THE IMPACT OF MINIMUM WAGES ON EMPLOYMENT IN A LOW-INCOME COUNTRY: A QUASI-NATURAL EXPERIMENT IN INDONESIA

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The extensive literature on the employment impact of minimum wages has focused heavily on industrialized nations and very little on the developing world, despite the importance of minimum wages in many low-income countries. One such country, Indonesia, was the setting for an unusual quasi-natural experiment: not only did minimum wages in Indonesia increase sharply between 1990 and 1996, but the resultant increment in average wages varied markedly across different areas in Greater Jakarta. The authors use household-level labor market data to determine the extent of compliance with the legislation, then estimate the employment impact in the clothing, textiles, footwear, and leather industries based on a census of all large and medium-sized establishments. The evidence suggests that there was no negative employment impact for large establishments, either foreign or domestic, but that workers in smaller, domestic establishments may have suffered job losses as a result of minimum wage increases.

The past decade and a half has seen much debate over the employment impact of minimum wage increases. The received wisdom that there is a negative impact on employment has come in for serious re-examination. Almost all of this research has occurred in wealthy industrialized nations. It is surprising that there are so few papers on this topic in developing countries, given that minimum wages are also widely employed there as a means of raising living standards. The issue of minimum wage setting in low-wage countries has stimulated considerable international interest, with concerned citizens in wealthy nations calling for higher wages to be paid in developing countries to limit the exploitation of labor by multinational corporations. However, increases in minimum wages may lead to subsequent large job losses and so may adversely affect some low-wage workers. Labor market conditions in these countries differ markedly from those in industrialized countries—most notably in terms of the existence of a large informal, uncovered sector. This means that research from industrial nations may not provide a sound basis for minimum wage policy in low-income countries.

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The data used in this paper are proprietary and can be purchased from BPS–Statistics Indonesia. Copies of the computer programs used to generate the results presented in the paper are available from the second author at the Department of Economics, University of Melbourne, 3010, Victoria, Australia. Email: lcameron@unimelb.edu.au.

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This paper uses data from a census of all medium and large Indonesian manufacturing establishments to examine the impact of minimum wages on employment in four industries—clothing, textiles, footwear, and leather—between 1990 and 1996. We focus on these industries because they rely heavily on low-wage (mainly female) labor.

Indonesia is an ideal site for a study of this sort for several reasons. First, it is a relatively low-income country (GDP per capita of US$980 in 1995) with a large, low-tech, low-wage manufacturing sector. Second, it has a long history of minimum wage legislation, and efforts by the government since 1990 to enforce compliance seem to make it likely that most middle-sized and large establishments, at least around the major metropolitan area that we study, pay the minimum wage. (Our examination of labor market survey data confirms that they do.) Third, minimum wages increased sharply in Indonesia during the 1990s, partly due to international pressure. On average, minimum wages across the nation tripled in nominal terms and doubled in real terms during the early 1990s (Rama 2001).

Finally, minimum wages in Indonesia are set at the provincial level. This gives rise to arbitrary differences in the legal minimum between establishments that are geographically close but on different sides of provincial borders. A particularly striking difference in minimums occurs within the bounds of Greater Jakarta (which is the manufacturing hub of Indonesia)—part of which is in the province of Jakarta and part in the neighboring province of West Java. In 1990 the minimum wage was 36% higher in Jakarta than in West Java. By 1994 there was no difference in minimums across the two regions. This provincial difference in minimum wages provides a "quasi-natural experiment" that allows us to identify the employment effect.

This study is the first to use arbitrary geographic differences in minimum wages within a developing country to identify the employment effect. It is only the second study of which we are aware that uses micro-level data to examine minimum wage effects in the developing country context. (Bell [1997] used firm-level data from Mexico and Colombia.) In addition to the quasi-experimental aspect of the study, this paper benefits from an unusually detailed data set that covers *all* establishments with 20 or more employees in Indonesia. The data cover a six-year period and so enable us to examine a relatively long time period around the minimum wage changes.

Previous Literature

Theoretical Structure

The simplest model of the effect of the minimum wage on employment is the standard neo-classical model, which assumes homogeneous labor, a competitive labor market, and complete coverage of the minimum wage legislation. A minimum wage set above the market-clearing wage then decreases the quantity of labor demanded by firms, and total employment decreases. The assumption of complete coverage is a strong one even in a developed country setting, and it will not hold in most developing countries. A number of theoretical models have explored the impact of minimum wages in the presence of a non-negligible uncovered sector (Gramlich 1976; Mincer 1976; Brown, Gilroy, and Kohen 1982; Harrison and Leamer 1995). Although these models differ in a number of ways—for example, in their assumptions about mobility between the uncovered and covered sectors—they all yield the conventional prediction of a negative employment impact in the covered sector.[1]

As is well known, market structures other than perfect competition can predict different employment effects. For example, if the labor market is assumed to be monopsonistic, increases in the minimum wage over a certain range cause employment to increase. The traditional monopsony model is not very palatable because most industries (as is the case for the Indonesian clothing/textiles/footwear and leather sector) cannot be

[1]They predict a reallocation of labor toward the uncovered sector, but differ on the extent to which the decrease in covered sector employment is compensated for by an increase in uncovered sector employment.

characterized as traditional monopsonies. However, more recent models of monopsonistic competition—for example, Bhaskar and To (1999) and Dickens, Machin, and Manning (1999)—allow for the existence of many firms within industries with monopsonistic power derived from labor market friction, such as search costs. Hence, the monopsony result may hold in markets that appear to be perfectly competitive.

Empirical Literature

The early empirical studies of minimum wage effects largely used time series data and regressed a measure of employment on a minimum wage variable and other controlling variables. These studies found a consistent moderate negative employment impact, in line with the standard neo-classical model of the labor market. (See Brown 1999 for a survey.) This methodology has a number of potential problems, however. First, the minimum wage variable is normally calculated relative to average earnings (and possibly weighted by a measure of coverage). Although this approach captures the extent to which the minimum is binding, the impact of minimum wage variation cannot then be separated from the impact of average wages. Second, these studies implicitly compare employment in relatively high minimum wage years with employment in relatively low minimum wage years, when it is likely that many other factors, including economic conditions that affect employment and minimum wages, have also changed. A measure of gross output is normally included, but to the extent that the GDP measures are unable to completely control for changes in economic conditions, the minimum wages are likely to be endogenous and the resultant estimates are biased.

Micro-data have become available only more recently and have provided conflicting evidence of the effect of minimum wages on employment. Some studies have continued to find support for the neo-classical result (for example, Burkhauser, Couch, and Wittenburg 2000; Baker, Benjamin, and Stanger 1999), while others have found that minimum wage increases are associated either with no negative employment impact or even with employment gains (see Card and Krueger [1994] for the U.S. and Dickens, Machin, and Manning [1999] for the United Kingdom). More recent time-series studies (using data beyond the 1970s) have also shown a very small or statistically insignificant impact of minimum wage increases (Wellington 1991; Klerman 1991).[2]

The methodology in many of the micro-level studies is similar to that in the time-series studies. Panel data are used, and a measure of employment in region r at time t is regressed on a minimum wage variable and other controlling variables. Thus the same concerns about omitted control variables arise in these studies. Departing from the methodology of previous studies, Card and Krueger (1994) calculated difference-in-differences estimates of the employment impact of minimum wages by comparing employment in fast-food establishments that were very close geographically and so arguably part of the same market (New Jersey and Pennsylvania) but subject to different minimum wages. This methodology reduces the problems associated with being unable to control for all economic differences between locations. If economic conditions in the two locations are the same, this also avoids the concern that variation in the minimum wage may result from differing economic conditions and hence be endogenous. It is this methodology that we follow in this paper. Greater Jakarta is an ideal setting in which to apply this methodology because historical administrative boundaries have resulted in arbitrary differences in minimum wages within one city—that is, within an area in which labor and product markets are more clearly fully integrated.

Developing Country Studies

In contrast to the extensive literature on the impact of minimum wages in developed

[2]Work using panels of cross-country data suggests that institutions play an important role in determining the impact. Neumark and Wascher (2004) used a panel of cross-country data for 17 OECD countries and found that minimum wages caused employment losses among youths but that this effect varied depending on labor market institutions.

countries, there is very little developing country research. The few such studies that do exist use the traditional regression-based methodological approach described above, with differing degrees of data aggregation. The results are mixed, but most of the studies have found a negative employment impact. Carneiro (2000) found a negative employment impact in the formal sector in Brazil using time-series data, as did Freeman and Freeman (1991) using national and industry-level data for Puerto Rico. Krueger (1995), however, reexamined the Puerto Rican data and concluded that the evidence on the minimum wage effects is quite fragile. Bell (1997) is the only study of which we are aware that used firm-level data. Bell estimated employment equations and found a negative employment impact in Colombia, where the minimum wage is found to have been binding, and no impact in Mexico, where the minimum was set below market-clearing.

The recent large increases in minimum wages in Indonesia have generated a small number of papers that have all used panels of province-level data. Rama (2001) aggregated establishment-level data and found a negative employment effect for small (<20 employees) establishments but a possible positive effect among large and medium-sized establishments. Estimates from household labor force survey data are sensitive to the specification used (see SMERU 2001; Islam and Nazara 2000).

All of the above developing country studies performed either time-series regressions or panel regressions using data covering a wide geographic area. One concern in addition to those already mentioned with respect to these methods is that much information is lost in the aggregation of data at the national, provincial, or industry level. In contrast, our approach allows us to exploit the richness of establishment-level data.

One of the more serious criticisms of Card and Krueger's methodology was that they were able to examine only a period from shortly before the minimum wage change to shortly after the change, and so captured only short-term effects of the minimum wage. In this study we use data over a much longer time period and so are able to measure longer-term effects of minimum wage increases.[3]

The Indonesian Context

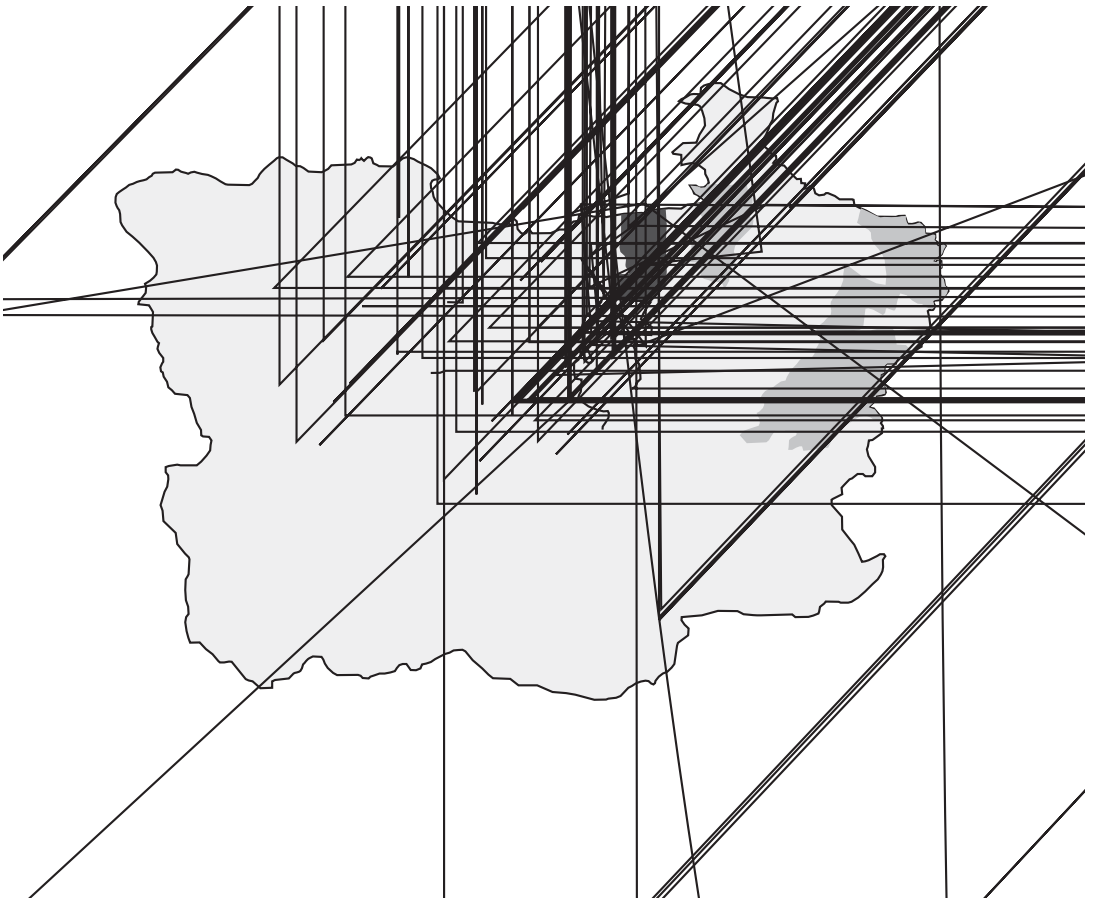
Indonesia occupies a land mass about one-fifth that of Europe, and with some 240 million people, it is the fourth most populous nation in the world. Due to its relatively low average per capita income, its economy is small in international terms, with a GDP equal to less than 3% that of the United States. Nevertheless, prior to the financial crisis of 1997 Indonesia was experiencing a manufacturing boom. Protectionist trade barriers had been dramatically reduced from their high levels in the mid-1980s, and the flow of foreign capital had also been liberalized. As a result, many multinational companies chose to locate in Indonesia, non–oil manufacturing production grew by an average of 11% per annum between 1985 and 1992, and manufactured exports increased by a remarkable 20–30% per annum in real terms from 1980 to 1992 (Hill 1996).

Indonesian manufacturing is highly concentrated in the Greater Jakarta region, which is informally called Jabotabek (a term formed by combining the beginnings of the names of each of its constituent regions—Jakarta, Bogor, Tangerang, and Bekasi). Eighty-two percent of national adult full-time formal sector manufacturing employment is on the island of Java, with the vast majority of this being in or close to Jakarta.

Jakarta is a province in its own right. The districts (kabupaten) of Bogor, Tangerang, and Bekasi (known collectively as Botabek) are all in the province of West Java (Figure 1).[4] As such, establishments in Jakarta are subject to the Jakarta-legislated minimum, while establishments just over the border

[3]Baker, Benjamin, and Stanger (1999) and Neumark and Wascher (1994) found that employment effects may be more adverse in the long run.

[4]Jabotabek is bounded on the west, east, and south by other districts in West Java and on the north by the Bay of Jakarta. Unlike in Tangerang and Bekasi, most of the manufacturing in the kabupaten of Bogor is located south of the city of Bogor, which is at a considerable remove from the Jakarta/West Java border. Excluding Bogor from the sample does not affect the results.



are subject to the (historically lower) West Java minimum.

Table 1 presents the average monthly minimum wage (in Indonesian Rupiah) in each province from 1990 to 1996. The government sets monthly minimums for full-time workers. For workers who do not work full-time, the corresponding pro-rata daily rates apply. These minimums apply to all firms, no matter how small, but not to workers in the informal sector.[5] In 1990 (with an exchange rate of Rp2500 to US$1) the Jakarta minimum was equivalent to US$22.32 per month—considerably less than one U.S. dollar a day. By 1996 this had risen to almost US$2 per day. Although low by international standards, this is quite high relative to the average manufacturing wage in Indonesia at the time. For example, the Jakartan (Botabek) minimum was 42% (31.2%) of the average manufacturing wage in Jabotabek in 1991. The minimum in both regions was 50% of the average wage by 1996.

Table 1 shows that in 1990 the minimum wage was about 36% higher in Jakarta than in West Java. Both provinces experienced relatively rapid increases in their nominal (and real) minimum wages. The larger increases in West Java eventually closed the gap between the two provinces, so that after 1993 there was no difference between

them.[6] The government's stated aim when establishing provincial minimum wage levels is to ensure that wages cover the cost of a consumption bundle defined by reference to individuals' minimum physical needs and the cost of living (Rama 2001). The initial difference between the minimum wages of Jakarta and West Java arose from differences in the average cost of living across the two provinces. Jakarta is an entirely urban province, whereas West Java is largely rural. The cost of living is consequently higher in Jakarta than it is, on average, in West Java, and the lower West Java minimum reflected this fact. However, Bo(c)-10(r)-7(r)-16(t)-6(a)-5(9o10(n)-10(t)-1(B))125.20110(a)-10(r)-21(t)-10(1r)-7(r

names in a list of non-compliers. In order to be dropped from the blacklist, companies have to "confess guilt and pledge to apology [*sic*]" (*Indonesia Times*, as cited in Rama 2001). Strikes by workers in non-complying firms are also part of the shaming process.[9]

If the minimum wages are binding, we would expect to see greater increases in average wages in Botabek than in Jakarta. Table 3a shows that this is the case. The average nominal wage bill per worker increased by 19.4 percentage points more between 1989 and 1996 in Botabek than in Jakarta (102.7% versus 83.3%). Further, we would expect both the Jakarta and Botabek distributions to become more compressed as a result of the minimum wage increases, with a larger decrease in inequality in Botabek. This is also supported by the data. Between 1989 and 1996 the interquartile range fell by 0.37 (from 0.78 to 0.41) or 47% in Botabek. In Jakarta it fell by 0.05 (from 0.44 to 0.39) or 12%. The 90-10th percentile range, the 60-40th percentile range, and the Gini coefficient show a similar pattern.[10]

Another test of whether minimum wages are binding and complied with is to visually inspect the distribution of wages for a spike or discontinuity close to the minimum wage. The spike arises when the wages of those who were earning below the new minimum prior to its introduction are pushed up to the new minimum. Establishing compliance by this means is more difficult in a developing country context than in developed countries because of the large role played by the informal, uncovered sector and the difficulty of identifying informal sector workers. Figures 2 and 3 are kernel density estimates of self-reported monthly wages at different points in time between 1990 and 1996 for Botabek residents and Jakarta residents, respectively.[11] They were constructed using data from the Indonesian Labor Force Survey, or Sakernas (*S*urvei *A*ngkatan *Ker*ja *Nas*ional = *Sakernas*).[12] Although the Sakernas does not allow us to clearly identify formal and informal sector workers, we minimize the inclusion of informal sector workers by limiting our sample to those employees aged 10 or more who reported working at least 40 hours a week in the urban manufacturing sector. We further restrict our sample to female workers because they were much more likely to receive the minimum wage than were male workers (Rosner 1995).[13] Ideally we would only examine wages in the clothing, textiles, footwear, and leather industries within the manufacturing sector here (as we do when examining the employment effects), but the sample size precludes us from doing so (there were approximately 500 adult women working in manufacturing in Jabotabek in each year of the survey). The difficulty in discerning a spike is increased by the smoothing of the kernel density estimator. Nevertheless, spikes at or close to the minimum are evident in most of the figures.[14]

Table 2 shows the timing of the minimum wage increases. The monthly minimum wage that was in force at the time is indicated in Figures 2–3 by a vertical line. In some cases the new and old minimum are shown (the old minimum being the vertical line to the left). The minimum wage in Botabek was the equivalent of Rp1600 per day from April 1990 to June 1991. It then increased to Rp2100

[9]Certain labor-intensive companies and small firms can apply for a 12-month compliance postponement, but because this involves opening their books to the government and a written agreement either with the workers' union or with a majority of workers, few applications are made. Rama (2001) reported that in the early 1990s the number of annual requests nationwide never exceeded 135.

[10]These figures are calculated from the average wage bill per worker in the Survei Industri data. Inequality measures calculated from the Labor Force Survey (Sakernas) show the same pattern.

[11]An Epanechnikov kernel was used. Observations greater than Rp200000 were dropped to allow us to focus on the lower portion of the distribution.

[12]The Sakernas is conducted by the Indonesian Central Statistical Agency (Badan Pusat Statistik = BPS). The survey is a random sample of approximately 65,000 households, or slightly more than 250,000 individuals across the nation.

[13]Rosner (1995) conducted a small survey of the footwear and garments industry. While male workers may earn more than the minimum, it was reported that female workers more often earned the minimum only.

[14]The average wage paid per worker in our firm-level data was noisier than in the Sakernas data but also shows spikes at or close to the minimum.


1990, Quarters 2, 3, & 4
1991, Quarters 1 & 2
1991, Quarters 3 & 4
1992, Quarters 1, 2, &

Daily Minimum Wage Rates in Jakarta and Botabek, 1989-1996.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1989	Jakarta:											1600
	Bobatek:											1400
1990	2100											
	1400			1600								
1991	2100										2500	
	1600					2100						
1992	2500											3000
	2100								2600			
1993	3000											
	2600											
1994	3800											
	3800											
1995	4600											
	4600											
1996	4600			5200								
	4600			5200								

per day. Figure 2a plots the distribution of wages in Botabek for the last three quarters of 1990, Figure 2b for the first two quarters of 1991, and Figure 2c for the last two quarters in 1991. (Plotting the quarters separately was possible only for years prior to 1994. After that, the survey was conducted annually—in August in 1994 and in July thereafter.) In all three figures there is a distinct peak almost exactly at the current minimum, and there is no discernible peak at the old minimum just after the minimum increased (Figure 2c).[15] There is some evidence in Figure 2b that the increase in June 1991 was anticipated, because there is also a peak close to what was to become the new minimum. The minimum wage stayed at Rp2100 per day until September 1992. Figure 2d shows that the spike in the distribution remained at this level in the first three quarters of that year, and that it then moved to the right when the new minimum became effective in the fourth quarter. This pattern of the peak shifting with the minimum wage is repeated in the subsequent years. Also, as expected in an economy with a positive inflation rate, the longer a minimum had been in place, the greater the percentage of the population that received above the minimum.

The figures for Jakarta (Figures 3a–g) follow a similar pattern. Only in 1990 (Figure 3a) and 1992 (Figure 3c) was there no spike at or close to the minimum.[16]

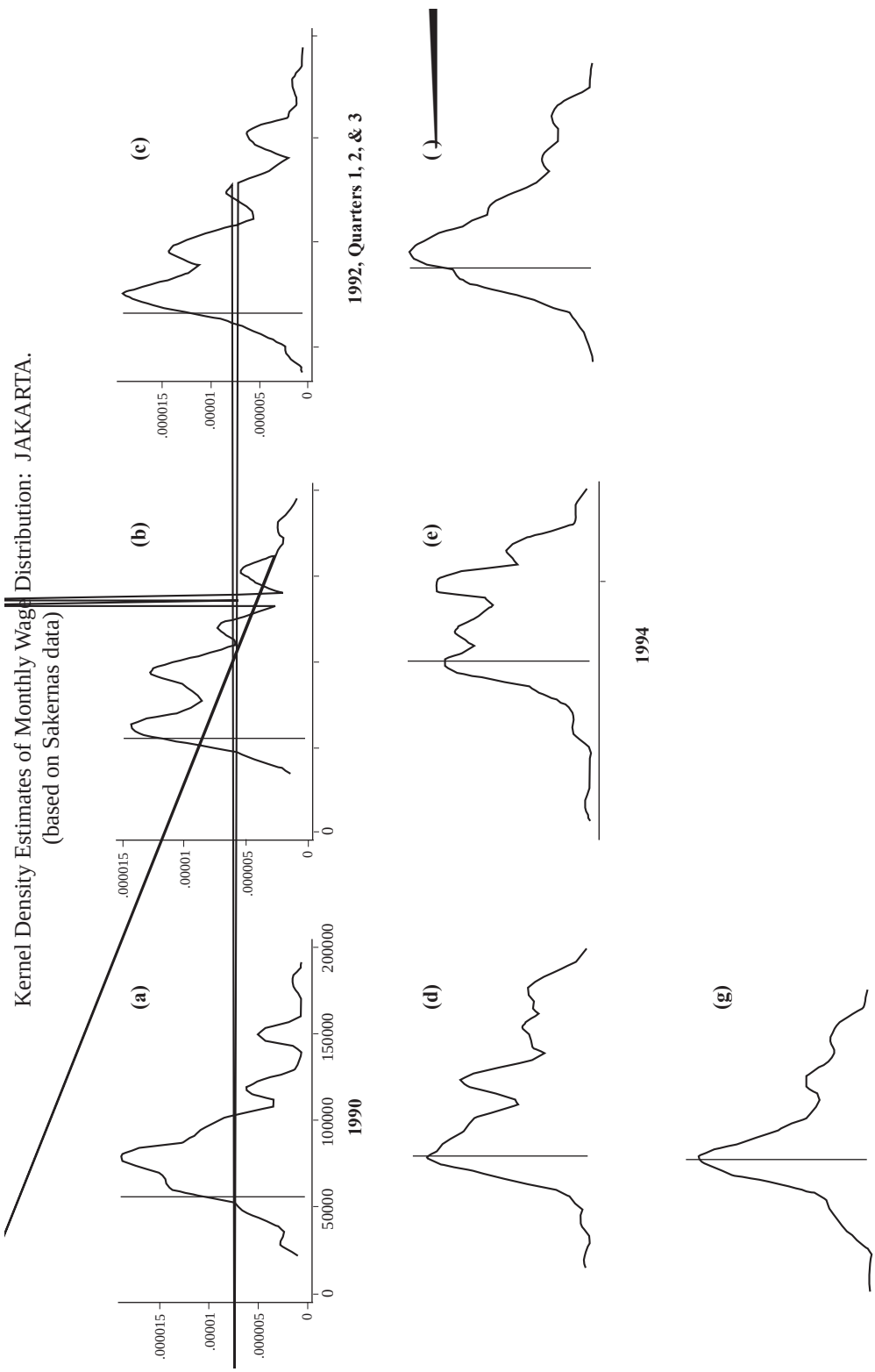
As anticipated, in both provinces a sizeable portion of the sample was receiving less than the minimum wage. These people likely were employed by small manufacturing businesses in the informal sector.

Establishment-Level Data

Having established that the minimum wages were binding and found evidence of compliance, we now examine the employ-

[15]The daily rates in Table 2 are converted to the monthly equivalents used in Figures 2 and 3 assuming a six-day workweek.

[16]The figure for the first three quarters of 1991 shows a peak just beyond the minimum. This is not surprising given that the minimum had already been in place for 12 months.


Kernel Density Estimates of Monthly Wage Distribution: JAKARTA.
(based on Sakernas data)
(a)
(b)
(c)
1990
1992, Quarters 1, 2, & 3
(d)
(e)
(f)
1994
(g)
.000015
.00001
.000005
0
50000
100000
150000
200000

ment impact of minimum wages. The data source we use is the Annual Survey of Manufacturing Firms (Survei Tahunan Perusahaan Industri, SI) for the years 1990 to 1996.[17] The data are collected by BPS and constitute a census of all manufacturing establishments in the country with 20+ employees. Owing to the size of these establishments, they are considered here as constituting the formal or covered sector of the labor market. The formal sector accounts for approximately 41% of all manufacturing sector employment (Departemen Perindustrian dan Perdagangan RI 2002:59).

The survey provides detailed data on the establishments' businesses, including 5-digit industry codes, information on the number of employees (broken down by production and non-production workers), the total wage bill, the percentage of foreign ownership, the proportion of output that is exported, value-added per worker, and land rental payments. Detailed geographic location information is also provided, so we know whether an establishment is in Jakarta or Botabek and also whether it is in one of the sub-districts immediately adjacent to the Jakarta/West Java border. Each establishment has a code that allows it to be tracked over time, although we are not able to follow establishments if they relocate, or to link establishments to firms.

It might be objected that much of the adjustment to the minimum wages occurs in smaller establishments that are not part of the sample. We view this as unlikely. Because smaller firms are, relative to larger firms, less clearly part of the formal sector to which minimum wages apply, the threat of enforcement is weaker for them, and hence compliance is likely to be much lower. Nevertheless, our estimates must be viewed as estimates of the impact of minimum wages on medium to large-sized firms only.[18]

After dropping a small number of irregular observations, we find that Jabotabek's clothing/textiles/footwear/leather sector (excluding batik) comprised 1,224 establishments in 1991 and 1,519 in 1996.

Empirical Methodology

We obtain estimates of the employment impact by comparing the average change in the number of production workers employed by establishments in Jakarta with the average change for like establishments over the border in Botabek.[19] This methodology differences out business cycle employment effects that are common to both Jakarta and Botabek. Any systematic difference between the Botabek and Jakarta establishments is attributed to the only known difference between the regions—different minimum wages. One thus needs to ensure that there are no other differences between establishments in the two regions that could account for the different employment patterns. Aside from minimum wage differences, there are no other administrative differences of which we are aware. There are, however, some systematic differences between establishments in the two areas. Table 4 shows that establishments were, on average, larger in Botabek than in Jakarta and there was a larger percentage of foreign-owned establishments in Botabek. This suggests that establishments in Jakarta may be less formal than those in Botabek and so the manufacturing technology may have differed across the two areas. To control for these potential differences, we calculate matched difference-in-differences estimates with matching on the basis of value-added per worker (as a proxy for the establishment's production technology). Value-added per worker may be affected by minimum wages, so we match on value-added in the base year (when the minimum wage was the same in Jakarta and Botabek).[20]

[17]We do not use data beyond 1996 for fear of contaminating our estimates with the impact of the Asian crisis that began in mid-1997.

[18]Small firms were entitled to apply for exemptions from the minimum wage legislation. Although few applications were made, this policy indicates that the government's main focus in implementing the laws was on larger establishments.

[19]The Survei Industri data provide information on the number of workers employed rather than the hours worked by employees. Most production workers in the clothing, textiles, footwear, and leather industries work full-time and work eight-hour shifts (Wolf 1992), so changes in the number of workers capture all substantive employment changes.

[20]We also calculated matched difference-in-differences estimates using the propensity score method

Table 3a. Monthly Average Cash Wage Paid to Production Workers (SI). (thousands of Rupiah)

	Mean Cash Wages			*Median Cash Wages*		
Year	*Jakarta*	*Botabek*	*% Diff.*	*Jakarta*	*Botabek*	*% Diff.*
1986	70.1	66.3	–5.4	52.5	49.4	–6.0
1989	89.7	88.0	–1.9	68.1	59.8	–12.3
1991	90.9	80.3	–11.7	78.0	65.9	–15.5
1992	111.2	94.8	–14.8	87.5	77.5	–11.4
1993	125.6	116.0	–7.6	101.25	97.9	–3.5
1994	123.8	141.3	14.1	112.5	115.0	2.2
1995	143.9	147.4	2.4	125.0	128.8	3.0
1996	164.3	178.3	8.5	145.0	153.8	6.1
1989–96 (percent increase)	83.3	102.7	19.4	112.8	157.5	44.6

In addition to matching by value-added per worker, we calculate separate estimates for small domestic establishments (20–150 workers), large domestic establishments (more than 150 workers, with no foreign ownership) and large foreign establishments (more than 150 workers, with non-zero foreign ownership; almost all of the firms with some foreign ownership were majority foreign-owned). Small foreign establishments are excluded because they were very few in number. It is desirable to differentiate by establishment size and foreign ownership because doing so increases the likelihood of matching like with like and also allows different establishment types to experience different minimum wage effects. For example, the increase in the minimum wage may impose a greater burden on smaller businesses than on large ones and so may affect them disproportionately. Table 3b supports this view. It shows that small establishments on average paid lower wages than large establishments and so were affected to a greater extent by increases in the minimum wage. Similarly, the behavior of foreign and domestic establishments may differ owing to their different cost structures and the greater ability of multinational firms to absorb cost increases. Table 3b also shows that foreign establishments often paid higher wages than their domestic counterparts.[21] Across the whole of the Indonesian formal manufacturing sector, small domestic establishments accounted for about 19% of employment, large domestic establishments for 63%, and large foreign establishments for 18%.[22]

We focus on the employment of production workers because they are likely to be less skilled than non-production workers, more likely to be receiving the minimum wage, and so more likely to be affected by the minimum wage increase.[23] Our estimator is

$$\hat{\beta} = \frac{\sum_{j=1}^{J} n_j (\Delta \bar{Y}_j^{JAK} - \Delta \bar{Y}_j^{BOT})}{\sum_{j=1}^{J} n_j}. \quad (1)$$

of Rosenbaum and Rubin (1983). We controlled for industry (clothing/textiles/footwear/leather), foreign ownership, proportion of output exported, and value-added per worker. The results were very similar to those we present.

[21]Tables 3a and 3b examine wages for the entire sample of firms. Restricting the sample to only those firms used to calculate the DID estimates produces very similar figures.

[22]These percentages are calculated from the 1996 Survei Industri data. The survey shows that in 1996 there were about 4.2 million workers in manufacturing firms with 20 or more employees. About half a million of these workers were in the clothing/textiles/footwear sector in Jabotabek.

[23]Information on the education levels of employees is available only for a subset of years. The 1995 data show that 54% of non-production workers had an upper secondary school education and 10% had a tertiary education, compared to 22% and less than 1%, respectively, for production workers.

Firms may react to increases in the minimum wage by hiring more skilled (non-production) workers. DID estimates of changes in the number of non-production workers also showed no employment impact.

Table 3b. Monthly Average Cash Wage Paid to Production Workers, by Establishment Size and Ownership. (thousands of Rupiah)

Year	*Small Domestic Firms*	*Large Domestic Firms*	*Large Foreign Firms*
1986	47.8	65.4	132.8
1989	62.8	81.3	173.2
1991	90.7	81.1	78.9
1992	100.0	121.4	101.8
1993	117.7	118.8	164.1
1994	121.7	141.7	139.3
1995	142.3	147.8	156.3
1996	158.6	181.2	210.4

Source: SI data. The 1990 figures are omitted because the SI data for this year do not allow identification of the firms' location beyond province. (We were able to calculate the DID estimates for established firms in 1990 by keeping only those firms in 1990 that were operating in Botabek or Jakarta in 1996.)

We calculate two sets of estimates—one in terms of changes in the number of workers and one in terms of proportional changes. J denotes the number of value-added-per-worker cells, n_j is the number of establishments in value-added cell j, and $\Delta\bar{Y}_j^{JAK}$ is the simple average across establishments in Jakarta within value-added cell j of either the change in the number of production workers employed between the initial and base year or the proportional change in the number of production workers employed between the initial and base year. $\Delta\bar{Y}_j^{BOT}$ is similarly defined for Botabek. That is, we calculate the employment change for each establishment, calculate the average of this change within value-added cells for Botabek and Jakarta, and then calculate a weighted average of the difference.

The base year must be a year in which minimum wages were equal across the two regions so that we are comparing changes from a time when we would expect establishment employment to be the same in both regions. It is also important to match on the basis of value-added per worker in the base year so that it is not affected by differences in the minimum wages. The minimum wage was equal across both regions from 1994 onward; thus, 1994, 1995, and 1996 are potential base years. The reported estimates use 1996 as the base year. This year is preferred on theoretical grounds because it is the most distant from the period in which the minimum wages differed. If the changes in the difference between minimum wages in Jakarta and West Java take more than a year to affect unemployment, then employment in 1995 will still be contaminated by the different minimums and so will not be an appropriate base year.[24]

We also present estimates from panel regressions that pool the data across years and so increase the power of our tests of statistical significance.

Center-Periphery Differences

Our aim in calculating the matched estimates is to ensure that we are comparing like establishments across the two regions. There may still be cause for concern, however, about differences in economic conditions between the periphery of Jakarta (Botabek) and the city proper. Note, though, that it is not accurate to characterize Jabotabek as consisting of a dense manufacturing center with less dense extremities. Henderson, Kuncoro, and Nasution (1996) characterized Jabotabek as a "multi-centered metropolitan area (with some centers in Botabek) rather than one dominated by central city employment." They found no statistically significant correlation between the distance from the center of Jabo-

[24]Note that if firms had still been adjusting to the minimum wage changes in 1996 (two years after the minimums became equal), we would see systematic differences between the regions during 1994–96 or 1995–96.

Table 4. Comparisons of Botabek and Jakarta Establishments, 1996.

Statistic	*Jakarta*	*Botabek*
Number of Workers per Establishment	159.7	424.1
Establishments with Some Foreign Ownership (%)	4.4	17.2
Value-Added per Worker (thousands of Rupiah per year)	7,112	11,294
Proportion of Product Exported	12.0	31.0
N	985	534

tabek and employment density in 1991. They also emphasized that unlike the U.S. pattern of development, which might see industry moving out of the center to the periphery of cities, the center of Jabotabek (particularly north Jakarta) remains a vibrant and growing manufacturing center. Nevertheless, we test whether there was a systematic difference in employment growth between establishments in Jakarta and Botabek in 1994–96 and 1995–96, when minimum wages were the same in both regions. We also conduct sensitivity tests that reduce or remove the propensity for center-periphery differences to bias the results. First we restrict the sample to those establishments that were very close to the Jakarta-Botabek border. Second, we use high-wage establishments in Botabek as the control group for low-wage Botabek establishments. These tests are explained in more detail below.

Establishment Openings and Closures

It is only possible to calculate the matched employment impact estimate shown in equation (1) for establishments that were open in both the initial year and the final year of the comparison.[25] This enables us to identify whether employment decreased in establishments that still existed in 1996, but it may give rise to an endogenous selection problem, as the most affected firms may have closed. Openings may also have been adversely affected. To examine openings and closures, we calculate differences-in-differences in the net rate of establishment openings between Botabek and Jakarta.

Results

Table 5 reports the difference-in-differences (DID) estimates of the employment impact when we match on value-added per worker. Five value-added per worker cells were used.[26] Negative estimates indicate a greater decrease in employment in Botabek than in Jakarta and so are consistent with the neoclassical prediction.

The first thing to note is that there was no systematic difference between Jakarta and Botabek in employment changes when the minimum wages were the same in both regions (1994–96 and 1995–96).

The estimates for the years in which the minimum wage differed across the two regions show no statistically significant employment impact for large establishments, domestic or foreign. All of the estimates for large foreign establishments are negative but statistically insignificant. Similarly, all estimates for large domestic establishments are statistically insignificant (some positive and others negative). This is true of the estimates in terms of the number of workers and those in terms of the proportion of workers. The only statistically significant effects occurred

[25]Bell (1997) similarly used a balanced panel. Card and Krueger treated closed firms as having zero employment. Such a procedure is not possible here, because for the matching we need a value for value-added per worker in 1996. The regression results are also estimated in logs and so cannot accommodate zero values, and some specifications use data on production and non-production wages, which are non-existent for establishments that are not in the sample. Further, setting employment equal to zero for establishments that exit the sample would appreciably overstate the negative employment effect, because our data only cover firms with 20 or more employees. Of firms that existed in 1991 (1995), 57% (86.4%) were still in operation in 1996.

[26]The results are not sensitive to the cell definitions. The cut-off points are 2,000, 4,000, 8,000, and 15,000 thousand rupiah per worker per annum.

Table 5. Jabotabek Matched Difference-in-Differences Estimates.
(matching on basis of value-added; base year = 1996)

Change in the Number of Production Workers Employed (Target Year to 1996)

Target Year	Base Year	Small/Domestic					Large/Domestic					Large/Foreign				
		N^{BOT}	N^{JAK}	DID	Std. Error	t	N^{BOT}	N^{JAK}	DID	Std. Error	t	N^{BOT}	N^{JAK}	DID	Std. Error	t
1990	1996	52	269	–12.4	7.57	–1.64	113	82	40.7	46.16	0.88	27	17	–94.2	146.4	–0.64
1991	1996	67	322	–22.1	12.23	–1.81*	144	94	35.4	51.4	0.69	46	21	–99.7	124.8	–0.80
1992	1996	79	399	–12.3	5.6	–2.20**	155	108	32.69	44.62	0.73	58	29	–45.2	96.5	–0.47
1993	1996	98	458	–5.05	4.67	–1.08	172	119	9.81	34.4	0.29	65	29	–36.4	82.6	–0.44
1994	1996	126	528	–3.13	3.21	–0.98	191	127	3.81	30.2	0.13	72	31	–98.8	106.4	–0.93
1995	1996	176	634	–2.15	1.83	–1.17	209	147	–18.7	19	–0.98	75	32	–159.8	99.6	–1.60

Proportional Change in the Number of Production Workers Employed (Target Year to 1996)

Target Year	Base Year	Small/Domestic			Large/Domestic			Large/Foreign		
		DID	Std. Error	t	DID	Std. Error	t	DID	Std. Error	t
1990	1996	–0.20	0.154	–1.30	0.054	0.078	0.70	–0.077	0.235	–0.33
1991	1996	–0.41	0.240	–1.71*	0.037	0.081	0.46	–0.028	0.159	–0.18
1992	1996	–0.16	0.094	–1.70*	0.032	0.072	0.44	0.007	0.141	0.05
1993	1996	–0.016	0.061	–0.26	–0.031	0.054	–0.57	–0.036	0.122	–0.30
1994	1996	0.01	0.051	0.20	–0.039	0.05	–0.78	–0.076	0.121	–0.63
1995	1996	–0.006	0.033	–0.18	–0.047	0.035	–1.34	–0.158	0.105	–1.50

*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

in small, domestic establishments. The point estimates in terms of the number of workers for the periods 1991–96 and 1992–96 show a negative impact and are statistically significant at the 10% and 5% levels, respectively. The estimate for 1990-96 is also negative and is very close to significant at the 10% level (p-value = 0.101). The estimates of the proportional employment change are also negative and significant at the 10% level for 1991–96 and 1992–96.

Hence it appears that the larger increase in the Botabek minimum may have reduced employment in smaller domestic establishments relative to Jakarta. The point estimates are substantial in size. For example, between 1991 and 1996 establishments in Botabek are estimated to have lost approximately 22 workers per establishment relative to Jakarta. (Note that actual employment grew, but by less than it did in Jakarta.) The point estimates decrease in magnitude as the initial year moves from 1991 to 1996. A comparison of the point estimates for 1991–96 and 1992–96 suggests that almost half of the total relative loss between 1991 and 1996 occurred in the first year. The magnitude of the relative employment loss in Botabek between 1991 and 1992 probably reflects not only the increase in Botabek's minimum wage relative to Jakarta's over that period, but also the lagged effects coming from the much larger relative increase between 1990 and 1991. It is surprising that the estimate for 1990–96 is smaller than the 1991–96 estimate, because the gap between the Jakarta and Botabek minimum wages was much larger between 1990 and 1996 than between 1991 and 1996. This may reflect the relative imprecision of the estimates. (The confidence intervals for the 1990–96 and 1991–96 estimates overlap considerably.) It may also reflect lower compliance with the legislation in 1990, which is commonly viewed as the first year in which enforcement was treated seriously.

In proportional terms, the point estimates are also large. The average rate at which employment in small establishments grew between 1991 and 1996 was 41% higher in Jakarta than in West Java. The proportional estimate is significantly different from zero only at the 10% level, and the 10% confidence interval is 1.4% to 81%. The point estimate for 1992 to 1996 suggests a 16% relative employment gain in Jakarta.

Table 6 presents coefficient estimates from regressions that pool the establishment-level data across years, within the establishment size/ownership categories. Pooling the data increases the power of our significance test, especially in the case of large foreign establishments, for which the sample sizes in each year are quite small.[27] Each regression controls for the minimum wage faced by the establishment at the time, establishment effects, and year effects. In some specifications we include measures of the average wage paid to production and non-production workers. Although this approach is potentially problematic since these wages are affected by the minimum wage, we include these estimates for comparability with the existing literature (see, for example, Bell 1997).[28]

The results are very similar to the DID estimates. There is no evidence of a negative employment impact for large establishments. The coefficient on the minimum wage is either statistically insignificant or positive and significant for both large domestic and large foreign establishments. For small establishments the coefficient is negative and statistically significant. It shows an elasticity in the range of –0.31 to –0.46, which is slightly smaller than but similar to the average for the DID estimates of –0.54 (the average elasticity calculated from the proportional estimates with target years 1990–93). That these estimates are larger than those commonly

[27]Note that the number of observations in the panel regressions differs from the total sample used for the DID estimates because the DID estimates require that the firm was in existence in 1996 whereas the fixed effect panel estimates only require a firm to be observed in at least two years of data.

[28]This reduces the sample size because not all firms hire non-production workers. Bell (1997) also included proxies for the cost of capital and inputs. These variables are not readily available in our data. Note that the geographic proximity of our firms (unlike Bell's, which are spread across the entire country) makes it unlikely that these variables vary much across firms. Although the matching estimates match on value-added (in the base year), we choose not to control for value-added here, both because it is potentially endogenous and because it is not included in comparable studies.

Table 6. Panel Regression Results.
(dependent variable = ln[number of production workers])

	Small Firms			*Large, Domestic Firms*			*Large, Foreign Firms*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
ln(min. wage)	–0.317**	–0.459**	–0.550***	0.533***	0.478**	0.525**	0.648***	0.320	0.357
	(–2.49)	(–2.34)	(–2.68)	(3.22)	(1.96)	(2.14)	(2.07)	(0.74)	(0.87)
ln(production wage)		–0.094***			–0.001			–0.169***	
		(–5.47)			(–0.02)			(–5.53)	
ln(non-production wage)		0.093***			0.070***			0.065***	
		(5.91)			(4.71)			(3.10)	
Establishment Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Establishments along Border Only	No	No	Yes	No	No	Yes	No	No	Yes
R-Squared	0.025	0.076	0.018	0.01	0.026	0.003	0.02	0.02	0.024
N	4,217	2,995	2,683	2,036	1,810	1,101	622	568	310

*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

found for the United States (which are in the range of –0.1 or –0.2) seems reasonable given that Indonesian employers are likely to have a much higher share of minimum wage workers. Bell (1997) estimated elasticities in the range –0.03 to 0.33 for firms of all sizes in Colombia.

Sensitivity Tests

As noted above, neither for small or large establishments nor for domestic or foreign establishments do we find a systematic difference in the changes in employment between Jakarta and Botabek in the period 1995 to 1996—when minimum wages were the same in the two regions. This is consistent with our identifying assumption of no systematic difference in employment patterns in the absence of minimum wage differences. Nevertheless, we conduct the following sensitivity tests to further reduce concerns that center-periphery differences might be driving the results.

(a) Establishments close to the Jakarta/West Java border. The first sensitivity test restricts the sample to only sub-districts (kecamatan) that are directly on the West Java/Jakarta border. Sub-districts are quite small areas. There are about 130 subdistricts in Jabotabek. Looking only at this narrow band reduces the probability of the estimates being contaminated by systematic differences in economic conditions between the center and the periphery. Table 7 presents the DID results for changes in the number of workers.[29] The results for large establishments—domestic and foreign—are very similar to the original results. Except for 1990–96 for large foreign establishments, which shows a negative impact, the estimates are statistically insignificant for every pair of years. The point estimates for small establishments still suggest a negative impact for 1990–96, 1991–96, and 1992–96; however, unlike the previous set of results, the estimates for small establishments are now statistically insignificant. As mentioned above, the regressions pool the data and so provide more powerful tests of significance. The increase in power is especially useful in this restricted sample. Columns (3), (6), and (9) of Table 5 show the regression results when they are estimated just on establishments close to the border. The coefficient estimate for small establishments is negative and statistically significant (and slightly larger in magnitude, at –0.55). The point estimates for both large domestic and large foreign establishments are positive but are statistically significant only for large domestic establishments.

[29]The proportional results are qualitatively the same and are available from the authors on request.

Table 7. Sensitivity Tests.
(matched difference-in-differences estimates; matching on basis of value-added)

(b) High-wage/low-wage comparisons. The second sensitivity test compares high-wage establishments in Botabek with low-wage establishments, also in Botabek. These estimates cannot be driven by economic conditions differing with geographic location.[30] High-wage establishments are defined as establishments in which the average wage paid in the initial year was at least as great as the 1996 minimum. Because this is the average wage, it is of course possible that some workers in these establishments were paid less than the 1996 minimum wage but these establishments are nevertheless likely to have been less affected by the minimum wage increase than establishments with a lower initial average wage. All other establishments are classified as low-wage. The estimates in Table 7 show no employment impact for large foreign establishments. Some of the estimates for large domestic establishments are statistically significant at the 10% level, but these suggest a *positive* employment impact. The point estimates for small domestic establishments remain negative for the years 1990, 1991, and 1992, but only the 1990 estimate is statistically significant.[31]

Rates of Establishment Openings and Closures

The estimates above were calculated for establishments that operated throughout the entire period and so ignored establishment openings and closures. Table 8 presents the difference-in-differences results for the rate of net establishment openings. These are calculated by subtracting the change in the net opening rate between the initial year and the base period in Jakarta from the same change in Botabek:

$$(2)\qquad \hat{\eta}_{9296} = \left\{\frac{(N^{O,96}_{BOT} - N^{C,96}_{BOT})}{N^{95}_{BOT}} - \frac{(N^{O,92}_{BOT} - N^{C,92}_{BOT})}{N^{91}_{BOT}}\right\} - \left\{\frac{(N^{O,96}_{JAK} - N^{C,96}_{JAK})}{N^{95}_{JAK}} - \frac{(N^{O,92}_{JAK} - N^{C,92}_{JAK})}{N^{91}_{JAK}}\right\}.$$

where $N^{O,96}_{BOT}$ denotes the number of establishments in Botabek that opened in 1996, $N^{C,96}_{BOT}$ denotes the number of establishments in Botabek that closed in 1996, N^{96}_{BOT} denotes the total number of establishments in Botabek in 1996, and the variables for Jakarta are defined analogously.[32]

Of the 12 estimates presented in Table 8, only one—for large foreign establishments between 1992 and 1996—is significant (p-value = 0.064). Its statistical significance

[30]It does, however, raise the question of whether high-wage firms are an appropriate control—if they are the same as low-wage firms, why are they paying higher wages?

[31]We also estimated separate regression coefficients for high- and low-wage firms and found that these were insignificantly different from one another in all establishment categories.

In addition to the sensitivity tests discussed here, we estimated difference-in-differences-in-differences (DIDID) estimates. That is, we subtracted the employment growth trend of the firm (as implied by the change in employment between 1995 and 1996, when minimum wages in Jakarta and Botabek were the same) from the change experienced when the minimum wages were changed by different amounts. Thus this estimator differences out any systematic difference in employment growth rates between firms in Botabek and Jakarta. Table 5 shows that these trends are insignificantly different from zero, which suggests that it is unnecessary to use this kind of estimator. DIDID estimators also can make it harder to reject a null hypothesis that should be rejected (Hamermesh 2000). All estimates using this method were statistically insignificant except for some positive and significant estimates for large foreign firms.

[32]These estimates are in terms of the number of firms rather than the number of production workers because they are calculated from the backcast SI data, which do not provide information on the number of workers. The backcast data supplement the regular SI data. Firms first appear in the regular data set when they are initially detected by BPS. If this is not actually the firm's first year of operation as a medium or large firm, a shorter array of supplementary questions is asked about previous years of operation. Responses to these questions comprise the backcast data. Note also that we are treating firms with under 20 employees as being closed, or not yet opened.

These estimates are not reported by firm size because most new firms are likely to be small and firms may downsize before finally closing. Estimates by firm size are, however, also statistically insignificant. We also calculated differences-in-differences for opening rates and closure rates separately. These estimations produced qualitatively similar results.

Table 8. Difference-in-Differences Estimates of Net Openings.
(target year – 1996)

	Net Opening Rate in Botabek (%)		*Net Opening Rate in Jakarta (%)*		*DID Estimate*	
Target Year	*1996*	*Target Year*	*1996*	*Target Year*	*(%)*	*t-Value*
			All Establishments			
1992	–2.19	5.39	–7.78	3.33	3.53	1.11
1993	–2.19	3.74	–7.78	–0.24	–0.55	–0.18
1994	–2.19	4.93	–7.78	1.51	2.17	0.77
1995	–2.19	7.6	–7.78	1.68	–0.33	–0.12
			Domestic Establishments			
1992	–2.67	4.31	–7.76	2.59	3.37	0.96
1993	–2.67	3.65	–7.76	–2.43	–0.99	–0.3
1994	–2.67	4.70	–7.76	1.89	2.28	0.72
1995	–2.67	9.19	–7.76	1.89	–2.21	–0.72
			Foreign Establishments			
1992	0	10.2	–8.33	20.5	18.6	1.85*
1993	0	4.12	–8.33	–1.89	2.32	0.34
1994	0	5.94	–8.33	–5.77	–3.38	–0.43
1995	0	0.93	–8.33	–2.04	5.36	0.64

*Because the SI data do not provide kabupaten codes for 1990, we do not know the total number of firms operating in that year, as required by equation (2), and we cannot calculate estimates for 1991.

*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

and positive value suggest that for foreign establishments the larger increase in the minimum wage in Botabek resulted in an increase in the net opening rate of large foreign establishments in that province. Hence, Table 7 provides no evidence that establishments closed down as a result of the minimum wage changes.

Conclusion

Our findings show a negative, and sizeable, employment impact of minimum wages on small establishments in Indonesia: the elasticity of employment with respect to the minimum wage for small establishments is estimated to lie in the range –0.31 to –0.55. There is, however, no evidence of more small establishment closures or fewer openings resulting from the minimum wage increase. We find no evidence at all of a negative employment impact in large establishments, either domestic or foreign. These results accord with those of Rama (2001), who, using provincial data for the whole of Indonesia, found that large establishments were unaffected (or even experienced a small positive effect) but that smaller establishments suffered a negative employment impact.

Our results hence suggest that forcing the Nikes and Reeboks of this world to pay higher wages is unlikely to have a detrimental effect on employment within these establishments. This may be because these establishments already pay higher wages than the smaller establishments and so are less affected by minimum wage increases. Some of the estimates for large establishments even suggest a positive employment effect. This could be consistent with reduced employment in small domestic establishments. The neoclassical theory predicts that employment will fall in establishments where minimum wage workers account for a higher share of costs. It is possible that employment then shifts from low-wage small domestic establishments to the higher-wage large establishments.

It is noteworthy that although foreign firms have the reputation of being very sensitive to wage levels, over the six-year period we studied we found no evidence that such firms relocated outside Indonesia in response to the minimum wage increases. This was also

true of domestic establishments. It may be that the wage cost increases, although quite substantial, were small relative to relocation costs. Six years may also be too short a period in which to capture relocation decisions.

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