

ISSN 1350-6722

*University College London*



**DISCUSSION PAPERS IN ECONOMICS**

THE EFFECT OF MINIMUM WAGES ON PRICES IN BRAZIL

by

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Discussion Paper 04-01

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# The Effects of the Minimum Wage on Prices in Brazil

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April, 2003

There is very little evidence on the effects of the minimum wage on prices in the international literature and none whatsoever for developing countries. This paper analyzes the effects of the minimum wage on prices using monthly Brazilian household and price data from 1982 to 2000 aggregated at a regional level. A number of conceptual and identification questions are discussed, for example: (1) Empirical evidence on price effects might help to answer the question of who pays for the higher costs: firms, consumers, or unemployed. The answer to this question is important for the controversial recent minimum wage debate. Employment might not be affected if firms are able to pass through to prices the higher labour costs associated to a minimum wage increase. (2) If the poor are the consumers of minimum wage labour intensive goods, or if these goods represent a large proportion of their consumption bundle, then minimum wage increases might hurt rather than aid the poor. Furthermore, if minimum wage increases are passed on to consumer prices causing inflation, they might again hurt the poor, who disproportionately suffer from inflation. This is particularly so in the presence of hyperinflation; even more so if the minimum wage has been used as anti-inflation policy in addition to its social role, as in Brazil. Robustness checks on the price effects at a regional level, on low and high income consumers and under low inflation are performed. Robust results indicate that minimum wage increases raise overall prices in Brazil. The resulting inflation is the same for the poor and the rich, smaller in low inflation periods, and larger in poorer regions.

Keywords: minimum wage, wage effect, employment effect, informal sector, cost shock. JEL code: J38.

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Minimum wage legislation has extensively been used in developing countries as a social policy ostensibly to improve the well being of the poor. There are two important issues if that is to be achieved: Can minimum wage legislation actually help the poor people? Are there alternative policies that would be more effective? The *broad objective* of this paper is to study whether minimum wage increases help the poor in Brazil. Hopefully this will shed some light on how such increases affect the poor in other developing countries as well. The *specific objective* is to estimate the effects of minimum wage increases on prices using a Brazilian household survey, only recently released for the public and not yet used for minimum wage studies, and price from 1982 to 2000.

This represents an important contribution to the literature because it will extend the current understanding on the effects of the minimum wage on prices and on the effects of the minimum wage in developing countries. This is crucial if the minimum wage is to be used as a policy to help poor people in poor countries. More specifically:

**(1)** Empirical evidence on price effects will help to answer the question of who pays for the higher costs associated to a minimum wage increase: firms, consumers, or unemployed. Employers facing higher labour costs respond by reducing profits, reducing employment, or raising prices.

Profits - Voters commonly assume that minimum wages will be paid out of profits. There is very little empirical evidence to support this hypothesis (Card and Krueger, 1995), but economic theory suggests this does not occur. Low wage firms are usually small firms in highly competitive markets and are not sufficiently profitable to absorb the extra costs. Even among larger and more profitable firms, capital is highly mobile and will flow to wherever profits are higher.

Employment - Most of the minimum wage literature has focused on employment effects, which implicitly assumes that output *prices are given* on a competitive market, and that firms lower employment as a result of a minimum wage increase. This hypothesis, however, has been broadly dismissed in the literature. In a recent survey, Brown (1999, p.2154) remarks: “the minimum-wage effect is small (and zero is often hard to reject)”. While there is yet no consensus, small employment effects, clustered around zero, are becoming prevalent in the literature (Freeman, 1994 and 1996; Brown, 1999). Evidence for Brazil is in line with the international literature (Camargo, 1984; Velloso, 1988; Neri, 1997; Carneiro, 2000; Carneiro, 2002; Corseuil and Servo, 2002; Lemos, 2003a, 2003b and 2003c).

Prices - There is very little empirical evidence on the effects of the minimum wage on prices. While there were over 300 papers on the *employment* effect of the minimum wage by 1995 (Card and Krueger, 1995), only a couple of papers had been written on its *price* effects by then (Wessels, 1980; Card and Krueger, 1995) [plus the US Labour Department reports (1965, 1967, and 1981)], and not many more have been written since. There has been considerable effort to reconcile the standard theory prediction of employment decrease in presence of wage increases with the available empirical evidence (Card and Krueger, 1995; Brown, 1999). However, little attention has been paid to the equally important theory prediction that an industry wide cost shock will be passed on to prices. Employment will not be affected if firms are able to pass through to prices the higher costs associated to a minimum wage shock. Constant prices is a reasonable assumption for an industry where firms affected by the increase compete with firms not affected. However, an increase in the minimum wage represents an industry wide increase in costs. It is then crucial to study the reverse hypothesis, which assumes that *employment is given*, and that firms raise their prices in response to the minimum wage increase. With employment and profits unaffected, higher prices are an obvious response to a minimum wage increase.

Further to playing an important role in the controversial recent minimum wage debate, answering the question of who pays for the increase is important for welfare analysis (Freeman,

1996). 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). Unfortunately, this question has not been asked quite so frequently in Labour Economics. Absent employment losses, the minimum wage is just a program that transfers money from one group to another. The effectiveness of this transfer as an antipoverty program is a question of redistribution. If the poor are the consumers of minimum wage labour intensive goods, or if these goods represent a large share of their consumption bundle, then minimum wage increases might hurt the poor. Moreover, if minimum wage increases cause inflation, they might hurt rather than aid the poor, who disproportionately suffer from inflation. This is particularly so in the presence of hyperinflation; even more so if the minimum wage has been used as anti-inflation policy in addition to its social role, as in Brazil.

(2) There is little empirical evidence on the minimum wage price effects in the international literature, and none whatsoever for developing countries. The international literature mainly utilizes data from the US. Perhaps because the price effects are small, little further research has been carried out. However, the available evidence needs to be proved robust to the US. Furthermore, this evidence might not carry out to developing countries. Further empirical evidence is urged both for developed and developing countries. “No single empirical study of an economic phenomenon is ever highly convincing” (Hamermesh, 2002, p. 4). Many data points are needed - many and independent data points are needed. Using non-US data is an unbiased way of extending the understanding of minimum wage effects and assessing the robustness of findings for the US. Hamermesh (2002, p. 15) argues for increased reliance on non-US data and policy evaluations: “policies like hours legislation and the minimum wage provide especially fruitful areas in which to apply the results of studying foreign experiences to the US”. Foreign experiences are especially fruitful if they generate exogenous shocks (an alternative to reliance on statistical methods to circumvent the problems arising from endogeneity), as in Brazil over the past 30 years.

The existing literature on price effects mainly utilizes data for the food sector – which employs a disproportionate share of minimum wage workers – implicitly assuming the overall price level as given. It is hard to find overall price effects, and even sectoral price effects are small. This is because, (a) the US minimum wage increases are small; and (b) the percentage of minimum wage workers is also small. For example, according to Card and Krueger (1995), a 15% minimum wage increase was estimated to raise the prices of (fast-food) restaurants by 2.2% for a labour’s share in total cost of 30%. A 15% increase in the price of a factor that is itself about 30% of costs raises overall prices by little enough to be ignored.

Larger price effects are expected in Brazil. To illustrate that, consider the average increase in the nominal minimum wage in Brazil, which was also 15% in the sample period. In Pernambuco, a poor region in Brazil, 11% of workers earn one minimum wage. Assuming 30% labour’s share (for comparison purposes), overall prices are expected to increase by 0.5%. If not only those at, but also those below the minimum wage have their wages increased (33% of workers), prices are expected to increase by 1.5%. If finally not only those at and below, but also those earning multiples of the minimum wage (0.5, 1, 1.5, 2, 2.5 and 3 minimum wages) wage have their wages increased (46% of workers), prices are expected to increase by 2.1%. For a rich region, Sao Paulo, these effects range from 0.2% to 1.8%. Furthermore, these effects are ten times larger when the largest minimum wage increase in the sample period (150%) is considered. Such effects are large because of three reasons: the percentage of workers affected by the minimum wage is large; the minimum wage increases are large and frequent; and the minimum wage plays an indexer role in Brazil, whereby agents take increases in the minimum wage as a signal for price and wage bargains.

(3) A number of conceptual and identification questions are discussed, for example: (a) A national minimum wage cannot explain variation in employment across regions (Brown et al., 1982; Card and Krueger, 1995; Burkhauser et al., 2000). Identification of the effect of the minimum wage separately from the effect of other variables on prices requires regional variation if no restriction on time modeling is imposed. This motivates the use of “spike” as a minimum wage variable, which is here argued to be superior to the commonly used “Kaitz index” and “fraction affected”. (b) Robustness checks on the price effects on low and high income consumers and under low inflation are performed.

The starting point here is to present a literature survey. On the one hand, most available studies in the literature are grounded on the standard theory model prediction discussed above that if employers do not respond to changes in the minimum wage by reducing employment or profits, they respond by raising prices. However, none of them discusses explicitly the theoretical model that delivered their empirical equation specification. On the other hand, while empirical work on the price response to minimum wage increases is limited, there is a large empirical literature on the price response to changes in other industry-wide costs, such as sales taxes and exchange rates - the so-called pass-through literature. A theoretically informed statistical investigation is here conducted, whereby the empirical equation is delivered by a theoretical model and then discussed in the light of the pass-through literature and the aggregate supply and Phillips curve empirical literature. Various alternative empirical specifications are used to check for the robustness of the pass-through estimate. Furthermore, the effect of the minimum wages on prices at a regional level, in low inflation periods and across the income distribution is estimated. Robust results indicate that minimum wage increases significantly raise overall prices in Brazil. The resulting inflation is the same for the poor and the rich, smaller under low inflation periods and larger in poorer regions.

This paper is organized as follows. Section 2 describes the minimum wage in Brazil. Section 3 presents the data. Section 4 presents a survey of the literature. Section 5 provides the theoretical foundation. Section 6 discusses the empirical equation specification (Section 6.1); discusses identification (Section 6.2), presents the results at a national and at a regional level (Section 6.3); provides robustness checks on the price effects on low and high income consumers and under low inflation (Section 6.4) and discusses the results (Section 6.5).

## **2. MINIMUM WAGE IN BRAZIL**

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

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

The minimum wage social role changed when the dictatorship installed in 1964 associated high inflation with wage adjustments. Nominal minimum wage increases can be inflationary because they affect production costs and prices, not only through its direct effect on minimum wage workers, but also through indirect spillover effects (Brown, 1999). The dictatorship limited labour organization,

reduced wage militancy, and implemented a centralized wage policy. One of the strategies of this policy was under-indexation of the real minimum wage, via erosion of the nominal minimum wage (Macedo and Garcia, 1978), which transformed the latter “from a social policy designed to protect the worker’s living standard into an instrument for stabilization policy” (Camargo, 1984, p.19). The “Teoria do Farol” (Lighthouse Effect) associated the subsequent increase in inequality revealed in the 1970 Census with the post-64 real minimum wage decrease (Souza and Baltar, 1979, 1980a and 1980b).

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

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

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

Graphs 1.a and 1.b show log nominal and log real hourly minimum wage between 1982 and 2000. The real minimum wage decreased steadily during the period; its highest (lowest) level was in November 1982 (August 1991), before the acceleration of inflation. In political terms, three events were important in the 80s: (a) in 1984, the minimum wage became national, after slow regional convergence; (b) with the end of the military regime in 1985, the 1988 Constitution re-defined the subsistence income (diet, accommodation, education, health, leisure, clothing, hygiene, transport, and retirement) for an adult worker and his/her family - even though such a bundle was unaffordable at the prevalent minimum wage; (c) the union movement re-emerged and became ever stronger, reaching a high union density for a developing country (Carneiro and Henley, 1998; Amadeo and Camargo, 1993). In economic terms, despite the political changes, the minimum wage was still a component of the centralized wage policy. The 80s and 90s witnessed an exhausting battle against

inflation. Five stabilization plans between 1986 and 1994 had different nominal minimum wage indexation rules depending on the inflation level. Since then, under reasonably stable inflation, the minimum wage has not been explicitly used as an anti-inflation policy.

### **3. DATA**

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

The price data are the National Consumers Price Index (INPC), the National Wide Consumer Price Index (IPCA), and the Necessary Minimum Wage (SMN), all of which can be disaggregated by region and by commodity. The choice of the price measure is very important in a high inflationary environment such as the one experienced in Brazil in the last 30 years. INPC (IPCA) is computed over the consumption bundle of households earning between 1 and 8 (1 and 40) minimum wages (Gonzaga and Machado, 2002); INPC puts more weight on goods consumed by poorer households. The two indices have a striking correlation of 0.99 both in levels and in differences. SMN is computed over the consumption bundle of households earning 1 minimum wage as defined in the Constitution, i.e., the subsistence income for an adult worker and his/her family (Section 2). Even though such a bundle has been unaffordable at the prevalent minimum wage, this is the effective inflation experienced by a household with subsistence levels of consumption. The correlation between SMN and INPC/IPCA, is 0.99 (0.88) in levels (differences). Graph 1.c shows the three indices over time. 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 all consumers were affected by the same inflation growth. The main price data used is INPC, but robustness checks using IPCA and SMN are performed (Section 6.4).

In addition to Graph 1, Graph 2 plots minimum wage and prices. The raw correlation of price and the nominal minimum wage is 0.999 (0.535) in levels (differences). The pattern both in levels and in differences of the two is remarkably synchronized. This is in line with the indexer role played by the minimum wage (Section 3). Aaronson (2000) reports price responses occurring within a month or two of the minimum wage change for the US.

### **4. LITERATURE SURVEY**

The Department of Labor published several studies on the effects of the 1961 and 1967 minimum wage increases (US Department of Labor, 1965 and 1969). Using difference in difference estimators, Southern and non-Southern industry prices were compared assuming greater minimum wage effect in low wage areas. Wholesale prices of industrial commodities and price trends for low wage industries were found relatively stable. Even though the increases became effective during a period of rising prices, they were found to have little influence on this upward trend. Later, using the same method and data, Wessels (1980) found little consistent pattern in price increases in manufacturing, but faster price increases in Southern services.

Sellekaerts (1981) reviewed twelve studies on wage and price inflation, among which Gramlich (1976) and Falconer (1978), that estimated a wage or Phillips curve relation, inserted or not in a

general equilibrium macro model, as a function of the minimum wage. They generally suggested that price effects exceeded wage effects. The effect on inflation of a 10% increase in the minimum wage across these studies ranged from 0.15% to 1.8%. Sellekaerts (1981) criticized these findings based on methodological problems, which she attempts to overcome with a modified version of the MIT/PENN/SSRC macro model of the US economy, using 1974 to 1979 data. She estimated the average annual total impact of a 10% minimum wage increases to be 0.6% for wage inflation and 0.2% for price inflation.

Sellekaerts' (1981) study is one of eight studies published on a special volume on inflation by the US Minimum Wage Study Commission (US Government, 1981). The implicit message across these studies is that the effect of the minimum wage on inflation was too low to be a concern. Two of these studies are worth noting. First, Oaxaca and Cox (1981) using data from 1974 to 1978 simulated the effect of freezing the minimum wage at its 1974 level on employment, output, wages and prices using a general equilibrium model. They reported that a 10% increase in the real minimum wage increases the aggregate real wage bill by 0.1%-0.5% (they do not report the effect on prices). Second, Wolf and Nadiri (1981) used data from CPS and an input-output model to trace the direct and indirect price effects of the 1963, 1972, and 1979 minimum wage increases. Their simulations assume full coverage and full compliance and thus estimate the upper bound effects of the increase. They estimated that a 10%-25% minimum wage increase raises prices by 0.3%-0.4%.

Using difference in difference and reduced form equations, and their own survey data, Katz and Krueger (1992) and Card and Krueger (1995) compared prices at fast-food restaurants in New Jersey and Pennsylvania following the 1992 New Jersey minimum wage increase. They found that average prices rose in New Jersey by about enough to cover the costs of the higher minimum wage. Within New Jersey, however, they found that prices rose just as quickly at restaurants paying the minimum wage and restaurants already paying as much as or more than the new minimum wage. Similar findings in their Texas study suggest that prices rose at about the same rate in fast-food restaurants that made larger or smaller wage adjustments following the 1990/1991 federal minimum wage increases. They also compared restaurant average price increases across cities and states surrounding the early 1990s federal increases using two different sources of price data. They found evidence that restaurant prices rose faster at (a) states that made larger adjustments following the federal minimum wage increase, and (b) cities with higher proportions of low wage workers in 1989. Their findings are imprecise and mixed, but suggest that a 10% minimum wage increase raises prices by up to 4%, which is consistent with predictions from a competitive model.

Spriggs and Klein (1994) conducted a similar experiment to Katz and Krueger (1992), differing only in the timing between the change in the minimum wage and the follow-up survey. They utilize data for one month before and after the 1991 minimum wage increase, which, they argue, already accounts for long run adjustments because the increase was announced two years in advance. Their findings suggest that the minimum wage did not significantly affect prices, which continued changing following a prior trend.

Using the 11 US macro model of the US economy, Wilson (1998) reported that the proposed 19.4% 1999-2000 increase in the minimum wage was estimated to increase overall prices by 0.2% in the first and by an additional 0.1% in the second year.

Lee and O'Roark (1999) used earnings and industry data from 1992 and 1997, and an input-output analysis to compute the minimum wage price effect. Assuming full pass-through, no substitution effect, and no spillover effects, they estimated that a 10% minimum wage increase raises prices among eating and drinking places by 0.74%. Even though they report this as an upper bound



estimate because of the full pass-through assumption, this might be undermined because of the no spillovers assumption.

MacDonald and Aaronson (2000) and Aaronson (2000) examine the effect of 1980's and 1990's minimum wage increases on prices in Canada and the US. They use a variety of data sources on restaurant data and regression analysis, performing a number of robustness checks. They found that prices and the wage bill rise by about the same in the short run, but remark that this effect dissipates over time. They also found that prices respond within a 4 to 6 months window around the increase, and warn that minimum wage changes might not generate the sort of coordination failure and stickiness in prices that other costs or demand shocks produce. They estimate that the long run effect of a 10% increase in the minimum wage on prices is 0.72%-0.73%. These estimates are remarkably close to Lee and O'Roark's (1999) estimates, which use an entirely different methodology and data.

MaCurdy and O'Brien-Strain (1997), O'Brien-Strain (1999) and O'Brien-Strain and MaCurdy (2000) argue that the short-run effect of a minimum wage increase may be a price increase, with employment effects becoming evident only in the longer run. They argue that this is in line with employment effects findings in the literature (Brown, 1999) and use a simulation approach to show that in absence of disemployment effects, the 1999-2000 minimum wage increase would drive California's families to pay more for goods and services than they would receive through higher earnings. They estimate a 10% increase in the minimum wage to raise prices by 0.3% to 2.16%, depending on the commodity, and compare their results to Lee and O'Roark's (1999). Using an extended sample of US states, MaCurdy and McIntyre (2000) applied the same methodology to analyze the 1996-1997 minimum wage increase. They estimate a 10% increase in the minimum wage to raise overall prices by 0.25%, and prices of food consumed outside (inside) the home by 1.2% (0.8%). They compare their results with Lee and O'Roark's (1999) and Aaronson's (1997) and argue that differences stem from the difference in methodology.

Using experimental data and regression analysis, Machin et al. (2002) study the effects of the introduction of the UK national minimum wage in April 1999 on the residential care homes industry, a heavily affected sector. They found no evidence that prices rose by more in low wage firms but argue that price regulations limit adjustments on this particular market.

Despite the different methodologies, data periods, and data sources, most studies found that a 10% US minimum wage increase raises food prices by about 1% and overall prices by about 0.2%. Brown (1999, p. 2150) in a recent survey (where, however, he only reviews Wessels (1980), Katz and Krueger (1992), and Card and Krueger (1995)) remarks, "the limited price data suggest that, if anything, prices rise after a minimum wage increase". The above studies are grounded on the standard theory model prediction that if employers do not respond to changes in the minimum wage by reducing employment or profits, they respond by raising prices. However, none of them discusses explicitly the theoretical model that delivered their empirical equation specification. This requires a more careful discussion.

## **5. THEORETICAL GROUNDING**

Economic theory establishes various routes through which minimum wage affects prices, and it is not obvious which equation should be estimated. Minimum wage affects prices in the following ways: (1) Labour Demand - by pressuring firm costs and prices upwards, changing the input mix and aggregate employment and output; (2) Labour Supply - by increasing worker's productivity, pressuring prices downwards; or by encouraging unemployed to look for a job, pressuring wages (prices) upwards; (3) Aggregate Supply - by decreasing employment and output, pressuring prices

upwards; and (4) Aggregate Demand - by increasing spending (changing the markup under imperfect competition) and pressuring prices upwards; or by stopping those who became unemployed to spend, pressuring prices downwards; or by decreasing the demand for (now more expensive) minimum-wage-labour-intensive-products, pressuring prices downwards. In other words, consumers balance between higher prices and lower consumption, and employers balance between higher prices, lower employment and lower profits. This, together with a rapidly changing economy, makes it very difficult to isolate the price effects due to a minimum wage increase.

Because of that, a general equilibrium model is constructed in four steps. The model consists of four equations (to solve for the four endogenous variables: employment, wages, prices, and output). A reduced form price equation is obtained in the final step and is used to deliver the empirical equation estimated below. Furthermore, in each step a price equation is obtained – each of which holds constant different variables - and is used to deliver robustness checks empirical equations. A labour demand equation is used to derive the first price equation; the equilibrium condition in the labour market arising from the interaction of labour demand and labour supply is used to derive a second price equation; the aggregate supply resulting from the labour market equilibrium is used to derive a third price equation; and finally, the general equilibrium condition arising from the interaction of aggregate supply and aggregate demand is used to derive a fourth (reduced form) price equation. A fifth price equation is then derived under imperfect competition.

**Labour Demand** - Assume perfect competition in both the input and output markets, and a production function depending on labour and capital,  $Y=f_{LK}(L,K)$ , with input and output prices  $W$ ,  $r$ , and  $P$ . Maximization of profits at the (representative) firm level delivers the aggregate unconditional demand for labour,  $L^d=L(P,W,r)$ , homogeneous of degree zero. The “inverse” unconditional labour demand is  $P=P_1(Ld,W,r)$ . There is no sense in a price equation at the (price-taker) firm level – and realistically, the minimum wage will affect the whole industry – but at the industry level, the labour demand function is well defined, and so is its “inverse”. The minimum wage then affects prices through its effects on wages and on productivity. If the production function depends on capital and two types of labour (say skilled, paid  $W$ , and unskilled workers, paid  $MW$ ), the minimum wage enters the equation directly,  $P=P'_1(Ld,W,MW,r)$ . This shows the relationship between aggregate prices and labour demand that follows from the firm behaviour, the critical dimension in explaining pricing. Aaronson’s (2000) specification can be thought of to be a labour demand curve.

This equation might not be very informative, as it tells what happens to prices when the minimum wage changes, holding constant employment. However, it reflects the implicit assumption discussed in the Introduction that holding employment constant, the minimum wage increase is passed on to prices. Furthermore, evidence of large wage effects and small employment effects in Brazil (Lemos 2003a, 2003b, and 2003c) is consistent with an inelastic labour demand curve and a particularly rapid wage-price spiral under high inflation (note saw-toothed pattern in Graph 1.b). Firms anticipate the wage-price spiral - encountering little resistance to upward prices adjustment, as nominal stickiness is smaller the higher inflation (Layard et al., 1991) - and do not adjust employment to avoid adjustment costs. Thus, it might not be too unrealistic to assume employment constant given short run changes. The minimum wage coefficient is expected to be positive: for given employment, wages, and interest rate, a minimum wage increase raises labour costs and prices of the entire industry.

**Labour Market Equilibrium** - If labour supply is assumed to depend on wages and prices,  $L^s=L(P,W,L^s\text{-shifters})$ , where  $L^s\text{-shifters}$  are supply shocks; and  $L^s=L^d=L$  is used to eliminate  $W$ , the “inverse” of the labour market equilibrium condition is  $P=P_2(L,r,L^s\text{-shifters})$ . The minimum wage can be included among the supply shocks or, as above, enter the equation directly,  $P=P'_2(L,MW,r,L^s\text{-shifters})$ . Alternatively, eliminating  $L$  delivers  $P=P'_2(W,MW,r,L^s\text{-shifters})$ . In contrast with the first

equation, labour supply factors are here allowed to affect prices. This equation tells what happens to prices when the minimum wage changes, accounting for the response of both firms and workers, holding constant other input prices, employment, and labour supply factors. A move along the labour demand curve is no longer described, as in the first equation; equilibrium points between demand and supply are now mapped.<sup>2</sup> This gives the extent of the pass-through, which is itself interesting, and is the aim here; only if labour supply is assumed perfectly elastic, structural parameters are identified. The minimum wage coefficient is expected to be positive, however, this effect is expected to be smaller than in the first equation where supply side responses were not accounted for.

**Aggregate Supply** – If now the production function  $Y$  substitutes out  $L$ , the aggregate supply equation is  $Y^s=Y(P,r,K,L^s\text{-shifters})$ , whose “inverse” is  $P=P_3(Y^s,r,K,L^s\text{-shifters})$  or  $P=P_3(Y^s,MW,r,K,L^s\text{-shifters})$ , as above. Subtracting and dividing both sides by lagged price delivers the Phillips curve.<sup>3</sup> This equation summarizes the possible combinations of price and output that equilibrates the labour market. Once more, it might not be very informative, as is it tells what happens to prices when the minimum wage changes, holding output constant. However, an inelastic aggregate supply might be associated to an inelastic labour demand, as argued above. Similarly to the first equation, the minimum wage coefficient is expected to be positive.

**General Equilibrium** – If  $Y^d=Y^s=Y$  is used, where  $Y^d=f(P,Y^d\text{-shifters})$ , and  $Y^d\text{-shifters}$  are demand shocks; the “inverse” of the economy equilibrium condition is  $P=P_4(r,K,L^s\text{-shifters},Y^d\text{-shifters})$  or  $P=P_4(MW,r,K,L^s\text{-shifters},Y^d\text{-shifters})$ , as above.<sup>4</sup> Most people will adjust their spending in response to higher prices. This determines whether and where jobs are lost and output is cut in the longer-run. The relationship between prices and the minimum wage need to account not only for aggregate supply but also for aggregate demand effects. This equation differs from previous ones because, in econometrics parlance, is a reduced form. It tells what happens to prices when the minimum wage changes, accounting for responses of firms, workers, and consumers; i.e. it accounts for the interaction of all above variables and their joint effect on prices. The specifications estimated by Card and Krueger (1995), Sprigs and Klein (1994), Aaronson and Macdonald (2000) and Machin (2002), reviewed in Section 4, can be thought of as reduced form equations. As discussed above, an increase in the minimum wage increases prices via labour costs and via employment (and output) decreases; but decreases prices via higher productivity. It increases prices via higher demand spending, but decreases prices via lower demand because of higher unemployment and because of more expensive minimum-wage-labour-intensive-products. However, the (net) minimum wage coefficient is positive because the minimum wage increase contracts the economy and increases prices.

**Imperfect Competition** – Assume a number of identical imperfectly competitive firms, each one of them with some market power; say that firms and consumers differ in their physical location and each firm has its own market area. Specifying a demand and cost relation and inverting the profit maximizing condition gives the price equation, where price is a markup over costs,  $P=[e/(1+e)]c$ , and  $e$  is the price elasticity of demand. Note that the two main components of costs are labour productivity and wages (and the minimum wage affects both), already accounted for in the first equation. Indeed, relaxing the price taking assumption does not change dramatically the above specifications - the cost function is the same for both monopolists and competitive firms - although it

<sup>2</sup> The alternative specification  $P=P_2(W,MW,r,L^s\text{-shifters})$  gives the effect of minimum wages on prices, including the impact via employment, so long spillover effects are not substantial (not the case for Brazil).

<sup>3</sup> The so-called New Phillips curve includes marginal costs and does not substitute out wages, reason why it is called a wage equation (Gali et al , 2001).

<sup>4</sup> One of the  $Y^d\text{-shifters}$  has to be a nominal variable (e.g. nominal government expenditure or the money stock) to ensure that  $Y^d(P)$  is homogeneous of degree zero (one) in nominal magnitudes.

gives a different flavor to the interpretation of the results. This is the starting point for most empirical work in the sale taxes and exchange rate literature (Section 6.1). The crucial difference here is that while for competitive markets, price is exogenous and the price equation is a standard labour demand function (as in the first equation), for price-setter firms, the price equation reveals a relationship that must hold for profit maximization, but it is not a labour demand function because prices are chosen jointly with employment. As in the first equation, the minimum wage coefficient is expected to be positive.

## **6. EMPIRICAL SPECIFICATION AND IDENTIFICATION**

Graph 2 plots log nominal minimum wage against log price and suggests a positive relationship. These raw correlations need to be proved robust when the effect of other variables (demand and supply shocks) on prices is controlled for. The particular choice of controls is given by theory, as discussed in Section 5 above. Given that so little work has been done in this area, the approach of this study is rather exploratory, aiming at a theoretically informed statistical investigation. The strategy here is to estimate all five above relations, which has two main advantages: (1) The different theoretical equations allow successively the impact of labour demand, labour demand and labour supply, aggregate supply, and finally, the aggregate demand and aggregate supply general equilibrium. The final reduced form equation accounts simultaneously for all routes by which the minimum wage affects prices. (2) It is all a matter of what variables are controlled for; in each stage different variables are held constant. This checks the robustness of the minimum wage coefficient to alternative controls. The interpretation of the minimum wage coefficient depends on which of the five equations above delivered the empirical equation.

### **6.1 EMPIRICAL EQUATION**

While empirical work on the price response to minimum wage increases is limited, there is a large empirical literature on the price response to changes in other industry-wide costs, such as sales taxes and exchange rates.<sup>5</sup> Because of this, the empirical equation delivered by the above theoretical models will be discussed in the light of this so-called pass-through literature. This literature is primarily concerned with the burden of higher costs on consumers, and thus is well suited to study the extent to which higher labour costs associated to minimum wage increases are passed on to consumers. It has two objectives. The first one is to measure the pass-through coefficient, which indicates whether 100% of the shock is passed through or not. This is estimated by a reduced form price equation where price is explained by a cost shock and other controls (cost shifters). The second objective is to use the results from the reduced form to infer market power and price discrimination. This paper estimates the cost shock coefficient.

Together with the pass-through literature, the aggregate supply and Phillips curve empirical literature also provided guidance for the price equations specification. Econometric explanation of inflation requires not only inertia and aggregate demand variables – as in the conventional Phillips curve – but also supply shocks (e.g. oil price, exchange rate, productivity growth, etc.) and government intervention or push-factors (e.g. minimum wage, social security taxes, employment

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<sup>5</sup> See Kotlikoff and Summers (1987) for a compendium on tax incidence and Poterba (1996) for a survey. Some authors found full pass-through (Poterba, 1996) and others, overshifting (Besley and Rosen, 1994) in contrast with partial pass-through in the earlier literature (Haig and Shoup, 1934). An extensive empirical literature on the impact of exchange movements on import and export prices (Goldberg and Knetter, 1997) usually finds partial pass-through (Gron and Swenson, 1996; Lee, 1997; Yang, 1997). As in minimum wage price effects literature (Section 2), the sale taxes and exchange rate literature also used before and after, input-output, and econometrics analysis.

protection, unions, etc.). Push-factors are key to understanding inflation; they might pressure real wages upwards, raising the natural level of unemployment that makes inflation constant.<sup>6</sup>

The above theoretical discussion motivates the following empirical equation counterpart. The different theoretical equations are obtained depending on which coefficients are constrained to zero. Approximating the theoretical price equation by a logarithmic function and modelling time and regional fixed effects using dummies, delivers:

$$P_{it} = \bar{f} + \beta MW_t + \gamma W_{it} + \delta r_{it} + \zeta C_{it} + \lambda L_{it} + \eta Y_{it} + \kappa K_{it} + \mu Z_{it} + f_i + f_t + v_{it} \quad (1)$$

where, for region  $i$  and time  $t$ :  $P_{it}$  is log prices;  $MW_t$  is log nominal minimum wage;  $W_{it}$  is average of log nominal wages;  $r_{it}$  is nominal interest rate;  $C_{it}$  is average costs, proxy for marginal costs;  $L_{it}$  is employment rate (and hours worked) or unemployment rate;  $Y_{it}$  is output or aggregate supply;  $K_{it}$  is capital;  $Z_{it}$  is either labour supply shifters or aggregated demand shifters;<sup>7</sup>  $f_i$  is regional fixed effects;  $f_t$  is time fixed effects;  $\bar{f}$  is the intercept; and  $v_{it}$  is the error term.

The starting place is an *ad hoc* specification where  $\bar{f}$ ,  $\beta$ , and  $\lambda$  only are allowed to be nonzero. Region dummies separate regional effects, and time dummies separate other macro variable effects, from the effect of the minimum wage on prices. The empirical counterpart of the first theoretical equation is obtained if  $\bar{f}$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , and  $\lambda$  are allowed to be nonzero; the second, if  $\bar{f}$ ,  $\beta$ ,  $\delta$ ,  $\lambda$  and  $\mu$  are nonzero; the third, if  $\bar{f}$ ,  $\beta$ ,  $\delta$ ,  $\eta$ ,  $\kappa$ , and  $\mu$  are nonzero; the fourth, if  $\bar{f}$ ,  $\beta$ ,  $\delta$ ,  $\kappa$ , and  $\mu$  are nonzero; and the fifth, if  $\bar{f}$ ,  $\beta$ ,  $\gamma$ , and  $\zeta$  are nonzero.

Alternative production functions were considered. Assuming that labour is the only variable factor in the long run,  $Y=f_L(L)$ , is equivalent to constraining the coefficients of capital and interest rate ( $\delta$  and  $\kappa$ ) to be zero. Each of the five theoretical equations was estimated assuming  $Y=f_L(L)$ , and  $Y=f_{LK}(L,K)$ . Furthermore, static specifications are too restrictive; the influence of inertia needs to be allowed. The effect of the minimum wage on prices over time is typically modeled by including lags of the minimum wage as regressors. The number of lags is an empirical matter; one year should be long enough for the effect of the minimum wage on prices to be complete. All models were estimated in first-differences.<sup>8</sup> Time and regional dummies were included after differencing.<sup>9</sup> The models were sample size weighted and White-corrected for heteroskedasticity.<sup>10</sup> Serial correlation was assumed to vanish after differencing, adding dynamics, controls, regional and time dummies.

<sup>6</sup> See Ball et al. (1988) and Goodfriend and King (1990) for surveys on prices and inflation modeling. For early work on the role of push factors, see Frye and Gordon (1981), Gordon (1982), and Layard and Nickell (1985 and 1986); for more recent work, see Jackman, Layard and Nickell (1996), Staiger, Stock and Watson (1996), and Tulip (2000).

<sup>7</sup> Labour supply shifters are mainly population and institutional variables that control for region specific demographics potentially correlated with the minimum wage, the proportion of workers in the population who are: young, younger than 10 years old, women, illiterates, retired, students, in the informal sector, in urban areas, in the public sector, in the building construction industry sector, in the metallurgic industry sector, basic education degree holders, high school degree holders, and the proportion of workers with a second job. Aggregate demand shifters include consumption, government expenditure, capital investment, imports, exports and taxes.

<sup>8</sup> Difference of the logs of prices is the usual specification in the literature (Section 2). Furthermore, the conceptual question here is how changes in the minimum wage change prices. Technically, the aim is to reduce the variables to stationarity, preventing spurious regression, which depends on the number of unit roots of the variables.

<sup>9</sup> The constant is the base dummy. The regional dummies model region specific trends because regions are expected to differ not only in their business cycles but also in their rate of growth over time.

<sup>10</sup> Heteroskedasticity arises from the regional aggregation because averages computed over a larger sample size have smaller variance. Incidentally, weighting captures the relative importance of each region to the (regional weighted)

## 6.2 IDENTIFICATION

Identification in the above models depends on how time is modeled - the so-called *ad hoc* identification predominant in the early minimum wage literature. Similarly, most studies reviewed in Section 4 use the national minimum wage as their shock variable. However, full identification requires the shock variable to vary across regions if no restriction on time is imposed. Aaronson (2000) and Aaronson and MacDonald (2000) rely in part on regional variation, as they use national and state minimum wages, but only a few states have their own minimum wage.

Many minimum wage variables with such a regional variation have been suggested in the minimum wage literature. (1) The typically used in employment models is “Kaitz index” (Kaitz, 1970), defined as the ratio of the minimum wage to average wage adjusted for coverage of the legislation. The Kaitz index varies across regions and over time, but the variation in average wages is what would drive the estimated impact of the ratio on prices. In other words, the effect of the inverse of the average wages on prices is what would be ultimately estimated (Welch and Cunningham, 1978; Freeman, 1982). (2) Another minimum wage variable suggested in the literature is “fraction affected”, defined as the proportion of people earning a wage between the old and the new minimum wage (Card, 1992). Card and Krueger (1995) and Spriggs and Klein (1994) used this variable in their price equations reviewed in Section 4. (3) A variable closely related to fraction affected is “spike”, defined as the proportion of people earning one minimum wage (Dolado et al., 1996).

Brown (1999, p. 2130) advocates that the “degree of impact” measures (e.g., fraction affected) are conceptually cleaner than the “relative minimum wage” variable (e.g., Kaitz index). He also notes that fraction affected is “not well-suited for studying periods when the minimum wage is constant, and so its impact should be declining. While there is more to be learned from a year in which the minimum wage increases by 10 or 15% more than average wages than from a year of modest decline, the periods between increases should together contain about as much information as the periods of increase.” In other words, fraction is constant at zero regardless of how unimportant the minimum wage might become. As discussed in Lemos (2003c), spike is superior to Kaitz index and fraction. That is because, on the one hand spike is conceptually related to fraction and is therefore methodologically clean; on the other hand spike does not suffer from the same drawback, as it can be defined even when the minimum wage is constant. Beyond statistical identification, an intuitive reason to use spike to measure the minimum wage impact on prices is that spike is a measure of wage inflation and thus, related to price inflation. Ultimately, the interest is on the bite of the minimum wage (and how it varies across regions). To that end, spike is just as good as any other empirical variable (Dickens et al., 1999; Williams, 1993). While spike was 4% for the US in 1993 (Dolado et al., 1996), it was 12% for Brazil, although as high as 25% in PE, a poor region. Its correlation with the real minimum wage, the Kaitz index and fraction affected in the sample period is 0.61, 0.67 and 0.10.

Once regional variation has been ensured, no restriction needs to be placed on the time dummies. The typical annual data model in the literature includes year and regional dummies to model time and regional fixed effects (Brown, 1999). The monthly analogue of this model would require month in place of the year dummies. However, that would eliminate all the variation in the model because each dummy would capture all that affects prices in each month - including the discrete minimum wage increases. As a result, there would be no variation but noise left to identify the minimum wage effect (Burkhauser et al., 2000). If on the one hand month dummies eliminate all the variation, on the other hand year dummies alone are not sufficient to model time in a month model. An alternative is

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average coefficient if the sample size is proportional to the labour market (Card and Krueger 1995; Neumark and Wascher 1992; Baker et al. 1999). Note that PME is sometimes weighted by projections of population size.

to include, in addition to year dummies, seasonal-month dummies to control for unobserved fixed effects across months, as in Burkhauser et al. (2000). Also, stabilization plan dummies<sup>11</sup> are included to capture common macro shocks under each stabilization plan.<sup>12</sup>

### 6.3 RESULTS

To ensure identification, log nominal minimum wage in equation 1 is replaced by spike. Table 1 shows positive and robust estimates. A 10% increase in the minimum wage raises prices by 0.08%-0.56% and 1.93%-3.07% in the short and long run across models, suggesting partial pass-through. These are sizeable for *overall* price effects; the existing literature reports less than 1% price increase in the *food* sector, and around 0.02% *overall* price effects (Section 2).

The coefficient of spike in the ad hoc prices models compares to the one in the wage models specifications in Lemos (2003a). A 10% increase in the minimum wage (increases spike by 0.3 percentage points)<sup>13</sup> increases prices by 0.15% and (average) wages by 0.08%, and the ratio between the two is 1.7. Card and Krueger (1995) calculate this ratio (their minimum wage variable is fraction affected) to be between 0.25 and 0.50. The larger ratio here is related to the indexer role played by the minimum wage in Brazil (Section 3).

The short run estimates are larger for models assuming  $Y=f_L(L)$  and dynamics. Dynamics allowed the effect of spike on prices to take one year to be complete; no restriction on the pattern of lags was imposed assuming that there was enough variation to estimate their coefficients with precision. Not all lagged minimum wage coefficient estimates were individually significant, but they were jointly significant.<sup>14</sup> These are long dynamics. Even though the rapid wage-price spiral discussed in Section 5 for Brazil suggests short dynamics, other factors such as the minimum wage indexer role and long inflationary memory in Brazil (Section 3) might perpetuate the minimum wage effect on prices over time. Aaronson (2000) and Macdonald and Aaronson (2000) included lags and leads in their specifications and found that most of the prices response occurs in the two-month period immediately after a minimum wage increase, while the rest occurs in a two months window around this. They argue that the short dynamics is because the minimum wage changes might not generate the sort of coordination failure and stickiness in prices that other costs or demand shocks produce.

As the minimum wage increase is national, its increase affects prices nationally. However, price effects across regions will differ as regional consumption patterns differ. Regions that have a higher cost of living or that consume more will carry more of the burden (MaCurdy and McIntyre, 2000). Increasing the minimum wage by 10% increases spike by 0.4 (0.1) percentage points in PE (SP), a

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<sup>11</sup> Each had very particular rules (Abreu, 1992); macro shocks were similar within, and different across plans. Additionally, a dummy was defined in October 1988, when the new Constitution: shortened the working week from 48 to 44 hours, and introduced an alternative working day of 6 consecutive hours.

<sup>12</sup> Wald and F tests were used to test whether spike had variation over and above the time dummies to explain prices. Both tests rejected the restricted model. This is reassuring that the variation captured by spike - further to that captured by the time dummies - is due to the minimum wage.

<sup>13</sup> This was obtained by regressing the difference of spike on the difference of the log of nominal minimum wage and controls associated to each empirical equation. However, because the nominal minimum wage does not vary across regions (Section 6.2), the Kaitz index (using not only average wage, but also median wage, 25<sup>th</sup> and 10<sup>th</sup> percentile wage as the denominator) was used instead. This figure was fairly robust across all such specifications.

<sup>14</sup> Nominal pricing rigidities studies find that prices remain fixed for long periods (Cecchetti, 1986; Kashyap, 1995), even though a rapid wage-price spiral is expected for the case of Brazil (Section 5). Robustness checks using 6, 18, and 24 lags were performed. The criterion for model selection was the individual and joint significance of the estimates of the lagged variables coefficients. Models allowing half an year dynamics severely censored dynamics; models allowing over an year dynamics produced small and non-significant higher lags coefficients.

poor (rich) region, and increases prices by 0.11%-0.91% (0.03%-0.23%) in the short run and by 0.26%-2.91% (0.06%-0.73%) in the long run across models. In other words, it causes four times more inflation in PE than it does in SP.

## **6.4 ROBUSTNESS CHECKS**

### **6.4.1 Who Pays The Bill**

The evidence so far is supportive of the hypothesis discussed in the Introduction that minimum wage increases are passed on to prices and are, therefore, born by consumers. Furthermore, this evidence suggests that overall prices increase and, therefore, all consumers – not just minimum wage labour intensive goods consumers – pay for the increase. The minimum wage affects overall prices because of (1) the indexer role played by the minimum wage, which “propagates” the price increase in minimum wage labour intensive industries to other industries (Section 2); (2) the associated large spillover effects in the wage distribution (Lemos, 2003a); and (3) the presence of minimum wage workers in industries other than the low wage (Ramos and Reis, 1993).

However, even in presence of overall price effects, different consumers need not be affected in the same way. The implicit assumption in the literature (Section 4) is that the largest increase in prices following a minimum wage increase occurs in minimum wage labour intensive goods industries. This means that the consumers of such goods pay proportionately more for the increase. It has been suggested in the literature that these consumers are the low income (Freeman, 1996; Deere et al., 1996; O’Brien-Strain and MaCurdy, 2000; MaCurdy and McIntyre, 2000). To test that, industry and consumption level data are required to identify what are such goods and who are their consumers. This would make it possible to define the typical low and high income consumption bundle and the respective income share spent on minimum wage labour intensive goods. SMN, INPC and IPCA measure the cost of the low, medium and high income typical consumption bundle and the implicit income share spent on minimum wage labour intensive goods. These indices can then be used to provide preliminary evidence on who pays for the increase. The relevant question here is whether the inflation caused by minimum wage increases affects the poor more severely.

Recall Graph 1.c that shows log of SMN, INPC and IPCA over time. 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 all consumers were affected by the same inflation growth. If, in the absence of minimum wage increases, prices rose equally to all consumers, then the simple comparison of indices would be an estimate of the relative inflation experienced by the poor and the rich following a minimum wage increase. However, changes in prices might also be due to changes in other variables. Thus, regression models were used to control for such variables. SMN and IPCA were used, in addition to INPC, to re-estimate the dynamic models of Section 6.3. The pass-through coefficient in these models measures the increase on the prices of goods consumed by the poor and the rich following a minimum wage increase. If this coefficient is the same in all three equations, then the inflation caused by minimum wage increases is the same to all consumers. If, however, it is larger for low income consumers, then the poor are exposed to higher inflation following a minimum wage increase.

Table 1 shows positive and significant pass-through coefficient estimates of roughly the same magnitude for low, medium and high income consumers. A 10% increase in the minimum wage raises low (high) income consumers prices by 0.30%-0.46% (0.28%-0.55%) and 2.23%-2.91% (1.74%-2.88%) in the short and long run across models. In other words, the inflation caused by the minimum wage is the same for low, medium and high income consumers both in the short and long run. This suggests that, whoever the consumers of minimum wage labour intensive goods are, they



are affected in the same way as other consumers. Contrary to what is assumed in the literature, either low income consumers do not spend a larger share of their incomes on minimum wage labour intensive goods or the prices of such goods do not go up by more. Both explanations are at work for Brazil. As it was mentioned above, minimum wage workers are present in various sectors throughout the economy, thus the prices of a wide range of goods go up. Furthermore, the indexer role and the spillover effects “propagate” the increase throughout the economy, increasing overall prices. As a result, consumers of all income level (not only low income consumers) spend a substantial income share on goods whose prices went up (which are not only minimum wage labour intensive goods).

This is not to say that the effect of the minimum wage on prices across the income distribution is neutral. The poor undoubtedly suffer disproportionately more from any given inflation rate, because of the nature of overall price increases - which can be compared with a regressive sales tax (MaCurdy and McIntyre, 2000; O’Brien and MaCurdy, 2000) - and because the poor have less effective means to defend themselves from the inflation (for example, they have no access to bank accounts). However, it is important to establish that in Brazil the poor are not exposed to a higher inflation rate following a minimum wage increase – either because they do not consume disproportionately the more expensive minimum wage labour intensive goods or because these goods are not relatively more expensive or both. MaCurdy and McIntyre (2000) find that when expressed as the income share of nondurable consumption, the extra costs in higher prices is slightly above 1% for families of all income groups in the US.

#### **6.4.2 The Bill Is Smaller Under Low Inflation**

Excluding the high inflation period prior to July of 1994 reduces the pass-through estimates across models to 0.01%-0.02% and 0.56%-0.72% in the short and long run. The upper limit of the long run estimates are four times smaller than in Section 6.3, even though all models include time and region fixed effects to account for the unusually high inflation periods. Unfortunately, the low inflation period is not long enough to produce precise estimates and most estimates in Table 1 are not statistically significant. Aaronson (2000) found evidence that the high inflation in the 1970s-1980s partially drives the significant minimum wage pass-through coefficient in the US and Canada. Weiss (1993) argues that prices adjustment differ in countries that have experienced low and high inflation. Freeman (1996) noted that it only seems inconceivable that minimum wage increases induced national wage inflation in the US because the minimum wage is low and affects a small proportion of the work force.

### **6.5 MAKING SENSE OF THE RESULTS**

In summary, minimum wage increases significantly increase overall prices in Brazil. (1) The pass-through coefficient is larger in the long run when firms have had the chance to adjust to the higher costs and the effect of the minimum wage on prices is complete. A 10% increase in the minimum wage increases prices by up to 1.93% and 3.07% in the short and long run, suggesting partial pass-through. (2) The pass-through coefficient is the same for low, medium and high income consumers, suggesting that the inflation caused by the minimum wage is the same for the poor and the rich. (3) The pass-through coefficient is smaller under low inflation when firms are less able to adjust prices. (4) The pass-through coefficient is four times larger in a poor than in a rich region.

The range of estimates produced is expected to embrace the true coefficient. The preferred specification is the one delivered by general equilibrium equation assuming dynamics and a more complete production function, i.e., column 2, row 4, panel B of Table 1. This specification is more

reliable conceptually and statistically: it is a reduced form equation; the effect of the shock variable on prices over time is accounted for through dynamics; adjustments in capital and other inputs in response to minimum wage increases are allowed; and errors are expected to be serially uncorrelated. Incidentally this “preferred” specification produces estimates fairly similar to the other specifications.

These findings are robust to a number of specifications using alternative theoretical equations, production functions and dynamics. They are in line with theory and with the international empirical literature. They are also in line with the hypothesis in the Brazilian literature that minimum wage increases are an important component of inflation (Section 3).

### **6.5.1 Reconciling Wage And Employment Minimum Wage Effects**

As discussed in the Introduction, theory and empirical evidence on the minimum wage employment effects are at odds. On the one hand, standard economic theory unambiguously predicts employment decrease in presence of wage increases. On the other hand, although empirical evidence has established that minimum wage increases raise the wage of the poor, there is no consensus on whether this drives employment increases or decreases (Card and Krueger, 1995; Brown, 1999). There have been many attempts to reconcile theory and empirical evidence (Brown, 1999). However, little attention has been paid to another prediction of the standard theory, i.e., an industry wide cost shock will be passed on to prices. If firms do not respond to minimum wage increases by reducing production, they might respond by raising prices.

The steady decrease of the real minimum wage over time showed in Graph 1.b suggests a move downwards along the labour demand curve. It is then not surprising that minimum wage employment effects in Brazil are non-negative, despite of sizeable wage effects (Lemos, 2003a and 2003c; Carneiro, 2000; Foguel, 1997; Gonzaga et al., 1999; Amadeo et al., 1995; Camargo, 1984). Furthermore, the evidence in Sections 6.3 and 6.4 suggests pass-through effect of the minimum wage on prices. Evidence of large wage effects, large price effects and small employment effects is consistent with an inelastic labour demand curve and a particularly rapid wage-price spiral under high inflation, as discussed in Sections 2 and 5. Firms are more able to increase prices when inflation is high (Cecchetti, 1986); in that case, they do not adjust employment to avoid incurring in adjustment costs. Cox and Oaxaca (1981) argue that the effects of a minimum wage increase depend on the accompanying monetary policy. An accommodating inflationary monetary policy offsets the disemployment effect of the minimum wage.

Another way to look at this is that the minimum wage is not binding for long enough to provoke disemployment in Brazil. The wage compression caused by minimum wage increases quickly vanishes away because of the wage-price spiral that follows. In other words, the effect of the minimum wage on the wage distribution is transitory. Grossman (1983) found evidence that the wage distribution becomes more compressed immediately after an increase, but that the wage structure gradually returns to its original state. Aaronson (2000) found similar evidence.

## **CONCLUSION**

There is very little evidence on the effects of the minimum wage on prices in the international literature and none whatsoever for developing countries. This paper estimates this effect using monthly Brazilian household and price data for the 80’s and 90’s recently released for the public and not yet used for studies of the minimum wage. Furthermore, the effect of the minimum wages on prices at a regional level, in low inflation periods and across the income distribution is estimated. Given that so little work has been done in this area, the equation of this paper is rather exploratory,

aiming at a theoretically informed statistical investigation. It also provides a minimum wage price effects survey, missing in the literature.

Robust results suggest that the minimum wage significantly increases *overall* prices in Brazil. A 10% increase in the minimum wage raises prices by up to 0.56% and 3.07% in the short and long run, suggesting partial pass-through. These are sizable in the context of the minimum wage literature - which reports less than 1% increase in the *food* sector prices - though they are consistent with the wage effects in the Brazilian literature. This is because of the high inflation environment in Brazil over the last decades, as well as the indexer role played by the minimum wage in this context, the large spillover effects and the presence of minimum wage workers in industries other than the low wage. At a regional level, the minimum wage causes four times more inflation in a poor than it does in a rich region.

Further to filling a gap in the existing literature, these findings are an important contribution for two reasons. On the one hand, they help to answer the question of who is paying for the minimum wage increase. Minimum wage increases are passed on to prices and are, therefore, bear by consumers. This has important implications for welfare analysis of the minimum wage. On the other hand, they help to reconcile the controversial recent minimum wage debate of large wages and small employment effects. Standard economic theory is not hurt if wage increases do not cause employment decrease but cause price increases. Firms will not adjust employment and incur in adjustment costs if they are able to pass through to prices the higher costs associated to an increase in the minimum wage.

These findings answer further the question of who is paying for the increase by suggesting that *overall* prices increase and, therefore, *all* consumers pay for the increase. The pass-through coefficient is the same for low, medium and high income consumers. In other words, the poor are not exposed to a higher inflation rate following a minimum wage increase. This is an important result because, contrary to what is assumed in the literature, either low income consumers do not spend a larger share of their incomes on minimum wage labour intensive goods or the prices of such goods do not go up by more. In Brazil, because overall prices go up (not only minimum wage labour intensive goods prices), consumers of all income level (not only low income consumers) spend a substantial income share on goods whose prices went up.

To say that the poor and the rich are exposed to the same inflation rate is not to say they are affected in the same way. The poor suffer disproportionately more from any given inflation rate. No doubt the best antipoverty policy is to lower inflation. However, while effective anti-inflation policies are not in place, increasing the minimum wage is the immediate – albeit transitory - answer to its rapid erosion.

Clearly the potential of the minimum wage to help the poor is bigger under low inflation. This is particularly so if the minimum wage has been used as anti-inflation policy in addition to its social role, as in Brazil. The minimum wage price effect is four times smaller in the long run when the high inflation period is excluded from the analysis. Not so large price effects together with the evidence of clustered around zero employment effects, both in the international and Brazilian literature, suggest that the minimum wage has a concrete potential to help the poor under low inflation.

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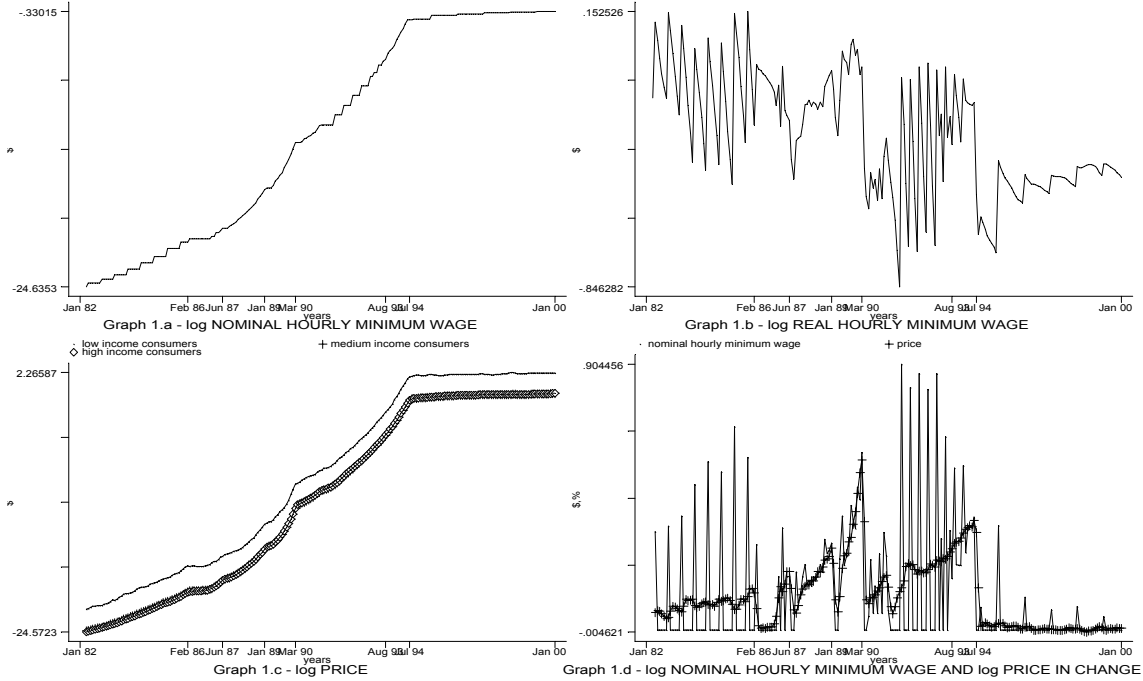
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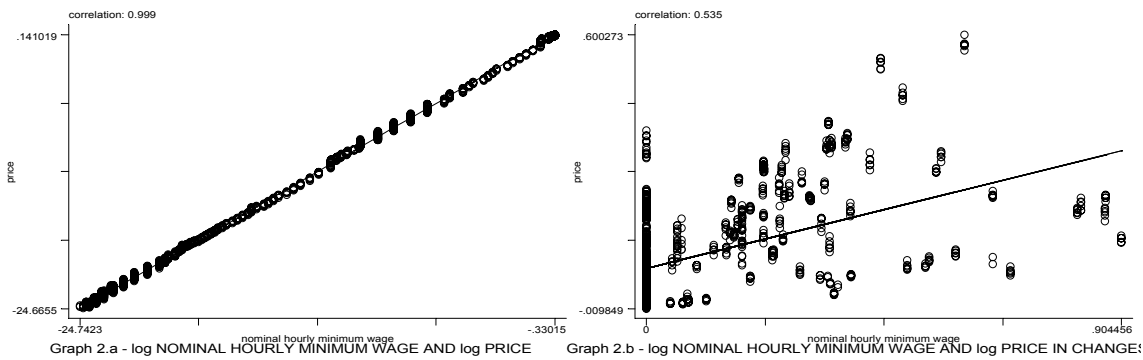
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BRAZIL from 1982 to 2000



Graph 1 - MINIMUM WAGE AND PRICE



Graph 2 - MINIMUM WAGE AND PRICE

Table 1 - Effect of a 10% increase in the minimum wage on prices

models	medium income					low income			high income			low inflation		
	static		dynamic			dynamic			dynamic			dynamic		
	short run (1)	s. errors	short run (2)	s. errors	long run	short run (3)	s. errors	long run (4)	short run	s. errors	long run	short run (5)	s. errors	long run
<b>(A) Y=f(L)</b>														
Ad Hoc	<b>0.15</b>	0.036												
Labour Demand	<b>0.31</b>	0.064	<b>0.56</b>	0.074	2.53	<b>0.46</b>	0.116	2.87	<b>0.53</b>	0.073	2.34	<b>0.01</b>	0.021	0.64
Labour Market Equilibrium	<b>0.25</b>	0.059	<b>0.51</b>	0.071	2.31	<b>0.42</b>	0.111	2.53	<b>0.49</b>	0.070	2.12	<b>0.02</b>	0.023	0.60
Aggregate Supply	<b>0.26</b>	0.065	<b>0.56</b>	0.080	2.36	<b>0.40</b>	0.114	2.46	<b>0.54</b>	0.079	2.18	<b>0.01</b>	0.023	0.61
General Equilibrium	<b>0.25</b>	0.064	<b>0.56</b>	0.081	3.07	<b>0.41</b>	0.118	2.91	<b>0.55</b>	0.080	2.88	<b>0.01</b>	0.022	0.72
Imperfect Competition	<b>0.24</b>	0.059	<b>0.50</b>	0.071	2.35	<b>0.42</b>	0.113	2.63	<b>0.48</b>	0.070	2.16	<b>0.01</b>	0.021	0.62
<b>(B) Y=f(L,K)</b>														
Labour Demand	<b>0.13</b>	0.050	<b>0.33</b>	0.061	2.09	<b>0.34</b>	0.111	2.64	<b>0.31</b>	0.060	1.90	<b>0.01</b>	0.021	0.61
Labour Market Equilibrium	<b>0.09</b>	0.049	<b>0.30</b>	0.062	1.93	<b>0.31</b>	0.110	2.33	<b>0.28</b>	0.060	1.74	<b>0.01</b>	0.023	0.59
Aggregate Supply	<b>0.08</b>	0.050	<b>0.31</b>	0.063	1.98	<b>0.31</b>	0.111	2.23	<b>0.29</b>	0.062	1.78	<b>0.01</b>	0.024	0.56
General Equilibrium	<b>0.09</b>	0.051	<b>0.32</b>	0.064	2.38	<b>0.30</b>	0.110	2.56	<b>0.30</b>	0.062	2.19	<b>0.01</b>	0.022	0.63
Imperfect Competition	<b>0.08</b>	0.050	<b>0.30</b>	0.062	1.98	<b>0.31</b>	0.109	2.42	<b>0.28</b>	0.060	1.78	<b>0.01</b>	0.021	0.59

- 1) The dependent variable is the difference of logs of prices. The shock variable is the spike.
- 2) Control variables depend on the theoretical equation (Sections 5 and 6). For each production function, five theoretical equations motivate the estimation of labour demand, labour market equilibrium, aggregate supply, general equilibrium and imperfect competition.
- 3) Panels A-B present estimates for two different production functions: as a function of labour and as a function of labour and capital.
- 4) Column 1 shows short run coefficient estimates for static models, and column 2 shows short run and long run coefficient estimates from dynamic models allowing for 12 lags of RHS dynamics. Columns 3 and 4 reproduce the dynamic models using alternative price measures for low and high income households. Column 6 re-estimates of the model in column (2) using a low inflation subsample.
- 5) Time effects are modelled with year, seasonal-month, stabilization and 1988 structural break dummies.
- 6) Estimates have been multiplied by 0.3 to indicate the percentual effect on prices of a 10% increase on the nominal minimum wage, which increases spike by 0.3 percentage points.



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