some aspects than others. They tend to comply more with certain legislation than with other. Risk of detection may play a role, but other institutional factors may too — legitimacy, reasonability, or plain custom.

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Understandably, minimum wage regulation has great appeal among politicians. If indeed it fulfills its promise of increasing the welfare of low income people, then it is a powerful policy tool. However, this is by no means granted. Particularly, there is no large body of evidence on what minimum wages do in settings where compliance is far from perfect. Understanding the effects of minimum wages in developing countries needs an understanding of its effects in both formal and informal sectors. So far, however, we have little evidence on this. Our objective here is to contribute to fill this gap by analyzing the effects of a minimum wage in a setting characterized by substantial non-compliance with labor legislation.

A handful of studies for developing countries have been produced that explicitly address the issue of differentiated effects in the formal and informal sectors - Bell (1997) for Mexico; Gindling and Terrell (2004) for Costa Rica; Lemos (2004) and Fajnzylber (2001) for Brazil; Jones (1997) for Ghana; and Maloney and Nuñez (2004) for Colombia. One surprising conclusion of this literature is that the minimum wage has significant effects in the informal sector. Further, some of these studies find larger effects in the informal than in the formal sector. This finding has been interpreted as evidence of a signaling (lighthouse) effect of the minimum wage. This idea was first proposed by Card and Krueger (1995) in their study of the fast food industry in the United States. In that context, it served the purpose of providing a rationale for the unorthodox finding of positive or nil employment effects of minimum wage increases. Contrastingly, in the case of Latin America it has been put forward even when employment effects are found to be strongly negative (Maloney and Nuñez, 2004; Fajnzylver, 2001). Consequently, perceived fairness considerations are thought to be associated with it, instead of the efficiency ones proposed by Card and Krueger. Of course, whether employers attach 'fair pay' attributes to official minimum wages has to do more with local conditions than with universal rationality. Thus, empirical responses may vary from country to country.

Peru provides an intriguing setting to evaluate the impact of minimum wage policies when compliance is incomplete and endogenous, for several reasons. First, it has a very large urban informal sector even for Latin American standards. No less than 60 percent of urban workers are estimated to belong to the informal sector. Second, it is different from other countries in the region in that minimum wage policy has followed an erratic course since the late eighties, when it lost efficacy due to hyperinflation. This is quite different

from other Latin American countries studied in the literature, where readjustments are periodical and institutional mechanisms for revising levels operate. This has one important methodological implication: changes are largely unanticipated. On the other hand, it may have consequences on the effectiveness of any potential signaling effect, if only because predictable signals are easier to follow.

In order to test for minimum wage effects on earnings and employment in both formal and informal sectors we use two approaches. First, we estimate kernel density functions for monthly earnings distributions, focusing on key points in the recent evolution of minimum wages, starting in 1996. This provides some intuition on the role of the legal wage floor in the earnings distributions. Next, we use quarterly panel data to econometrically estimate effects of a minimum wage change on wages and the probability of remaining employed. We follow Neumark et al. (2000) empirical setting in controlling for worker position on the wage distribution, but adapt it to Peruvian data. In addition, we find evidence of a ‘regression to the mean’ problem and proceed to correct it.

Results indicate that though the minimum wage plays a role in the shape of long run earnings distributions for both formal and informal workers, this role is stronger for formal workers. Analysis of the short run effects of the last minimum wage increase using quarterly panel data offers little support for numeraire or ‘lighthouse’ effects. Labor monthly earnings are affected only at the bottom of the distribution (0.25-0.60 of the minimum wage), made up mostly of informal workers; and for formal workers earning between the old and the new minima. Negative effects on the probability of retaining employed status are weak or non significant for informal wage earners below the minimum wage, but significant for formal workers ‘trapped’ between minima, and for both formal and informal earning just above and up to 2 times the minimum wage. Independent workers below minimum suffer weakly significant to significant negative effects on employment, but no significant effect on earnings.

The remaining of the paper is organized as follows. In section 2, the relevant literature is discussed, with particular focus on differentiating effects in formal and informal sectors. Next, in section 3 we describe the institutional setting of minimum wage policy in Peru and analyze the recent evolution of the statutory minimum wage. In section 4 we briefly describe the methodological approaches. Section 5 details the methodology used in

estimating the kernel distributions. Results are also presented and discussed. Sections 6 through 8 do likewise with the econometric approach. We conclude in section 9.

## 2. Literature discussion

Continued academic interest on the effects of minimum wages has different sources. First, it has the attraction of simplicity in putting theory to test: it provides a textbook example of interference with the price-setting mechanism. Second, it has potential distributional effects, so policy implications are warranted. Third, empirical findings are the object of controversy. In the simplest textbook model, a binding minimum wage is a rigidity that causes unemployment. A worker is paid the value of her/his marginal productivity. A minimum wage above this level forces firms to lay off those workers below that productivity level. If there exists full compliance, and holding technology constant, possible adjustment variables are employment and hours worked (including substitutions between full-timers and part-timers). Also, the change in relative prices may induce substitutions away from low-skilled labor towards higher-skilled labor. In countries where compliance is partial, many informal firms will ignore the change, while another possible adjustment margin is the transition from formal to informal hiring.

Rationale for minimum wage laws is associated to market failure and/or to redistributive goals. On the first count, it is argued that in practice wage setting presents anomalies in relation to the theoretical model. For example, persistent differences in the earnings of virtually identical workers are found even in the least sophisticated occupations: some industries pay more for their janitors than others.<sup>4</sup> From the perspective of market failure, the strongest theoretical underpinning for minimum wages derives from the presumed existence of monopsonies (Card and Krueger, 1995). Beyond the one company-town caricature, it is argued that the presence of job-switching costs provides a degree of monopsony power to employers. As long as information on job opportunities and working conditions is scarce, job-switching costs are significant. Within this context, minimum wage signaling (the so called lighthouse effect), may contribute to labor market efficiency. Also, especially

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<sup>4</sup> This is the case of the US car industry vis-à-vis the service sector (Card and Krueger 1995: 153-4).

in inflationary and distorted relative price settings, agents may interpret minimum wage hikes as a signal that prices and wages are open to bargain.

On the redistribution front, it is argued that minimum wages have the potential to moderately affect the wage distribution by improving the earnings of those at the bottom of the labor income scale (Freeman, 1996). If this may be accomplished at low cost in terms of job losses, then it might be a worthwhile policy. The evaluation of this policy instrument, however, has to consider the relative strength of two opposite effects (higher earnings versus lower employment). What types of adjustments prevail when a minimum wage hike occurs is entirely an empirical matter, and one quite intensely debated as well. In the past decade Card and Krueger (1995) have animated the debate by presenting evidence, surprising in the light of the competitive market model, that if the minimum wage had any effect on employment, this was positive. Although in a few cases these results have been replicated and theoretical models to justify them produced (Dickens, et al. 1999), empirical research has tended not to reproduce these results. Castillo-Freeman and Freeman (1996), for example, found strong negative effects of a substantial minimum wage increase in Puerto Rico. Neumark et al. (2000) for the United States and Abowd et al. (1999) for United States and France have also identified considerable unemployment effects. Kertesi and Köllö (2004) and Rama (2000) have also found strong negative consequences on employment of large increases in minimum wages in Hungary and Indonesia, respectively.

For Latin America, Bell (1997) found no aggregate employment effects in 1980s Mexico, where the minimum wage was low, but large effects in Colombia (elasticities between -0.2 and -1.2 for low wage workers), where its level is closer to the average wage in the formal sector. More recently, Maloney and Nuñez (2004) found similarly negative effects on employment, using a different methodology. Following Neumark et al. (2000), they use quarterly panel data to analyze both the percent change in hourly wages and the probability of becoming unemployed considering the worker's position in the wage distribution. They find the expected positive effect on wages and negative on the probability of retaining employment. These effects go way beyond those trapped between the former and the new minima, suggesting numeraire effects across the wage distribution. For Brazil, Fajnzylver (2001), also using Neumark et al. (2000) empirical setting, finds significant effects of the predicted sign on wages, running through the wage distribution, and employment.

Few authors have focused on minimum wage effects on the formal and informal sectors. Gintling and Terrell (2004) have analyzed effects on wages in Costa Rica. They define different informal sectors in both urban and rural areas, finding that minimum wage increases affect both formal and informal sectors. Further, effects are found to be strongest in the rural informal sector, although only somewhat weak effects are identified in the urban informal sector. Bell (1997) also found larger effects in the informal than in the formal sector in Mexico. Lemos (2004) also finds significant effects of the minimum wage in the Brazilian informal sector. Again for Brazil, Fajnzylver (2001) estimates similar effects on earnings for registered (formal) and unregistered (informal) workers, running through the wage distribution. Unemployment effects are also important and tend to be stronger for informal workers (elasticities going from -.35 to -.25) than for formal workers (-.16 to -.09). Maloney and Nuñez (2004) estimate kernel distributions for different Latin American countries, finding that in virtually all countries considered there is some influence on the informal sector. In Brazil, Mexico, Argentina and Paraguay the influence of the minimum wage seems far stronger in the informal than in the formal sector. Thus, they conclude that the minimum wage is an important “benchmark” for establishing ‘fair’ pay. In sum, available evidence clearly indicates that in Latin America minimum wage effects go beyond the formal sector of the economy.

Conceptually, in a context of widespread non-compliance with labor regulations, a minimum wage could still have an effect if it provides useful information to market agents, who subsequently adjust current wages. On this respect, one interesting aspect is that while Card and Krueger (1995) use this idea to explain their unorthodox result of zero to positive employment effects, in the case of evidence from Latin America what is obtained is substantially negative effects on employment. Thus, whereas for the United States one may argue, as Card and Krueger have, that the minimum wage has an efficiency-enhancing effect, in Latin America if there is any such effect, it is not sufficient to prevent employment from falling. The alternative explanation proposed, which necessarily departs from efficiency considerations and moves into the ideological realm, is that economic agents attach a notion of fairness to legal minimum wages (Maloney and Nuñez, 2004). Were this so, one would expect that minimum wages may be binding even within the informal sector.

In this case, in addition to being a formal institution, official minimum wages, would qualify as an ‘informal institution’ in the sense of Douglass

North (North, 1990: 4). The preservation of this institution would require that agents perceive the minimum wage as legitimate and reasonable, and internalize adjustments in its level as part of a normal labor relation. This, in turn, suggests several conditions should be met:

- There must be a validated tradition of minimum wage regulation.
- Minimum wage adjustments must occur in regular predictable intervals (even if the decided adjustment equals zero).
- The adjustment process must be institutionalized, that is, there should be a legitimate political agency (or set of agencies) in charge of analyzing and deciding on the adjustment margins.

From this perspective, compliance with minimum wage legislation is endogenous to both the minimum wage level, a point already made by Freeman (1993), among others, and to the institutional features of its implementation. Consequently, local conditions in which the policy is implemented are relevant and the question of minimum wage effects in the informal sector is thus an empirical one. Peru provides an interesting, as well as intriguing, setting to test for these effects for several reasons. First, it has a very large urban informal sector even for Latin American standards: less than one-third of private sector wage earners enjoy social security coverage (Jaramillo, 2003). Second, minimum wage regulation in the last decade has been erratic and unpredictable, in sharp contrast with other Latin American countries for which analysis has been done. Finally, these features provide confidence in that changes in the legal minimum have had an unanticipated character, which is more difficult to argue in the case of other countries.

### **3. Minimum wages in Peru**

#### **3.1 Institutional features**

Minimum wages were used in Peru for the first time in 1914 and since then they have been a standard part of labor policy. Since 1985 there is one single minimum wage that applies at the national level to all wage earners in the private sector. The Ministry of Labor was in charge of determining the minimum wage level until 2001, when the National Work Council (Consejo Nacional del Trabajo – CNT)), a tripartite forum, was established. The law that created the CNT gave it the power to set and adjust minimum wage levels, but so far it has not used it. In practice, minimum wage setting and readjusting has

been a decision of the president. In fact, the last minimum wage hike was announced by the president and then sent to the CNT for approval. No agreement was reached there and the Ministry of Labor passed the law anyway. This is consistent with the recent history of minimum wage adjustments: there is no institutional mechanism at work to periodically revise the minimum wage level.

The hyperinflation period in the late eighties was a watershed for minimum wage policies. In the last years of the 1980s hyperinflation made minimum wage revisions very frequent - monthly and even bi-weekly adjustments - were the rule. All the same, the legal minimum wage, as well as mean wages, declined dramatically. With the reduction of inflation rates and the set in of structural adjustment, regular revisions were abandoned. After 1991 and until the end of the first of Fujimori's presidential periods there were only two readjustments, even when annual inflation was still at the two-digit level throughout. This meant that the real value of the minimum wage tended to decline until the mid-nineties.

When many analysts of the Peruvian labor market thought that the minimum wage was no longer part of the policy instruments, it made an extraordinary comeback during Fujimori's second period. In a period of less than one year four increases were enacted, coinciding with a period of rapidly declining support for Fujimori's regime. These increases amounted to a 161 percent hike in real terms in a lapse of twelve months. After this hectic season, however, no additional hikes were implemented until March 2000, when in the middle of the presidential race, another increase came. After that there has been only one additional increase by Toledo's administration, in September 2003. This recent history of minimum wage policy in Peru serves to illustrate the most salient features of the institutional environment in which this policy is executed. These features have tended to undermine the credibility and legitimacy of the policy instrument and may well account for the seemingly odd result in the light of the experience of other Latin American countries, of no 'lighthouse' effect.

In effect, Peru has not pursued a minimum wage policy in a consistent manner. This is reflected in at least two aspects of policy implementation. First, adjustments in the level of the minimum wage have been sporadic and followed no clear time pattern after the hyperinflation period. Thus, most increases during the last decade (four out of six) have concentrated in the lapse of one year (October 1996 to September 1997). BID (2004) puts Peru among



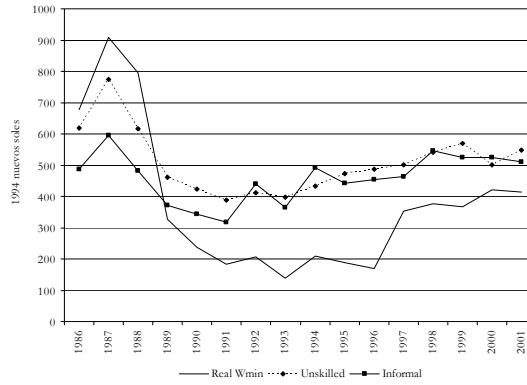
the three countries in the region with the greatest minimum wage volatility. In addition, adjustments have tended to come at politically sensitive periods, and thus have tended to be interpreted by public opinion as political gestures rather than serious policy decisions. Second, there has been no attempt to institutionalize a procedure to revise minimum wage levels periodically. Allocating power to do so to the CNT so far has been a hollow gesture, since it is presidential will that still dominates decisions in this regard, as the process for the last adjustment clearly indicates. As a result of these features, minimum wage regulation has been a highly erratic policy and, thus, quite unpredictable.

### **3.2 Recent trends in the minimum wage**

As shown in Figure 1, the value of the minimum wage reached its peak in 1987, after which it fell drastically, along with wages in general, until the beginning of the 1990s. This is related to the process of hyperinflation. From 1991 to 1996, its value has tended to decline, following a pattern of inflation erosion with two discrete increases in 1992 and 1994 (see Figure 2). In a twelve-month period between 1996 and 1997, however, it increased dramatically, nearing the level of average pay for both informal and unskilled workers. A new increase was enacted in March 2000, as the presidential election approached. Three years later the current government made a 12% increase whereby the wage floor reached its current value of 460 new soles.

Adjustments to the minimum wage in the nineties were different from those in the previous decade in that they were not part of a salary indexation policy. Thus, they were not associated with changes in objective indicators (like inflation), and they have been greater than accumulated inflation. There has not been any systematic relation with GDP growth either. Likewise, although the minimum wage shows a positive relationship with mean salaries for Metropolitan Lima, its increments in the past decade have been much larger than the growth in earnings of unskilled labor, which are an appropriate point of reference, since this sector is potentially the most affected by this type of regulation (see Figure 1). The increase has also surpassed that of earnings in the informal sector, which should be a benchmark in the determination of an appropriate level of minimum wage that does not reduce employment formality.

**Figure 1: Metropolitan Lima: Evolution of minimum wage and real average. Monthly earnings of unskilled and informal workers (1994 nuevos soles)**



Note: Calculated for full time salaried workers (35 hours of work per week or more). Unskilled workers are those with less than 9 years of formal education. Informal workers are those working in private firms who have no health insurance, no contract, do not receive payment invoices and are not affiliated with a union.  
Source: INEI, National Household Surveys, 1986-2001.

**Figure 2: Metropolitan Lima: Ratio minimum / average wage, and percentage of non compliance with the minimum wage\***



Note: Calculated for full time salaried workers in the private sector (35 hours or more per week).  
Source: INEI, National Household Surveys, 1986-2001.

In this way, since 1996 the ratio of minimum to mean wage has consistently increased, as Figure 2 illustrates. Also, a positive correlation between this ratio and the level of non-compliance is observed. Thus, during the past decade the percentage of salaried workers that earned less than the minimum has maintained an increasing tendency. At the beginning of the present decade, approximately 40% of full time salaried workers in Metropolitan Lima, the highest productivity region of the country, earned less than minimum wage.

How do these indicators compare with those of other countries in the region? Using the ratio of the minimum wage to the median salary, BID (2004) places Peru among the five countries with the highest minimum wage levels, only below Nicaragua, Costa Rica, Colombia and Venezuela. In addition, Peru stands out in Latin America as far as non-compliance with minimum wage regulations goes. Data from the same source shows that at the end of the nineties, with 24% of workers between 26 and 40 years, who work no less than 30 hours per week, Peru is among the countries with the highest levels of non-compliance, only below Nicaragua and Colombia<sup>5</sup>. However, if we focus on private wage earners, as shown in Figure 2, the number for Metropolitan Lima is closer to 40 percent. In some countries, as diverse as Argentina, Bolivia and Mexico, this index is lower than 5%. The level of non-compliance is associated with the minimum wage position related to average salary, but is also linked with the general institutional environment. Chile, for example, has a ratio of minimum wage to average salary only slightly below that of Peru, but its level of non-compliance is only 7%.

From this overview of the minimum wage in Peru, one can conclude that, in relation to average or median salary in the economy, it is above the average for Latin America, closer to the higher-level countries than to the lower-level ones. Non-compliance is among the highest in the region as well. The effects on worker earnings and employment are related to both characteristics; however, it is not clear what type of effects we should expect. On the one hand, these features are similar to those of Colombia, so one may be inclined to expect that the same type of effects prevail. On the other hand, Peru is very different from Colombia in the way minimum wage policies are implemented.

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<sup>5</sup> BID, 2004: table 7.2. Note that workers younger than 26 are excluded, though they have legally the same right to receive no less than the minimum wage, and it is potentially the main affected group.

In the following sections, we deal with the empirical estimation of these effects.

#### 4. Methodological approach

In order to evaluate the effects of minimum wage increases on earnings and employment we use two approaches that are well-known in the literature. First, we estimate kernel density functions for the distribution of workers' earnings, around different inflexion points in the recent evolution of minimum wages, starting in 1996. This graphic analysis allows us to illustrate how the minimum wage has moved towards the center of the earnings distribution for the informal sector, while providing some intuition on the role of the minimum wage in the earnings distribution as well as on the effects of minimum wage changes. Second, we use panel data to carry out an econometric analysis in order to estimate effects of a minimum wage shock on both wages and the probability of retaining employment. The identification strategy rests on comparing quarterly transitions affected by a minimum wage increase and those not affected.

#### 5. Effects on the distribution of real monthly earnings

In this section we evaluate changes in earnings dispersion through the estimation of *kernel* density functions. The *kernel* estimation process in its basic form consists of disseminating the observed value of a point in its own neighborhood, through a function that is usually the *Gaussian* or the *Epanechnikov*. In this way, the kernel estimation of the density function that generates data is constructed like a weighted sum of the calculated values with a K function in the following manner:

$$\hat{f}_K = (nh)^{-1} \sum_{i=1}^n K \left[ \frac{x - X_i}{h} \right] \quad (1)$$

Where the chosen *kernel* function in this case is that of *Parzen*:

$$K_{[z]} = \begin{cases} \frac{4}{3\sqrt{5}} (1 - .2z^2) & \text{if } |z| < \sqrt{5} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

We have used the same bandwidth for all the estimated distributions. The exact bandwidth ( $h$ ), 0.15, was selected in order to identify the multiple modes in the distribution of monthly income data. Also, optimal bandwidths incorporated in the statistical package tend to over smooth the observed distribution.

Graphic analysis allows us to look at minimum wage effects in two different ways. First, we can focus on the role of the minimum wage in the earnings distribution in the long run, and, second, we can examine how the distribution changes (or not) when the legal minimum changes. On the first front, we look at earnings distributions at least two years after the most recent change in the wage floor. These are presented in Figure 3. We start with a minimum wage set at a low level, about 40 percent of average earnings in the informal sector, in 1996 (top panel). At this point, the minimum wage is largely non-binding in the formal sector, so no effect is apparent on the earnings distribution of that sector. In the informal sector distribution, however, one can perceive a jump around the minimum wage level, suggesting that at that point it may have been a relevant benchmark for this sector.

In 1999, with the floor at a significantly higher level -1.4 times in real terms-, non-compliance has increased in both formal and informal sectors. It is difficult to identify an effect on the distribution in the informal sector, because even though a spike crosses the minimum wage line, it is not clear whether the distribution would look any different without a legal minimum wage. In the formal sector there is a small cliff, but the shape of the distribution does not seem to be dramatically affected by the minimum. Finally, in 2003, 3.5 years after the previous increase, the distributions for both formal and informal sectors show steep cliffs around the minimum wage level, suggesting a role for the minimum wage in shaping the distributions.

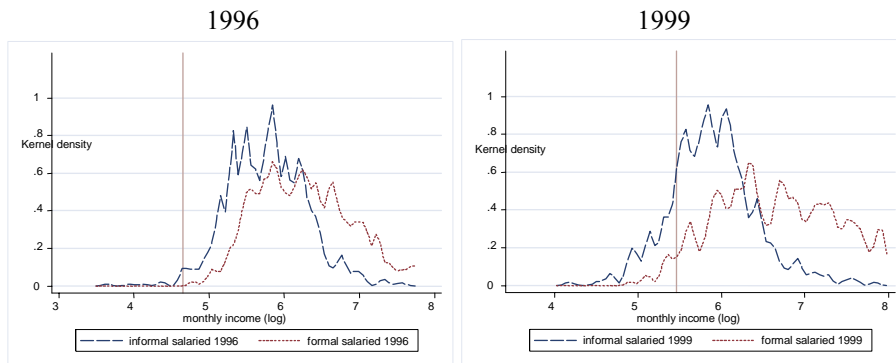
Summing up, when the minimum wage is at a low level, it seems to affect primarily the distribution of earnings in the informal sector. It is also fair to say that when the minimum wage is binding, it has an effect on the distribution of monthly earnings of formal sector workers. Evidence seems somewhat less conclusive on whether there is an effect in the informal sector. However, considering that the data set is better for 2003, where the role of the minimum wage is clearer, one may conclude that there are long run effects in the informal sector as well.<sup>6</sup>

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<sup>6</sup> See Appendix for the size of the different data sets used.

Two additional points are worth noting. One, the graphs show very clearly how the minimum wage has shifted from far on the left to close to the center of the earnings distributions for the informal sector in a rather short period of time. Two, when comparing the distributions over time, it would seem that concentration has increased, as shown by the central mode reaching vertically beyond the 1.0 mark. This is also validated by the change in the coefficient of variation (standard deviation / mean), which moves from around 0.7 in 1997 to 0.55 in 2003.

**Figure 3: Kernel distributions of private sector workers monthly earnings, Metropolitan Lima**



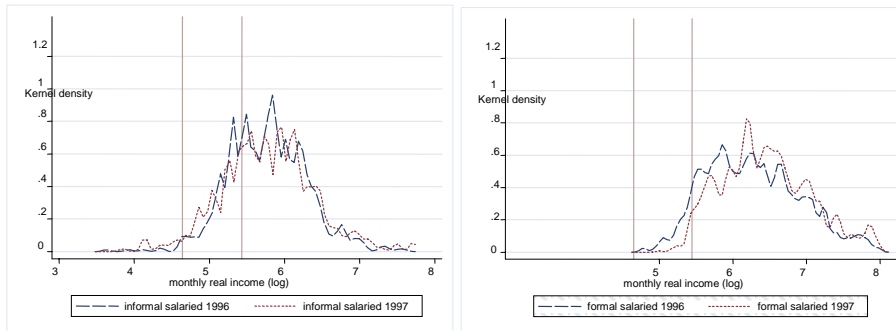
Note: Vertical lines represent the current minimum wage  
Source: ENAHO 1996-III.

Graphic analysis can also provide some intuition as to what happens in the short run when the minimum wage level changes. Figure 4 presents earnings distributions before and after a change in the legal minimum wage. Looking at the top panel, the 1996-1997 hikes, which moved the minimum from a low, largely non binding, to a rather high level, do not seem to have any clear effect on the informal sector distribution. Contrastingly, in the formal sector the distribution moves to the right and shows a cliff around the new level. The 2003 increase produced a move to the right in both sector distributions, but more pronounced in the case of the formal sector. In the informal sector the slope of the cliff close to the initial minimum wage line declines, moving to the right, but not much change can be detected around the new minimum wage line and further up the distribution. In the case of the formal sector, the cliff

around the initial minimum wage level moves to the right in a similar fashion, but in this case, a greater concentration around the new minimum can be identified. In sum, it seems that the formal sector earnings distribution adjusts in the short run to changes in the minimum wage, while the informal sector does not.

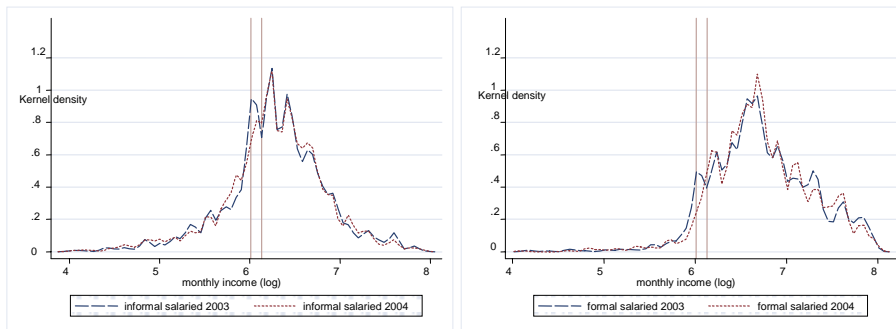
**Figure 4: Short run changes in earnings distributions following a minimum wage increase, Metropolitan Lima**

**1996-1997**



Source: ENAHO III, 1996.

**2003-2004**



Note: Vertical lines represent the current minimum wage

Source: INEI, EPE 2003-II

Graphic analysis seems to take us only so far. In order to more rigorously establish effects of the minimum wage we need to proceed with econometric analysis.

### **6. Effects on earnings and employment: econometric analysis**

We use econometric analysis to estimate the effect of a change in the minimum wage on both monthly earnings and the probability of staying employed. The analysis focuses on three groups in the labor market: wage earners in the private formal sector, wage earners in the private informal sector, and independent workers.

We follow Neumark et al. (2000) in controlling for the worker's position in the earnings distribution. However, we depart from their empirical setting in several respects. One, we estimate short run effects only. This is a limitation imposed by the data, since we only have quarterly panels. The fact that turnover rates are typically higher and tenure lower in developing countries, and more so among workers earning around or below the minimum wage, suggests that this is not a serious limitation, although, of course, it would be desirable to test effects over a longer period of time. Also, our data cover the period 2002-2004, during which only one minimum wage increase was observed. In addition, the issue of overlapping effects of successive changes in the minimum wage is not relevant since the existing distance between the last increment of the minimum wage and the previous one is more than three years. Thus, we do not incorporate lagged effects in our specification.

Finally, since quarterly inflation rates are extremely low during the period of analysis and we have only one change in the normative minimum wage (in September of 2003), the inclusion of the real variance of minimum wage as regressor would represent above all the price shocks that are not associated with seasonality or activity level (since the regression controls for both) and brings with it the risk of erroneously attributing effects to the change in the minimum wage or possible overestimation.

The identification strategy consists of comparing "regular" worker transitions with others shocked by a minimum wage increase. The manner in which effects of a change in the legal wage floor are evaluated is by generating a dummy that identifies whether an individual worker that pertains to a determined income group faced a change in minimum wage in the period between observations. The following specifications are used:



$$\left[ \frac{w_{i,2} - w_{i,1}}{w_{i,1}} \right] = \beta_o + \beta_1 X_{i,1} + \beta_2 Z_{i,1} + \sum_{q=2}^4 \phi_q T_i + \beta_2 Y_{i,2} + \sum_j \theta_j \cdot D_{i,j}(w_1; mw_1) + \sum_j \gamma_j \cdot D_{i,j}(w_1; mw_1) \cdot E_i + \sum_j \pi_j \left( \frac{w_{i,1}}{mw_1} \right) \cdot D_{i,j}(w_1; mw_1) + \varepsilon_i \quad (3)$$

for changes in monthly earnings from primary occupation, and

$$\Delta \Pr[o_2 = 1 | o_1 = 1] = \beta_o + \beta_1 X_{i,1} + \beta_2 Z_{i,1} + \sum_{q=2}^4 \phi_q T_i + \beta_2 Y_{i,2} + \sum_j \theta_j \cdot D_{i,j}(w_1; mw_1) + \sum_j \gamma_j \cdot D_{i,j}(w_1; mw_1) \cdot E_i + \sum_j \pi_j \left( \frac{w_{i,1}}{mw_1} \right) \cdot D_{i,j}(w_1; mw_1) + \varepsilon_i \quad (4)$$

for changes in the probability of retaining employed status.

X is a vector of individual characteristics (sex, age, education level), which capture the distinct occupational vulnerability or volatility of income between groups of individuals. The variable Z includes individual characteristics related to labor activity (number of workers in the firm, job tenure, etc.). T and Y control for changes in the economic environment. T consists of a group of dummy variables that indicates whether the observations of each individual correspond to the first and second trimester, second and third, etc. This variable captures the effect of the presumed seasonality present in the data. Y indicates variation in the activity level of the relevant sector for each individual. The indicator is the quarterly variation in GDP in the sector in which the individual worked during the first observation. Dj is a set of dummy variables that identify the earnings range in relation to the minimum wage in the initial period (0.25-0.6, 0.6-1.2, 1.2-1.5, etc.). The full set of ranges considered is in the Appendix. The 2-2.5 range is left out of the regression to avoid perfect multicollinearity;  $w_{i,1}/mw_1$  is the labor income to minimum wage ratio for each individual. Finally, E identifies the individuals that confront the minimum wage shock, that is, those that were observed both before and after the minimum wage change.

While  $\theta_j$  captures the effects of belonging to a particular range in the distribution of labor income, the coefficient of the interaction term between variables Dj and E,  $\gamma_j$ , informs us about the effect attributable to the minimum wage change on a particular group in the earnings distribution. This is the coefficient of central interest to our research.

## Data

Data used in this paper come from the Metropolitan Lima Permanent Employment Survey (EPE). The survey covers 49 districts in the provinces of Lima and Callao. The unit of observation is the dwelling and its occupants with habitual residency, excluding those that are members of the armed forces and collective households. The design structure of the EPE survey is quarterly, consisting of three consecutive monthly survey rounds. It includes a rotating panel. In this way, each selected household is interviewed twice a year in two consecutive quarters. The sample is renovated in such a way that between one mobile quarter and the next 17% of the total sample is new.

The size of the monthly sample is approximately 1600 dwellings or households, within which 6500 individuals are interviewed on average. From this set of individuals the panel is constructed, 2100 (about a third) making up the panel portion of the sample. For this study, 25 of these panels have been used, adding up to a sample of 32410 employed individuals observed between March 2002 and December 2004.<sup>7</sup> These 25 panels are those started in 2002, from March until December, and whose second observations went from June 2002 until February 2003, respectively, plus, in a similar manner, the nine panels started in 2003 from March to December, whose second observation went from June 2003 to February 2004, respectively, plus, finally, the seven panels started in 2004 from March to September, whose second observation went from June 2004 to December 2004. Note that there are nine panels' beginnings each year, since in March of each year the sample is completely renewed. The distribution of the sample by earnings ranges in relation to the minimum wage is presented in the Appendix, tables A2 and A3.

## 7. Results

### *Earnings*

Table 1 summarizes effects on the most likely affected groups. Full regression results are in the Appendix (first four columns of table A5). Two are the most striking results. First, effects are the strongest at the bottom range of the earnings distribution. In effect, it is on workers earning up to 0.6 of the

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<sup>7</sup> The survey was implemented in March 2001 with a panel that observed individuals for four consecutive quarters on that year. However, the absence of crucial data for our multivariate analysis, like the educational level of the individuals, made it necessary to exclude this segment of the panel for the purposes of this study.

minimum wage that impact is most significant. The direction of the effect runs counter for wage earners (+) and independent workers (-), however. Coefficients are large: a 12 percent variation in the minimum wage is associated with increases greater than 40 percent on informal salaried workers within this earnings range. Very few workers in the formal sector belong in this earnings range, so no significant effect is found for them. This also explains similar coefficients for the informal sector wage earners and for wage labor in the private sector generally. Effect on independent workers is also large, the implicit elasticity being around 1.5 in absolute value, but weakly significant.

**Table 1: Effects of the 12% increase of the minimum wage on monthly earnings (from regression output)**

	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independent
Affect].25 - .6]*MW1	0.442 (4.27)***	0.493 (4.27)***		-0.194 (1.70)*
Affect].6 - .95]*MW1	0.020 (0.32)	0.043 (0.60)		-0.076 (0.92)
Affect].95 - 1.2]*MW1	0.015 (0.32)	-0.040 (0.67)	0.164 (2.03)**	-0.018 (0.18)
Affect]1.2 - 1.5]*MW1	-0.044 (1.09)	-0.020 (0.34)	-0.077 (1.38)	-0.033 (0.36)
Affect]1.5 - 2]*MW1	-0.029 (0.80)	-0.032 (0.55)	-0.029 (0.63)	0.040 (0.36)
Affect]2 - 2.5]*MW1	-0.040 (0.84)	0.069 (0.83)	-0.111 (1.97)**	-0.223 (1.49)

Note: Absolute value of t statistics in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

Second, effects on those caught between the previous and new minimum wage levels are only significant in the formal sector. The coefficient is more reasonable, but still quite high, the implicit elasticity above 1. No effects are found on informal sector wage earners in this earnings range.

One concern with these results relates to the large coefficients for workers at the bottom of the wage distribution other than formal salaried. Were these

reflecting “true” elasticities, we could have at hands a powerful policy tool to redistribute income towards low-wage informal workers, though at the expense of similar low-income independent workers. One possible source of problems, however, may have to do with the earnings data, which might be producing a problem of regression towards the mean. This occurs because baseline values are negatively correlated with change, as individuals with low earnings will naturally improve theirs more than those with high earnings. The general statistical phenomenon has been well documented in bio-medical research, but paid much less attention in economic analyses.<sup>8</sup> Although in our case it is to some extent limited by the presence of a control group, there may be chance imbalances at baseline that are not controlled for.

We tested the ‘regression to the mean’ hypothesis through the following procedure. First, we ran a series of regressions “faking” minimum wage increases for every quarterly panel available in our data set. The conclusion is that regardless of the quarterly panel chosen as “affected” by the fake shock, significant coefficients for the group earning below 60% of the minimum wage were all very large. This is a good indication of a problem of regression to the mean. In order to confirm this finding, we used a different control variable, which is not suspect of generating regression to the mean, to proxy position in the earnings distribution. The obvious selection is education. Results of this exercise are presented in the Appendix (Table A6). Coefficients turn out much smaller, particularly for those groups that presumably compose the lower segments of the wage distribution, that is, individuals with complete secondary or less. This confirms the evidence of a regression to the mean problem for the bottom section of the distribution. The next step is, of course, to correct it.

In order to correct this problem we follow the analysis of covariance method (Vickers and Altman 2001, Barnett et al. 2005). Thus, we modify our specification as follows:

$$\begin{aligned} \log(w_{i,2}) = & \beta_o + \alpha \cdot \log(w_{i,1}) + \beta_1 X_{i,1} + \beta_2 Z_{i,1} + \sum_{q=2}^4 \phi_q T_i + \beta_2 Y_{i,2} + \sum_j \theta_j \cdot D_{i,j}(w_1; mw_1) + \sum_j \gamma_j \cdot D_{i,j}(w_1; mw_1) \cdot E_i \\ & + \sum_j \pi_j \left( \frac{w_{i,1}}{mw_1} \right) \cdot D_{i,j}(w_1; mw_1) + \varepsilon_i \end{aligned} \quad (5)$$

<sup>8</sup> In effect, it is typical in clinical trials, where a measurable variable of interest, such as blood pressure, cholesterol, weight or blood-sugar levels, can be ranked and analysis of the impact of treatment on the extremes of the distribution is important. See Davies (1976), Barnett et al. (2005), Bland and Altman (1994, 1994a), *inter alia*. On the economics front, see Friedman (1992).

Results are presented in the following Table 2 and are consistent with those obtained with our prior specification.<sup>9</sup> Statistical significance declines somewhat and, as expected, the coefficients are smaller. Implicit elasticities are around 2 for wage earners at the bottom of the distribution and 1 for those trapped between minima. The significant effect on independent workers at the bottom vanishes.

**Table 2: Effects of 12% increase of the minimum wage on monthly earnings, covariance analysis (from regression output)**

	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independent
Affect].25 - .6]*MW1	0.238 (2.45)**	0.271 (2.42)**		-0.128 (1.33)
Affect].6 - .95]*MW1	0.036 (0.60)	0.054 (0.77)		-0.039 (0.56)
Affect].95 - 1.2]*MW1	0.010 (0.22)	-0.035 (0.60)	0.127 (1.77)*	-0.011 (0.12)
Affect]1.2 - 1.5]*MW1	-0.035 (0.91)	-0.023 (0.40)	-0.055 (1.11)	-0.013 (0.18)
Affect]1.5 - 2]*MW1	-0.014 (0.40)	-0.010 (0.17)	-0.015 (0.37)	0.070 (0.75)
Affect]2 - 2.5]*MW1	-0.000 (0.00)	0.096 (1.19)	-0.062 (1.24)	-0.196 (1.56)

Notes: Absolute value of t statistics in parentheses. \* Significant at 10%; \*\*significant at 5%; \*\*\* significant at 1%.

*Probability of staying employed*

Table 3 sets out estimated discrete effects on the probability of retaining employed status. These were calculated from the regression coefficients, considering the individual’s earnings range and the rest of variables at sample means.

Coefficients are uniformly negative, though most are not statistically significant. We find weakly significant effects on informal salaried workers earning below 0.6 of the initial minimum wage. The coefficient is large,

<sup>9</sup> Table A5 in the Appendix presents both regressions, with and without correcting for regression to the mean for the purpose of comparison.

implying an elasticity of around 1 in absolute value. For those ‘trapped’ between the previous and the new minimum wage levels effects are also significant, but, contrastingly, these are driven by wage earners in the formal sector (the effect on the informal sector is significant only at the 14% level). Consequently, the implicit elasticities are similar for total salaried and for formal workers, -0.75. Effects are similar in size for formal workers earning up to 2 minimum wages as well as for informal workers just above the minimum. For the latter, both significance and the size of the effect weaken as we move to the 1.5-2 minima earnings range.

Independent workers earning below 90 percent of the minimum wage are also negatively affected in their employment prospects by the increase. The size of the effect is similar to that for wage earners in the lower range of the distribution.

**Table 3: Discrete effects on the probability of retaining employed status**  
(calculated from regression coefficients at sample means)

Income Range/ RMV	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
]25-.6]	-0.106**	-0.120*		-0.104*
]6-.95]	-0.006	-0.024		-0.075**
]95-1.2]	-0.102**	-0.081	-0.090**	-0.106
]1.2-1.5]	-0.083***	-0.091***	-0.096**	-0.029
]1.5-2]	-0.068***	-0.054*	-0.096**	-0.032*
]2-2.5]	-0.035*	-0.043	-0.053	-0.073
]2.5-3]	-0.054		-0.086	

Notes: Asterisks indicate statistical significance: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

## 8. Discussion

Our results are somewhat at odds with those of studies for other Latin American countries using similar methodologies. Specifically, we fail to find either significant effects throughout the wage distribution (numeraire effects) or strong effects in the informal sector (“lighthouse” effects), as Fejnzyilver (2001) or Maloney and Nuñez (2004) found for Brazil and Colombia,

respectively. Effects on labor earnings are significant only at the bottom of the distribution, where informal workers dominate, and (weakly) for formal workers trapped between the old and the new minimum wage levels. Unemployment effects are significant only for total wage labor and those in the informal sector (weakly) with earnings below 0.6 of the minimum wage, but significant for those in the ranges between 0.95 and 2 minimum wages (as of the initial period). Among those trapped between minima, effects are significant only on the formal salaried, but in the two following ranges there are also effects on the informal, though weak for those in the 1.5-2 range. Independent workers below the minimum also suffer unemployment effects, particularly those in the .6-.95 range.

Thus, we find little support for lighthouse effects in Peru in the short run. This should not be all that surprising, since theoretically it is not clear why such effects should be strong, particularly in a sector that is by definition outside the reach of labor regulations. Card and Krueger (1995) have stressed the informational qualities of the minimum wage to account for zero or positive employment effects. However, in Latin America employment effects tend to be negative. The alternative explanation proposed is that notions of 'fair pay' are attached to the minimum wage (Maloney and Nuñez, 2004). If this is the case, it is likely that perceptions of the minimum wage may vary with local conditions, generally, and with the features of minimum wage policy, specifically. In this direction, when comparing Peru with Colombia and Brazil, one finds contrasting institutional features in regards to minimum wage policy. While in the latter countries this policy has been consistently pursued, in Peru its recent course, after the hyperinflation experience, has been rather erratic. Large increases in the wage floor have been followed by periods with no adjustments. Further, there is no institutional mechanism at work to discuss changes, as these have come as momentous presidential decisions. Under these conditions any signaling effects have to be weak, particularly in the short run.

An additional aspect where our results somewhat depart from others is in the size of responses. This led us to suspect and subsequently confirm a problem of regression towards the mean. Even after correcting for this effect, our coefficients tend to be rather large where significant, with implicit earnings elasticities around 2 for those at the bottom of the distribution, which compare with 1.7 for Colombia and 1.4 for Brazil. Also, employment elasticities go from 0.5 to 0.75 in absolute value. One possible explanation for this, in line with our previous argument, is that if agents have internalized the

rule (as they seem to have done in Brazil or Colombia), they must come to expect a periodic variation in the official minimum wage. In effect, in both of these countries, minimum wage levels are adjusted on a yearly basis. If employers anticipate the change, or a portion of it, effects should be smaller, since adjustments may have been made in advance. An unanticipated shock is likely to have a larger effect.

One final important point is related to the effect on low-income independent workers, as they do not obtain any gain in earnings, yet suffer unemployment consequences. In a general equilibrium model, lower earnings may be related to increased competition deriving from the unemployment effects in the wage earning sectors if displaced workers move to the independent sector. In turn, the reduction in relative earnings of independent workers may encourage flows out of the sector into either job searching in the salaried sector or inactivity. At this point, however, we cannot test this hypothesis. More generally, our results raise the question of the type of interactions between the formal and informal wage labor, and the independent sectors. The study of transitions between these sectors under different settings seems like a promising avenue to better understand labor market adjustments to minimum wage as well as other types of shocks when compliance is both incomplete and endogenous.

## **9. Conclusions**

Within a context of erratic management, the statutory minimum wage in Peru has gone from low, largely non-binding levels to very high levels in a rather short period of time. The kernel distributions show very clearly how the minimum wage has shifted from far on the left to close to the center of the earnings distributions. Within this context, the evidence presented on minimum wage effects in the formal and informal sector is mixed. On the one hand, graphic analysis suggests that when the minimum wage is at a low level, it affects primarily the distribution of monthly earnings in the informal sector. When the minimum wage is binding, however, it has an effect on the distribution of earnings of formal sector workers. Evidence seems somewhat less conclusive on whether it plays a role in the informal sector distribution, however, though on balance we are inclined to conclude that there is indeed some effect.



On the other hand, econometric analysis indicates that short run effects of minimum wage shocks are different in the formal and informal sectors. In the informal sector earnings are affected only at the bottom of the distribution. In the formal sector, we identify significant effects only on those caught between old and new minima. Unemployment effects among informal workers earning below the new minimum wage are only weakly significant. Workers earning in the range of 1.2 to 2 minimum wages in both formal and informal sectors are affected, but those trapped are affected only if in the formal sector. Independent workers earning below the minimum are also affected. Thus, we find little evidence of either numeraire or lighthouse effects in the short run. This, of course, does not mean that informal sector workers are untouched by minimum wage. Clearly, some of them are, even in the short run. Thus, though the minimum wage is not a lighthouse in Peru, it nonetheless provides some signaling in the long run.

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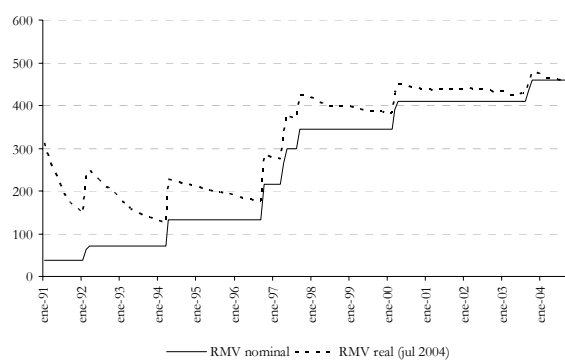
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## Appendix

**Figure A1: Statutory Minimum Wages, 1991-2004**  
(nuevos soles)**Table A1: Data sets used in Kernel estimates**

Year	Data set	Number of observations
1996	ENAHO; quarter III	1467
1997	ENAHO; quarter III	1028
1999	ENAHO; quarter III	727
2000	ENAHO; quarter III	720
2003	EPE; quarter II	3294
2004	EPE; quarter II	3418

**Table A2: Sample for earnings variation regression**

	Total private salaried		Informal salaried		Formal salaried		Independents	
	Not affc	Affected	Not affc	Affected	Not affc	Affected	Not affc	Affected
2 ] .25 - .6]*MW1	269	27	236	24	33	3	367	40
3 ] .6 - .95]*MW1	584	79	520	70	64	9	462	83
4 ] .95 - 1.2]*MW1	1034	148	733	105	301	43	389	52
5 ] 1.2 - 1.5]*MW1	1601	207	992	114	609	93	485	67
6 ] 1.5 - 2]*MW1	1704	244	823	118	881	126	348	44
7 ] 2 - 2.5]*MW1	918	137	390	51	528	86	189	24
8 ] 2.5 - 3]*MW1	477	65	181	23	296	42	66	9
9 ] 3 - 4]*MW1	510	52	135	13	375	39	73	5
10 ] 4 - 5]*MW1	263	33	54	3	209	30	35	5
11 ] 5 - +]*MW1	669	93	98	5	571	88	64	6
Total	8029	1085	4162	526	3867	559	2478	335

**Table A3: Sample for probability of retaining employment regression**

	Total private salaried		Informal salaried		Formal salaried		Independents	
	Not affc	Affected	Not affc	Affected	Not affc	Affected	Not affc	Affected
2 ] .25 - .6]*MW1	444	57	391	50	53	7	572	64
3 ] .6 - .95]*MW1	901	116	804	107	97	9	678	119
4 ] .95 - 1.2]*MW1	1473	218	1,080	159	393	59	565	76
5 ] 1.2 - 1.5]*MW1	2074	277	1,313	164	761	113	764	107
6 ] 1.5 - 2]*MW1	2198	321	1,131	168	1,067	153	548	73
7 ] 2 - 2.5]*MW1	1199	179	531	73	668	106	293	35
8 ] 2.5 - 3]*MW1	626	95	250	39	376	56	122	17
9 ] 3 - 4]*MW1	661	81	190	30	471	51	103	10
10 ] 4 - 5]*MW1	338	38	86	5	252	33	50	5
11 ] 5 - +]*MW1	811	104	123	7	688	97	89	8
Total	10,725	1,486	5,899	802	4,826	684	3,784	514

**Table A4: Probability of retaining employment regression output**

Dependent variable: Probability of retaining employment [Probit]	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
] .25-.6]*MW1	-0.406	-0.725	-0.294	0.193
] .6-.95]*MW1	-0.406	-0.753	-0.208	0.615
] .95-1.2]*MW1	-1.010	-1.535	0.333	-0.442
] 1.2-1.5]*MW1	-0.153	-0.371	0.125	0.355
] 1.5-2]*MW1	-0.376	-0.500	-0.082	1.227
] 2.5-3]*MW1	-0.997	-1.416	-0.587	-0.083
] 3-4]*MW1	0.151	0.422	0.397	-0.226
] 4-5]*MW1	1.822	2.768	1.209	1.958
] 5-+]*MW1	0.001	-0.077	0.424	0.864
affect ] .25-.6]*MW1	-0.395**	-0.382*		-0.331*
affect ] .6-.95]*MW1	-0.028	-0.084		-0.346**
affect ] .95-1.2]*MW1	-0.272**	-0.203	-0.460**	-0.267
affect ] 1.2-1.5]*MW1	-0.397***	-0.391***	-0.404**	-0.115
affect ] 1.5-2]*MW1	-0.275***	-0.223*	-0.344**	-0.348*
affect ] 2-2.5]*MW1	-0.228*	-0.305	-0.215	-0.214
affect ] 2.5-3]*MW1	-0.147		-0.234	
affect ] 3-4]*MW1	-0.388**		-0.378	
affect ] 4-5]*MW1	0.125		0.497	
affect ] 5-+]*MW1	-0.050		-0.059	
Elementary complete	-0.030	-0.076	0.076	-0.048
Secondary complete	-0.028	-0.037	-0.050	-0.174*
Post-secondary complete	0.026	-0.032	0.033	-0.279***
Age	0.054***	0.056***	0.055***	0.038***
Age squared	-0.001***	-0.001***	-0.001***	-0.001***
6 - 49 workers	-0.031	-0.032	0.022	
50 + workers	0.086**	-0.036	0.201***	
Quarter I - II	0.292***	0.389***	0.137	-0.210**
Quarter II - III	0.092**	0.148***	0.023	-0.202**
Quarter III - IV	0.131***	0.162***	0.091	-0.094
Var% GDP, activ. t=1	0.065	-0.132	0.538**	0.036
at least 3 mths, current job	-0.423***	-0.387***	-0.547***	-0.444***
Female	-0.172***	-0.201***	-0.144***	-0.287***
w/MW*range].25-.6]	-0.038	-0.132	0.584	1.003*
w/MW*range].6-.95]	0.167	0.144	0.437	0.177
w/MW*range].95-1.2]	0.810*	0.939*	0.045	1.348*
w/MW*range]1.2-1.5]	0.144	0.029	0.291	0.251

**Table A.4 (continued)**

Dependent variable:	Private	Informal	Formal	Independents
Probability of retaining employment [Probit]	Salaried	Private Salaried	Private Salaried	
w/MW*range]1.5-2]	0.185	-0.001	0.343	-0.240
w/MW*range]2-2.5]	-0.019	-0.171	0.188	0.494
w/MW*range]2.5-3]	0.350	0.347	0.396	0.270
w/MW*range]3-4]	-0.067	-0.259	-0.008	0.341
w/MW*range]4-5]	-0.419	-0.767*	-0.154	-0.228
w/MW*range]5-+]	-0.003	-0.021	-0.001	-0.013
Constant	0.299	0.661	-0.268	0.110
Observations	12211	6701	5510	4298
Pseudo R2	0.06	0.06	0.05	0.05

Absolute value of z statistics in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.



**Table A5: Earnings variation regression outputs**

Dependent variable:	% variation in monthly earnings from primary source [Specification 1]						log income t=2 [Specification 2]			
	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents	Private Salaried	Formal Private Salaried	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
]25-6]*MW1	1.992 (8.69)***	1.714 (5.10)***	1.859 (4.48)***	2.478 (4.06)***	0.749 (2.79)***	0.517 (1.51)	0.772 (1.51)	0.772 (1.51)	0.517 (1.29)	0.581 (0.74)
]6-.95]*MW1	1.328 (5.81)***	0.975 (2.92)***	1.359 (2.92)***	1.880 (2.96)***	0.523 (2.19)**	0.400 (0.96)	0.400 (0.96)	0.400 (0.96)	0.362 (0.85)	0.815 (1.23)
]95-1.2]*MW1	1.005 (3.88)***	0.419 (1.12)	1.862 (4.74)***	1.546 (2.20)**	0.605 (2.41)**	0.191 (0.48)	0.191 (0.48)	0.191 (0.48)	1.310 (3.70)***	0.709 (1.10)
]1.2-1.5]*MW1	0.869 (3.90)***	0.340 (1.00)	1.311 (4.42)***	1.206 (1.82)*	0.484 (2.26)**	0.137 (0.39)	0.137 (0.39)	0.137 (0.39)	0.739 (2.77)***	0.841 (1.43)
]1.5-2]*MW1	0.625 (2.89)***	0.266 (0.78)	0.862 (3.17)***	0.915 (1.32)	0.374 (1.83)*	0.098 (0.29)	0.098 (0.29)	0.098 (0.29)	0.566 (2.34)**	0.518 (0.88)
]2.5-3]*MW1	0.200 (0.59)	-0.031 (0.05)	0.344 (0.84)	0.891 (0.72)	0.078 (0.24)	-0.292 (0.53)	-0.292 (0.53)	-0.292 (0.53)	0.273 (0.75)	1.280 (1.23)
]3-4]*MW1	0.465 (1.59)	-0.250 (0.44)	0.794 (2.42)**	1.041 (0.99)	0.220 (0.80)	-0.769 (1.38)	-0.769 (1.38)	-0.769 (1.38)	0.635 (2.17)**	1.474 (1.66)*
]4-5]*MW1	-0.318 (0.83)	-1.130 (1.42)	0.054 (0.13)	1.904 (1.11)	-0.365 (1.01)	-0.919 (1.17)	-0.919 (1.17)	-0.919 (1.17)	-0.094 (0.25)	1.907 (1.31)
]5-+]*MW1	0.296 (1.59)	-0.195 (0.62)	0.553 (2.43)**	0.519 (0.84)	0.287 (1.33)	-0.347 (0.82)	-0.347 (0.82)	-0.347 (0.82)	0.595 (2.52)**	1.056 (1.64)
affect ]25-6]*MW1	0.442 (4.27)***	0.493 (4.27)***		-0.194 (1.70)*	0.238 (2.45)**	0.271 (2.42)**	0.271 (2.42)**	0.271 (2.42)**		-0.128 (1.33)
affect ]6-.95]*MW1	0.020 (0.32)	0.043 (0.60)		-0.076 (0.92)	0.036 (0.60)	0.054 (0.77)	0.054 (0.77)	0.054 (0.77)		-0.039 (0.56)
affect ]95-1.2]*MW1	0.015 (0.32)	-0.040 (0.67)	0.164 (2.03)**	-0.018 (0.18)	0.010 (0.22)	-0.035 (0.60)	-0.035 (0.60)	-0.035 (0.60)	0.127 (1.77)*	-0.011 (0.12)

Table A5: Earnings variation regression outputs (cont.)

Dependent variable:	% variation in monthly earnings from primary source [Specification 1]						log income t=2 [Specification 2]					
	Private Salaried		Informal Salaried		Formal Salaried		Private Salaried		Informal Salaried		Formal Salaried	
affect [1.2-1.5]*MW1	-0.044 (1.09)	-0.029 (0.80)	-0.020 (0.34)	-0.077 (1.38)	-0.033 (0.36)	-0.035 (0.91)	-0.023 (0.40)	-0.055 (1.11)	-0.013 (0.18)			
affect [1.5-2]*MW1	-0.029 (0.80)	-0.040 (0.84)	-0.032 (0.55)	-0.029 (0.63)	0.040 (0.36)	-0.014 (0.40)	-0.010 (0.17)	-0.015 (0.37)	0.070 (0.75)			
affect [2-2.5]*MW1	-0.040 (0.84)	-0.039 (0.55)	0.069 (0.83)	-0.111 (1.97)**	-0.223 (1.49)	-0.000 (0.00)	0.096 (1.19)	-0.062 (1.24)	-0.196 (1.56)			
affect [2.5-3]*MW1	-0.039 (0.55)	-0.039 (0.84)	-0.071 (0.89)	-0.071 (0.89)		-0.031 (0.48)	-0.031 (0.48)	-0.065 (0.92)				
affect [3-4]*MW1	0.116 (1.53)	0.116 (1.53)	0.001 (0.02)	0.001 (0.02)		0.143 (2.02)**	0.143 (2.02)**	0.043 (0.60)				
affect [4-5]*MW1	-0.069 (0.73)	-0.069 (0.73)	-0.119 (1.28)	-0.119 (1.28)		-0.082 (0.92)	-0.082 (0.92)	-0.155 (1.88)*				
affect [5-+]*MW1	0.065 (1.15)	0.065 (1.15)	0.073 (1.33)	0.073 (1.33)		0.091 (1.70)*	0.091 (1.70)*	0.088 (1.83)*				
Elementary complete	0.109 (3.05)***	0.109 (3.05)***	0.109 (2.42)**	0.103 (1.62)	0.036 (0.74)	0.102 (3.04)***	0.096 (2.21)**	0.099 (1.75)*	0.053 (1.30)			
Secondary complete	0.180 (5.18)***	0.180 (5.18)***	0.181 (4.08)***	0.142 (2.34)**	0.141 (2.91)***	0.174 (5.37)***	0.172 (4.02)***	0.136 (2.53)**	0.147 (3.60)***			
Post-secondary complete	0.303 (8.44)***	0.303 (8.44)***	0.309 (6.44)***	0.247 (4.05)***	0.340 (6.07)***	0.286 (8.50)***	0.280 (6.03)***	0.232 (4.29)***	0.296 (6.28)***			
Age	0.019 (7.60)***	0.019 (7.60)***	0.022 (5.92)***	0.013 (3.54)***	0.022 (4.00)***	0.021 (8.79)***	0.022 (6.04)***	0.018 (5.67)***	0.022 (4.77)***			
Age squared	-0.000 (6.64)***	-0.000 (6.64)***	-0.000 (5.15)***	-0.000 (3.43)***	-0.000 (4.11)***	-0.000 (7.96)***	-0.000 (5.44)***	-0.000 (5.60)***	-0.000 (4.93)***			

**Table A5: Earnings variation regression outputs (cont.)**

Dependent variable:	% variation in monthly earnings from primary source [Specification 1]				log income t=2 [Specification 2]			
	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
6-49 workers	0.015 (1.04)	-0.013 (0.74)	0.025 (0.96)	0.000 ( )	0.056 (4.31)***	0.030 (1.73)*	0.060 (2.57)**	0.000 ( )
50+ workers	0.053 (3.89)***	0.021 (0.92)	0.011 (0.47)	0.000 ( )	0.116 (9.05)***	0.065 (2.94)***	0.071 (3.33)***	0.000 ( )
Quarter I - II	-0.043 (2.11)**	-0.040 (1.31)	-0.039 (1.42)	-0.155 (3.06)***	-0.043 (2.26)**	-0.038 (1.30)	-0.039 (1.60)	-0.121 (2.84)***
Quarter II - III	-0.022 (1.36)	0.001 (0.04)	-0.041 (2.01)**	-0.114 (2.67)***	-0.028 (1.88)*	-0.004 (0.18)	-0.046 (2.51)**	-0.067 (1.86)*
Quarter III - IV	-0.004 (0.28)	0.035 (1.43)	-0.035 (1.72)*	-0.084 (2.14)**	-0.012 (0.77)	0.037 (1.56)	-0.050 (2.74)***	-0.055 (1.66)*
Var% GDP, activ. t=1	-0.049 (0.95)	0.031 (0.42)	-0.144 (1.99)**	0.080 (0.56)	-0.032 (0.65)	0.022 (0.31)	-0.086 (1.33)	0.052 (0.43)
at least 3 mths. current job	-0.056 (3.66)***	-0.047 (2.51)**	-0.028 (0.86)	-0.051 (0.93)	-0.081 (5.61)***	-0.072 (4.00)***	-0.047 (1.63)	-0.060 (1.31)
Female	-0.108 (9.23)***	-0.153 (8.39)***	-0.078 (5.28)***	-0.309 (10.10)**	-0.083 (7.58)***	-0.112 (6.34)***	-0.070 (5.35)***	-0.266 (10.37)**
w/MW*range].25-.6]	-1.907 (6.12)***	-2.204 (6.13)***	-0.828 (1.08)	-1.801 (4.99)***	-0.539 (1.52)	-1.100 (1.82)*	0.326 (0.46)	0.616 (0.78)
w/MW*range].6-.95]	-0.641 (3.50)***	-0.701 (3.40)***	-0.341 (0.65)	-1.060 (3.29)***	-0.116 (0.58)	-0.362 (1.10)	0.323 (0.68)	-0.087 (0.19)
w/MW*range].95-1.2]	-0.367 (2.03)**	-0.175 (0.77)	-0.999 (3.18)***	-0.681 (1.78)*	-0.254 (1.40)	-0.192 (0.71)	-0.775 (2.72)***	0.046 (0.12)

Table A5: Earnings variation regression outputs (cont.)

Dependent variable:	% variation in monthly earnings from primary source [Specification 1]						log income t=2 [Specification 2]					
	Private Salaried	Informal Salaried	Private Salaried	Formal Salaried	Independents		Private Salaried	Informal Salaried	Private Salaried	Formal Salaried	Independents	
w/MW*range[1.2-1.5]	-0.219 (2.22)**	-0.115 (0.86)	-0.395 (2.67)***	-0.390 (1.69)*	-0.390 (1.69)*		-0.100 (0.94)	-0.129 (0.71)	-0.156 (1.11)	-0.156 (1.11)	-0.078 (0.28)	
w/MW*range[1.5-2]	-0.105 (1.53)	-0.146 (1.41)	-0.099 (1.10)	-0.209 (0.98)	-0.209 (0.98)		-0.059 (0.77)	-0.172 (1.19)	-0.030 (0.34)	-0.030 (0.34)	0.124 (0.54)	
w/MW*range[2-2.5]	0.185 (2.18)**	-0.024 (0.18)	0.303 (2.93)***	0.254 (0.95)	0.254 (0.95)		0.117 (1.39)	-0.125 (0.82)	0.237 (2.47)**	0.237 (2.47)**	0.383 (1.56)	
w/MW*range[2.5-3]	0.052 (0.48)	-0.034 (0.19)	0.095 (0.74)	-0.160 (0.40)	-0.160 (0.40)		0.062 (0.59)	-0.010 (0.05)	0.091 (0.78)	0.091 (0.78)	-0.166 (0.48)	
w/MW*range[3-4]	-0.048 (0.71)	0.023 (0.16)	-0.066 (0.93)	-0.174 (0.67)	-0.174 (0.67)		-0.000 (0.00)	0.097 (0.65)	-0.032 (0.49)	-0.032 (0.49)	-0.176 (0.77)	
w/MW*range[4-5]	0.143 (1.88)*	0.218 (1.30)	0.115 (1.44)	-0.245 (0.67)	-0.245 (0.67)		0.144 (1.98)**	0.107 (0.64)	0.152 (2.11)**	0.152 (2.11)**	-0.137 (0.44)	
w/MW*range[5-+]	-0.010 (3.92)***	-0.017 (1.70)*	-0.010 (3.94)***	-0.027 (1.43)	-0.027 (1.43)		-0.004 (0.62)	-0.037 (2.09)**	0.001 (0.12)	0.001 (0.12)	0.009 (0.31)	
log income t=1												
Constant	-0.986 (5.11)***	-0.647 (2.11)**	-0.984 (3.97)***	-1.094 (1.81)*	-1.094 (1.81)*		0.259 (0.48)	-0.335 (4.66)***	0.565 (1.04)	0.565 (1.04)	1.756 (0.92)	
Observations	914	4688	4426	2813	2813		914	4688	4426	4426	2813	
R-squared	0.12	0.16	0.09	0.23	0.23		0.62	0.39	0.70	0.70	0.43	

Absolute value of t statistics in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table A6: Earnings variation regression outputs with interactions between educational level and being affected by change in MW**

Dependent variable % variation in monthly earnings from primary	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
]25-.6]*MW1	1.899***	1.632***	1.796***	2.240***
]6-.95]*MW1	1.267***	0.951***	1.316***	1.643***
]95-1.2]*MW1	0.945***	0.431	1.689***	1.277*
]1.2-1.5]*MW1	0.828***	0.334	1.265***	0.959
]1.5-2]*MW1	0.591***	0.284	0.792***	0.689
]2.5-3]*MW1	0.236	0.035	0.335	0.693
]3-4]*MW1	0.378	-0.229	0.708**	0.583
]4-5]*MW1	-0.361	-1.023	-0.014	1.004
]5-+]*MW1	0.223	-0.246	0.479**	0.225
Elem. complete	0.097**	0.098*	0.094	0.072
Second. incom	0.092**	0.097**	0.086	0.025
Second. complete	0.162***	0.161***	0.138**	0.151***
Post second. No univ. incomp.	0.198***	0.226***	0.135*	0.104
Post second. No univcompl	0.267***	0.281***	0.213***	0.241***
Post second. univ. incom.	0.256***	0.269***	0.199***	0.202**
Post second. univ. Compl.	0.360***	0.386***	0.294***	0.485***
affect _Elem. incom. o menos	-0.042	-0.063	0.116	0.021
affect _Elem. Complete	0.031	0.026	0.060	-0.168
affect _Second. Incomp	0.140***	0.119*	0.166*	0.019
affect _Second. Complete	0.024	0.078**	-0.058	-0.069
affect _Post second. No univ. incom.	-0.088	-0.118	-0.079	0.015
affect _Post second. No univ. compl	-0.066	-0.067	-0.064	-0.293*
affect _Post second. univ. incomp.	0.016	-0.052	0.064	-0.111
affect _Post second. univ. compl	-0.046	-0.076	-0.032	-0.147
Age	0.018***	0.021***	0.012***	0.022***
Age squared	-0.000***	-0.000***	-0.000***	-0.000***
6 - 49 workers	0.013	-0.015	0.027	0.000
50 + workers	0.048***	0.013	0.012	0.000
Quarter I - II	-0.045**	-0.041	-0.041	-0.159***
Quarter II - III	-0.025	0.001	-0.048**	-0.118***
Quarter III - IV	-0.008	0.032	-0.040*	-0.087**
Var% GDP, activ. t=1	-0.052	0.028	-0.152**	0.058

**Table A6 (continued)**

Dependent variable	Private Salaried	Informal Private Salaried	Formal Private Salaried	Independents
% variation in monthly earnings from primary				
at least 3 mths, current job	-0.059***	-0.047**	-0.032	-0.057
Female	-0.110***	-0.156***	-0.081***	-0.311***
w/MW*range].25-.6]	-1.734***	-1.968***	-0.832	-1.827***
w/MW*range].6-.95]	-0.626***	-0.690***	-0.363	-1.058***
w/MW*range].95-1.2]	-0.359**	-0.214	-0.874***	-0.645*
w/MW*range]1.2-1.5]	-0.233**	-0.130	-0.413***	-0.379*
w/MW*range]1.5-2]	-0.121*	-0.173*	-0.099	-0.214
w/MW*range]2-2.5]	0.154*	-0.033	0.264***	0.133
w/MW*range]2.5-3]	0.014	-0.070	0.070	-0.179
w/MW*range]3-4]	-0.040	0.005	-0.063	-0.118
w/MW*range]4-5]	0.132*	0.183	0.107	-0.108
w/MW*range]5-+]	-0.011***	-0.017*	-0.011***	-0.030
Constant	-0.909***	-0.602**	-0.896***	-0.842
Observations	9114	4688	4426	2813
R2	0.13	0.16	0.10	0.23

Absolute value of t-statistics in parentheses. \* Significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**MINIMUM WAGE EFFECTS UNDER ENDOGENOUS  
COMPLIANCE: EVIDENCE FROM PERU****MIGUEL JARAMILLO BAANANTE****SUMMARY**

JEL Classification: J23, J38, O17

Latin American labor markets feature large informal sectors. In practice, however, the simple duality formal-informal has many different shades: firms tend to comply more with certain legislation than with other. Recent evidence has suggested that minimum wages have significant effects on the informal sector (Bell (1997) for Mexico; Gindling and Terrell (2004) for Costa Rica; Lemos (2004) and Fajnzylver (2001) for Brazil; and Maloney and Nuñez (2004) for Colombia). Further, some of this evidence suggests effects throughout a large part of the wage distribution. This has been interpreted as evidence of ‘lighthouse’ or numeraire effects. We test this hypothesis using panel data from Peru to identify effects throughout the wage distribution. Although there are some effects on informal sector workers, overall results provide little support for numeraire or ‘lighthouse’ effects. Labor monthly earnings are affected only at the bottom of the distribution (0.25-0.60 of the minimum wage), made up mostly of informal workers, and for formal workers earning between the old the new minima. Negative effects on the probability of retaining employed status after a minimum wage shock are either weak or non significant for wage earners below the minimum wage, but significant for formal workers ‘trapped’ between minima, and for both formal and informal earning between 1.2 and 2 times the minimum wage. Independent workers earning below minimum suffer negative effects on both earnings and employment.