

**DO MINIMUM WAGE PRICE EFFECTS HURT
THE POOR MORE?^{1,2}**

SARA LEMOS³

I. Introduction

Whether, and to what extent, minimum wage legislation helps the poor is a crucial question for policymakers. Recent academic empirical work has sparked a heated debate with two clear sides: those who find evidence of adverse employment effects -- in line with the standard theoretical prediction - - and those who fail to find such evidence (Freeman, 1996; Brown, 1999). If firms do not respond to minimum wage increases by reducing production and employment, they might respond by raising prices. Theory predicts that an industry wide cost shock, such as a minimum wage increase, is passed on to prices. A small, but growing, empirical literature has examined such price effects of minimum wages (Brown, 1999). However, this evidence is primarily focused on the relatively small US food sector, which employs a disproportionately large share of minimum wage workers. The main finding of small overall and sectoral price effects in the US (Card and Krueger, 1995) is thus perhaps not too surprising. It is far from clear whether such findings could be generalized to developing country contexts, where poverty is more extensive and minimum wages influence a larger proportion of the workforce.

In this paper we estimate the minimum wage price effects in Brazil, using monthly household and firm data over nearly two decades. We thus provide, to the best of our knowledge, the first empirical evidence on the price effects of minimum wages in a key developing country. In Brazil, minimum wage

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increases are large and frequent and the proportion of workers directly affected is large. In addition, minimum wage changes also indirectly influence a substantial number of workers, earning below and just above the minimum wage threshold. As a result, the effect of the minimum wage on wages is sizeable, although the effect on employment is small, as recent empirical evidence indicates (Neumark et al., 2003; Lemos, 2004). This suggests that Brazilian firms may pass on the rising labor costs, associated with minimum wage increases, mainly in the form of higher prices.

Moreover, since our data contains information on the prices of goods consumed by the poor (and those consumed by the rich), we are able not only to estimate the price effect of a minimum wage in a poor country but also to examine its impact on the poor within the country. If the consumption bundle of the poor contains a large share of goods produced in low wage sectors then minimum wage increases may adversely affect the purchasing power of the poor. In addition, if such increases contribute substantially to overall price movements, the poor may again be adversely affected, as they suffer disproportionately from inflation. This is a particular concern in countries, like Brazil, where minimum wage changes have induced wage-price inflation spirals (Gramlinch, 1976; Freeman, 1996).

The main finding of this paper is that poor consumers in Brazil are adversely affected by the price effect of minimum wage increases. They experience inflation rates three times higher than rich consumers in the month of the increase. The differential effects diminish over time with the poor experiencing twice the inflation rate of the rich after six months, but roughly the same rate after a year of adjustment. In conjunction with other evidence indicating that employment effects are clustered around zero (Brown, 1999; Freeman, 1996; Lemos, 2004), this suggests that minimum wage increases in Brazil are primarily passed on to consumers, with poor consumers bearing the brunt of the adverse inflationary effects.

This paper is organized as follows. The data is introduced and described in Section 2. Our empirical approach is outlined in Section 3, which includes a discussion of the identification strategy. We present and discuss our results in Section 4, whilst Section 5 concludes.

II. Data

II.1 Minimum Wage Data

The minimum wage in Brazil is the same for all individuals. There are no differentiated minimum wage rates for different regions, specific demographic groups or labor market categories. Since the mid 1960s, the real minimum wage has been systematically under-indexed because nominal minimum wage increases are inflationary.

Firstly, the nominal minimum wage has a strong effect on other wages in Brazil, as it was used as a coordinator of the wage policy (Carneiro and Faria, 1998). In the presence of high inflation and distorted relative prices, rational agents took increases in the minimum wage as a signal for price and wage bargains - even after laws forbade its use as *numeraire* in 1987. The phenomena of minimum wage indexation and the reinforcement of inflationary expectations were first noticed by Gramlich (1976), and are more recently discussed by Card and Krueger (1995) and Freeman (1996). Maloney and Nunes (2004) show that the *numeraire* effect is a general phenomenon in Latin America.

Secondly, the nominal minimum wage has a strong effect on the large and growing public deficit via benefits, pensions, and the Government wage bill. This impact was often a key criterion associated to the affordability of minimum wage increases.

Figure 1 shows the erosion of the real minimum wage between January 1982 and January 2000. The horizontal axis indicates the timing of the five stabilization plans over this period. The minimum wage increases during this period were subject to the rules of five different stabilization plans. These increases were large and frequent, but quickly eroded by the subsequent inflation. For example, in early 1986, the nominal minimum wage was increased by 15% and initially adjusted bi-annually. It was then adjusted whenever inflation was higher than 20%. Despite that, the real minimum wage was 25% lower in mid 1987 than it was in early 1986. The nominal minimum wage was then initially frozen for three months before it was indexed monthly by past inflation. In early 1989, it was again frozen, and in mid 1989 it was again indexed monthly. In early 1990, the real minimum wage was 45% lower than it was in early 1989. In late 1991, the nominal minimum wage was again indexed monthly. In 1993, adjustments were made bi-monthly and then

monthly. In early 1994, adjustments were made daily, but this did not prevent the real minimum wage from decreasing by 40% in the first half of 1994. In mid 1995 the nominal minimum wage was increased by 42%, and since then it has been adjusted annually.

II.2 Price Data

The choice of the price measure is very important in such a high inflationary environment. We use three different consumer indices to measure price increases across different income levels. The Wide Consumer Price Index (IPCA), the Consumer Price Index (IPC), and the Necessary Minimum Wage (SMN) measure inflation for consumption bundles of households earning, respectively, between 1 and 40, 1 and 8, and 1 times the minimum wage as defined in the 1988 Constitution. Even though such a bundle has been unaffordable at the prevalent minimum wage, SMN is the effective inflation experienced by poor consumers, while IPC and IPCA measure the inflation experienced by the middle-class and rich consumers. Although SMN is largest during the whole sample period, suggesting that inflation was highest for the poor, the pattern over time is similar for the three indices, suggesting that the poor and the rich were affected by similar inflation growth. The correlation between IPC and IPCA is 0.99 in differences, while the correlation between SMN and IPC or IPCA is 0.88 in differences. Figure 2 shows that the patterns of the log nominal minimum wage and log (national aggregate) IPC in differences are remarkably synchronized, with a correlation of 0.55.

II.3 Other Data

The remaining data we use is from PME (Household Monthly Employment Survey), PIM (Industrial Monthly Survey), ELETROBRAS (Brazilian Electricity Agency) and BACEN (Brazil Central Bank). PME is a household rotating panel survey, similar to the US CPS (Current Population Survey), available for the six main Brazilian metropolitan regions (Salvador, Recife, Belo Horizonte, Rio de Janeiro, Sao Paulo and Porto Alegre). PIM is a firm panel dataset available for most of the Brazilian metropolitan regions, including the six regions above. All data is monthly aggregated across these six regions between 1982 and 2000.

The data show considerable regional variation, and it is this variation that we exploit to identify the minimum wage effect on prices in the models in

Section 3. Table 1 summarizes the main aspects of the data for a poor (Recife) and a rich region (Sao Paulo) over the sample period. All data is available from the IBGE (Instituto Brasileiro de Geografia e Estatística) and FGV (Fundacao Getulio Vargas).

III. Empirical Approach

III.1 Econometric Model

Although the burden of minimum wage increases to consumers has not been of much interest in Labor Economics, the burden of taxation and exchange rate fluctuations is one of the most fundamental questions in Public Finance and International Economics (Poterba, 1996; Goldberg and Knetter, 1997). A simple equation, commonly used in this so-called "pass-through" literature, is the inverse of the profit maximizing condition under imperfect competition, where price is a mark up over costs:

$$(1) \Delta \ln P_{it} = \alpha + \sum_{l=-k}^L \beta_l \Delta \ln MW_{t-l} + \gamma \Delta \ln W_{t-l} + \delta \Delta r_{it} + \epsilon \Delta \ln E_{it} + \\ + \mu \Delta \ln A_{it} + \sum_{m=1}^M \rho_m \Delta \ln P_{it-m} + f_i + f_t + w_{it}$$

For region i and time t , P_{it} is prices. We model costs by average wages W_{it} , minimum wage MW_{it} , real interest rate r_{it} , productivity A_{it} , and industrial power consumption E_{it} (industrial power costs data was not available). We define the real interest rate as the national nominal interest rate minus regional inflation. And we define productivity as the total industrial production divided by total number of workers directly employed in production in the metallurgic industry. We use regional dummies to model region specific growth trends f_i , and month and year dummies to model time specific effects f_t . The error term is w_{it} . We use lagged rather than contemporaneous wages to circumvent endogeneity problems arising from the simultaneous determination of wages and prices at the macro level. We assume that the static specification is valid at each period and allow dynamics by adding lags and leads of the shock variable (indexed by $l = -k, \dots, L$) and lags of the dependent variable (indexed by $l = m, \dots, M$). The number of lags and leads is an empirical matter and is discussed in Section 4.

As a robustness check, we estimate Equation (1) using two different production functions, $Y=f_L(L)$ and $Y=f_{LK}(L,K)$, where L is labor and K is capital. If we assume that capital is fixed in the short run, we can constrain the coefficient of the real interest rate (δ) to zero. The aim is to check whether the estimates are sensitive to controlling for the real interest rate, or put differently, to allowing the labor capital mix to be altered following a minimum wage increase.

All models are sample size weighted to account for the relative importance of each region (and for heteroskedasticity arising from aggregation), as well as corrected for serial correlation across and within regions, assuming a region-specific autoregressive process.

III.2 Identification

As the nominal minimum wage does not vary across regions in Brazil, β is not fully identified in Equation (1). To circumvent this problem, the typical minimum wage variables used in the literature are the "Kaitz index", defined as the ratio of the minimum wage to average wage adjusted for coverage of the legislation (Kaitz, 1970), and "fraction affected", defined as the proportion of workers earning a wage between the old and the new minimum wage (Card, 1992). The "Kaitz index" has been largely criticized in the literature because the variation in average wages is what drives the variation in the ratio in any given time period. As a result, the effect of the inverse of the average wages on prices is what would ultimately be estimated (Welch and Cunningham, 1978). "Fraction affected" has also been criticized in the literature because it is constant when the nominal minimum wage is constant, and thus does not capture the erosion of the minimum wage in relation to other wages and prices (Brown, 1999).

A variable closely related to "fraction affected" is "fraction at" the minimum wage, defined as the proportion of workers earning one minimum wage (Dolado *et al.*, 1996) (plus or minus 0.02%, to account for rounding approximations). Unlike "fraction affected", "fraction at" has variation across regions both when the nominal minimum wage is constant and when it is increased. Thus, in a similar fashion to Card and Krueger (1995), we use "fraction at" in place of log nominal minimum wage in Equation (1) to ensure identification of the effect of the minimum wage on prices. The new equation is:

$$(2)\Delta \ln P_{it} = \alpha + \sum_{l=k}^L \beta_l F_{it-l} + \gamma \Delta \ln W_{it-1} + \delta \Delta r_{it} + \epsilon \Delta \ln E_{it} + \mu \Delta \ln A_{it} + \\ + \sum_{m=1}^M \rho_m \Delta \ln P_{it-m} + f_i + f_t + u_{it}$$

Nonetheless, the interpretation of "fraction at" in Equation (2) is not straightforward. This is because the coefficient of interest β is informative of the change in prices given a change in the proportion of workers earning one minimum wage but not given a change in the minimum wage itself, which is the relevant policy variable. A more intuitive and policy relevant minimum wage variable is the interaction of the nominal minimum wage with "fraction at". This gives a weighted nominal minimum wage, where the impact of a national minimum wage increase in each region is being measured by the proportion of workers earning one minimum wage in that region. The correlation between log (national aggregate) IPC and log (national aggregate) weighted nominal minimum wage in differences is 0.45. Thus, we include the weighted nominal minimum wage in the model. The new equation is:

$$(3)\Delta \ln P_{it} = \alpha + \sum_{l=k}^L \beta_l^W \Delta \ln MW_t F_{it-l} + \beta F_{it} + \gamma \Delta \ln W_{it-1} + \delta \Delta r_{it} + \\ + \epsilon \Delta \ln E_{it} + \mu \Delta \ln A_{it} + \sum_{m=1}^M \rho_m \Delta \ln P_{it-m} + f_i + f_t + v_{it}$$

where β^W is the coefficient of interest.

III.3 Estimation

It has been suggested in the minimum wage literature that the poor are those consuming minimum wage labor intensive goods and that therefore they pay proportionately more for the minimum wage increase (Freeman, 1996; MaCurdy and McIntyre, 2001). As discussed in Section 2.2, SMN, IPC and IPCA measure price increases experienced by consumers with different income levels. Thus, we use these indices to provide evidence on price increases paid by poor, middle-class and rich consumers, respectively, following minimum wage increases. The relevant question here is whether the inflation caused by minimum wage increases affects the poor more severely.

The preliminary evidence is that although SMN is largest during the whole sample period, indicating that inflation was highest for the poor, the pattern over time is similar for the three indices, suggesting that the poor and the rich were affected by similar inflation growth (see Section 2.2). To obtain further evidence, we use SMN, IPC and IPCA each in turn to estimate Equation (3). The respective β^W estimates measure the increase in prices paid by the poor, the middle-class and the rich following a minimum wage increase. If this estimate is larger in the SMN equation, then the poor are exposed to higher inflation following an increase.

IV. Results

IV.1 Price Increases for the Poor

Panel A of Table 2 shows WLS β^W estimates using SMN, the price index that measures the inflation experienced by poor consumers. The estimates of the static version of Equation (3), shown in Panel A1, indicate that a 10% increase in the minimum wage raises prices by 0.09%, regardless of whether the real interest rate is controlled for or not. This effect is larger when allowing the effect of minimum wage increases on prices to take several months to be complete (adding lags of the shock variable) and when allowing several months for price adjustments in response to minimum wage increases (adding lags of the dependent variable). For example, the estimates allowing dynamics for six months, shown in Panel A2, indicate that a 10% increase in the minimum wage raises prices by 0.13% (0.12%) in the short run and by 0.27% (0.27%) in the long run before (after) controlling for the real interest rate. The slightly smaller estimate, when controlling for the real interest rate, suggests that the minimum wage is picking up some of the negative effect of the real interest rate on prices when $Y=f_L(L)$ is assumed. Furthermore, the short run estimates do not change when allowing dynamics for twelve months. Nonetheless, the long run estimates are smaller, as shown in Panel A3, suggesting that firms adjust on other margins (profits or employment) in the longer run.

Our preferred specifications are those that control for the interest rate, thus separating the effect of the minimum wage from the effect of the real interest rate on prices. Using these specifications, a 10% increase in the minimum wage raises prices by 0.12% in the month of the increase and by 0.17% after

twelve months of adjustment. This suggests that the poor suffer from overall price increases triggered by raises in the minimum wage. This evidence is in line with theory and with previous overall price effects in the international literature ranging from 0.20% to 0.40% (Sellekaerts, 1981; MaCurdy and McIntyre, 2001; Aaronson, 2001).

IV.2 Price Increases for the Rich

Panels B and C of Table 2 show WLS β^W estimates using the price indices that measure the inflation experienced by middle-class (IPC) and rich (IPCA) consumers. The estimates of the static version of Equation (3), shown in Panel B1, indicate that a 10% increase in the minimum wage raises prices by 0.06% regardless of whether the real interest rate is controlled for or not. This effect is smaller when allowing for dynamics. For example, the estimates allowing dynamics for six months, shown in Panel B2, indicate that a 10% increase in the minimum wage raises prices by 0.05% (0.04%) in the short run and by 0.17% (0.17%) in the long run before (after) controlling for the real interest rate. As before, this effect is slightly smaller in the short run after controlling for the real interest rate, but unchanged in the long run. The estimates are fairly robust when allowing dynamics for twelve months, as shown in Panel B3.

The estimates for rich consumers, shown in Panels C1 to C3, demonstrate a very similar picture to that for middle-class consumers. Using our preferred specifications, a 10% increase in the minimum wage raises prices by 0.05% (0.04%) for the middle-class (rich) in the month of the increase and by 0.15% (0.15%) after twelve months of adjustment.

IV.3 Discussion

The evidence above suggests that minimum wage increases significantly raise overall prices in Brazil and that the poor are exposed to three times the inflation rate that the rich are exposed to in the month of the increase, to twice that inflation after six months of adjustment, but to roughly the same inflation rate after twelve months.

First, this evidence is supportive of the theoretical hypothesis, discussed in Section 1, which minimum wage increases are passed on to prices and are, therefore, born by consumers. This is in line with employment effects clustered around zero, as reported in the empirical literature. Furthermore, the

evidence here suggests that minimum wage increases affect all consumers, through affecting overall prices.

Second, although minimum wage increases affect all consumers, different consumers need not be affected in the same way. In the short run, the poor are exposed to three times the inflation that the rich are exposed to. Either the poor spend a much larger share of their incomes on minimum wage labor intensive goods, or the prices of such goods go up by much more, or both. Thus, the poor bear more of the immediate burden of the increase. In the long run, however, the poor and the rich are exposed to roughly the same inflation rate. This suggests that the increase slowly propagates throughout the economy. This is because minimum wage workers are present in various sectors throughout the economy and thus the prices of a wide range of goods go up. Furthermore, the indexer and *numeraire* roles, together with wage spillover effects, propagate the increase (see Section 2.1). As a result, the rich (just like the poor) spend a substantial income share on goods whose prices went up (which are not only minimum wage labor intensive goods). Once the increase propagates throughout the economy, the burden is more evenly distributed across the poor and the rich.

Third, the effect of the minimum wage on prices is clearly different for the poor compared to the rich. The poor suffer disproportionately more from any given inflation rate -- this can be compared to a regressive sales tax. Furthermore, the poor suffer from higher inflation for the first six months after the increase, when they are exposed to almost twice the inflation the rich are exposed to. Only after twelve months does the inflation rate for the poor fall to similar, but still slightly higher levels than that of the rich -- which is roughly the same after six or after twelve months of adjustments. Thus, the poor carry a substantially heavier share of the burden.

These results suggest that, even if detrimental employment effects are small, the minimum wage may adversely affect the poor. MaCurdy and McIntyre (2001) provide evidence for the US that supports this view. This is particularly the case if minimum wage increases induce wage-price inflation spirals (Gramlich, 1976; Freeman, 1996) that quickly erode the benefits of the increase and leave more permanent inflation side effects, like in Brazil.

V. Conclusion

In this paper we estimated the effect of the minimum wage on prices paid by poor and rich consumers using monthly Brazilian household and firm data over nearly two decades. The results indicate that the minimum wage raises overall prices in Brazil. This is in line with evidence in the literature that suggests that employment effects are clustered around zero.

Nonetheless, although minimum wage increases affect all consumers, different consumers need not be affected in the same way. We show that the poor are exposed to three times the inflation rate that the rich are exposed to in the month of the increase, to twice that inflation after six months, but to roughly the same inflation after twelve months. A 10% increase in the minimum wage raises prices paid by the poor (rich) by 0.12% (0.04%) in the month of the increase, by 0.27% (0.16%) after six months, and by 0.17% (0.15%) after twelve months. This is in line with theory and with previous empirical results in the international literature, which reports overall price effects ranging from 0.20% to 0.40%.

Thus, the poor bear more of the brunt of the inflationary effects of the increase and that continues to be the case for the following six months. After twelve months, however, the burden is more evenly distributed between the poor and the rich. This occurs because minimum wage workers are present in various sectors throughout the economy, because of the indexer and *numeraire* roles played by the minimum wage and because of wage spillover effects.

The main policy implication following from these results is that minimum wage increases might adversely affect the poor in Brazil. Even if detrimental employment effects are small, raising the nominal incomes of poor working households, we have shown that the cost of poor households consumption bundles will rise. Furthermore, the impact of minimum wage increases on overall prices has a lasting adverse effect on the poor, who disproportionately suffer from inflation. More research is needed to explore what the overall effect of minimum wage increases on the poor is, before the minimum wage can be convincingly justified as a poverty alleviation measure.

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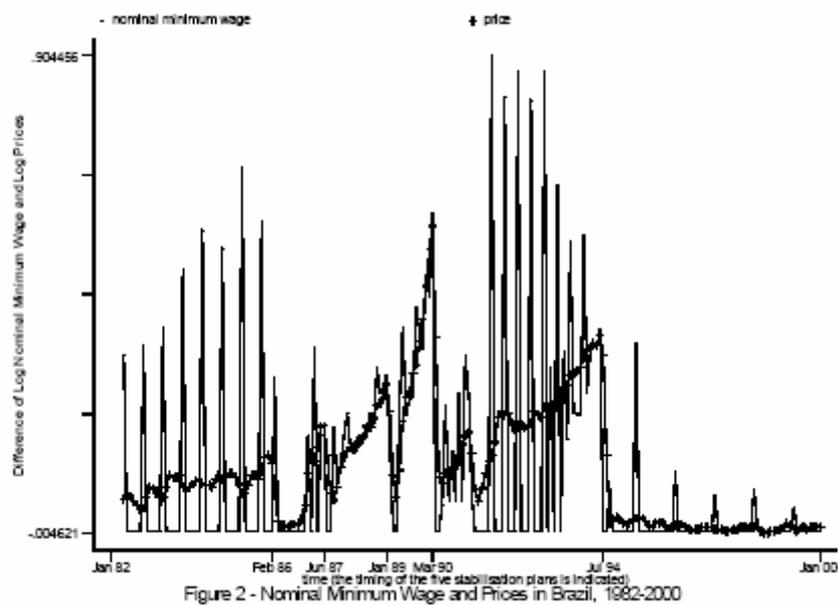
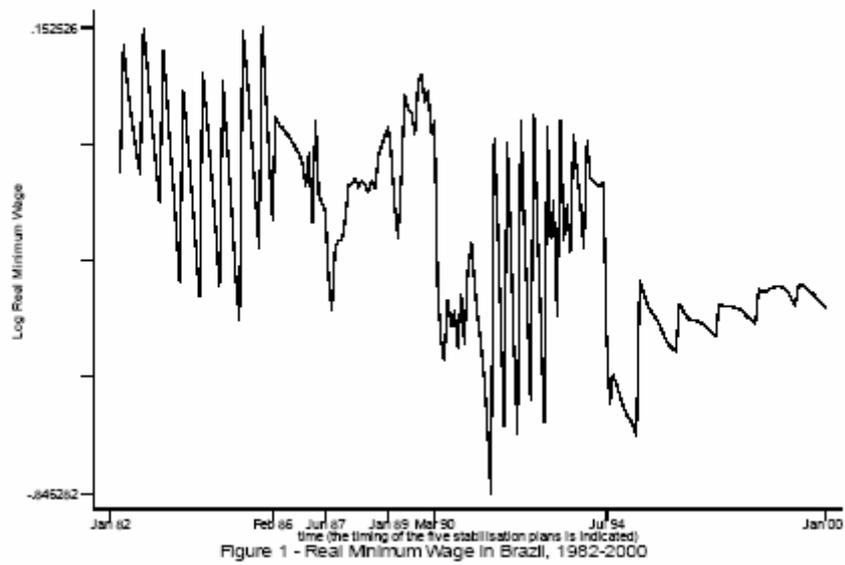


Table 1 - DESCRIPTIVE STATISTICS ACROSS REGIONS AND TIME

Variables	Recife (poor region)	Sao Paulo (rich region)
I - Percentage of Population		
aged 0 to 14 years old	0.18	0.15
aged 15 to 24 years old	0.27	0.25
aged 25 to 64 years old	0.47	0.53
aged over 65 years old	0.07	0.07
women	0.45	0.43
student	0.31	0.22
enrolled in schooling	0.38	0.31
literate	0.86	0.95
elementary education (8 years of schooling)	0.43	0.38
secondary education (11 years of schooling)	0.14	0.14
graduates	0.08	0.11
retired	0.13	0.11
in urban areas	0.93	0.97
II - Percentage of Workers		
metallurgic industry	0.07	0.19
building construction	0.03	0.04
commerce	0.09	0.09
services	0.26	0.29
public sector	0.07	0.05
informal sector	0.23	0.36
III - Economy Wide		
unemployment rate	10.2%	7.4%
average hours worked by those employed	41.33	40.70
average hours worked in the labor force	37.12	37.68
"fraction at"	15.1%	4.0%
log weighted nominal minimum wage	-0.4638	-0.2185
log real minimum wage	4.9247	5.0458
log 25th percentile hourly real wage distribution	4.9380	5.7292
log 50th percentile hourly real wage distribution	5.3872	6.2283
log 75th percentile hourly real wage distribution	6.0179	6.7970
log average hourly real wage distribution	5.5289	6.2963
log standard deviation hourly real wage distribution	6.5533	7.1351
log price index	-9.0101	-9.1312
log real interest rate	2.0809	2.0805
log productivity	0.1351	0.2078
log industrial power consumption	7.9324	9.3027
sample size	2475815	3708834

Table 2 - THE EFFECT OF A 10% INCREASE IN THE MINIMUM WAGE ON PRICES ACROSS INCOME LEVELS

models	(A) POOR			(B) MIDDLE CLASS			(C) RICH		
	short run coefficient (1)	standard error	long run coefficient (2)	short run coefficient (1)	standard error	long run coefficient (2)	short run coefficient (1)	standard error	long run coefficient (2)
(1) static									
$Y = \beta_1(L)$	0.09	0.02		0.06	0.01		0.06	0.01	
$Y = \beta_{1K}(L, K)$	0.09	0.02		0.06	0.01		0.06	0.01	
(2) dynamic (including 6 lags of the shock variable and of the dependent variable)									
$Y = \beta_1(L)$	0.13	0.02	0.27	0.05	0.01	0.17	0.05	0.01	0.16
$Y = \beta_{1K}(L, K)$	0.12	0.02	0.27	0.04	0.01	0.17	0.03	0.01	0.16
(3) dynamic (including 12 lags of the shock variable and of the dependent variable)									
$Y = \beta_1(L)$	0.13	0.03	0.18	0.05	0.01	0.16	0.05	0.01	0.16
$Y = \beta_{1K}(L, K)$	0.12	0.02	0.17	0.05	0.01	0.15	0.04	0.01	0.15

(a) The dependent variable is the difference of log prices. The shock variable is the difference of log weighted annual minimum wage, where the weights are the proportion of workers among the minimum wage across regions.
 (b) Time effects are modelled with month and year dummies, region effects are modelled with region dummies, cont dummies are included as controls, depending on which of the two production functions is used, $Y = \beta_1(L)$ or $Y = \beta_{1K}(L, K)$.
 (c) These are β^* , WLS estimates in run using price indices for the poor, the middle class and the rich. The weights are the squared root of the inverse of the sample size.
 Standard errors are corrected for serial correlation across and within regions (assuming an autoregressive process specific to each region).

**DO MINIMUM WAGE PRICE EFFECTS HURT
THE POOR MORE?****SARA LEMOS****SUMMARY**

JEL Classification: J32.

Minimum wage legislation is potentially a powerful policy tool to help alleviate poverty in developing countries. This is especially the case when the detrimental employment effects are small. However, of critical importance is whether, and to what extent, minimum wage increases will generate price effects that might adversely affect the poor. This might occur, firstly, if the poor consume a lot of goods produced in sectors dominated by minimum wage workforces. Secondly, this may occur if minimum wage increases raise overall prices, as the poor disproportionately suffer from inflationary costs. In this paper we estimate minimum wage price effects for Brazil, using monthly household and firm data over nearly two decades. We find that minimum wage increases significantly raise overall prices in Brazil. Furthermore, we examine the price effect of the minimum wage separately on poor and rich consumers. The poor experience inflation rates three times higher than the latter, in the immediate aftermath of a minimum wage increase, with the differential effect diminishing over time.

Keywords: minimum wages, labor costs, price effects, cost shocks, Brazil.