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What Does the Minimum Wage Do in Developing Countries? A Review of Studies and Methodologies

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1. Introduction

Issues of the effect of the minimum wage on labor and product markets remain a matter of ongoing interest to economists and policy makers and a prolific area for research. More than 600 studies of the minimum wage were authored between 2000 and 2010 and the number has continued to grow. Current empirical research is notably varied in methods, data and measures, especially in contrast with earlier research on the minimum wage, which was dominated by univariate time series methods. The coming of the "New Minimum Wage Research" (NMWR) in the early 1990s resulted in fresh approaches to obtaining the effects of the minimum wage. These include the analysis of panel data methods and quasi-experiments. More recently, the use of synthetic control techniques has entered this literature.

There has also been a broadening of the outcomes considered in the minimum wage research. While the employment consequences of the minimum wage remain the staple of contemporary research, there is greater consideration of employment related effects such as the effect on hours of work, on accessions and separations, on unemployment and vacancies and on second job and part-time job holding as well as the division of employment between the formal and informal sectors. There is also more attention to the impact on wages and earnings, and in particular distinguishing between the effect on bound workers who earn the minimum wage and the spillover effects on workers who had been earning more than the new minimum wage. There has been some research on the effects on receipt of health care and pensions, as well as an increased volume of work looking at the effects of the minimum wage on schooling and training and impacts on family income. There is considerable new work on effects on prices, particularly on prices in eating and drinking places. This greater range of methods and outcomes is accompanied by consideration of a broader variety of potentially affected groups. Studies of teenagers and young adult once comprised a majority; research now looks at the effects on those with limited education, on men and women, on racial and ethnic groups, on specific industries, on full and part time workers and on low income households.

Most research on minimum wages has focused on the OECD countries, but a substantial body of research is emerging on less developed countries. The consequences of the minimum wage are of particular concern for these countries, which face greater challenges in improving the conditions of low income workers and promoting wage employment. The estimates from the many studies of low income and developing countries have been ably summarized in several papers but, to date, no work has explicitly considered the methodologies used in these studies.[1] In the last two decades, empirical work on the minimum wage has

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[1] Recent reviews of the literature include Nataraj, S., F Perez-Arce & K. B. Kumar, "The Impact of Labor market Regulation on Employment in Low-Income Countries: A Meta-Analysis," Journal of Economic Surveys, (2014), Vol 28, No. 3, pp 551-572; Broecke, S., A. Forti, & M Vandeweyer, "The Effect of Minimum Wage on Employment in Emerging Economies: A Literature Review," monograph; and Betcherman, G, "Labour Market Institutions: A Review of the Literature," University of Ottawa, Background paper for the

provided insights into the strengths and weakness of competing methodological approaches to understanding the effect of the minimum wage. Given the importance of these issues to developing countries, deeper understanding of the learning of the last two decades is key to effective use of this research.

This review focuses on issues of methodology in minimum wage research, with particular attention to measures of outcomes and of the minimum wage, and to empirical methods. We begin with an overview of measures and methods, followed with a discussion of issues of identification, of accuracy in hypothesis testing, and of distinctions between static and dynamic models. The second section of the paper reviews research on the minimum wage in developing countries with respect to measures and methodology since 2000. We suggest that although some of this work is methodologically sophisticated, it does not always use latest methods and, in some instances, uses methods that have been recognized as problematic. These methodological issues are not unique to research on developing countries; the authors of this report discuss these at length in *What Does the Minimum Wage Do?* (Belman and Wolfson, 2014) in the context of research on developed countries. In the last section, we outline an approach to developing standards for studies of the minimum wage in developing countries which may be useful in assuring that estimates are methodologically sound and providing guidance in the design of policies for developing countries.

2. Models and Measures

In this review of models and measures, we first discuss several of the more common models used to estimate the minimum wage equations before moving to a discussion of dependent variables and measures of the minimum wage.

2.1 The "Canonical Model"

The most common approach to estimating minimum wage effects is the estimation of panel data models either with the data aggregated into "state" by year observations or repeat cross section data on individuals with "state" and year variables in the data.[2] This structure, first applied to the minimum wage research by Neumark and Wascher (1992), allows for the inclusion of state and year fixed effect dummieswhich absorb time invariant state effects and state invariant year effects. This reduces the need for elaborate controls for factors other than the minimum wage which might affect the dependent variable. This model, now referred to as the "canonical model", takes the form

$$Y_{it} = \alpha + \beta_{MW} MW_{it} + \underline{\beta}' \underline{X_{it}} + \underline{\theta}' YEAR_t + \underline{\psi}' \underline{S_i} + \varepsilon_{it} \qquad (1)$$

[2] More formally, the geographic unit can be any administrative unit which sets its own minimum wage. Depending on the country, this might be a state, province, region or county, among other terms for administrative unit. We use the term "state" for this discussion because so many of these models are estimated with U.S. data and the relevant administrative units are the states.

where

Y_{it} is the value of the dependent variable at location i at time t.

MW_{it} is the measure of the minimum wage at location i at time t.

X_{it} is a vector of values of other explanatory variables for location i at time t.

$YEAR_t$ is an indicator variable for year t.

S_i is an indicator variable for state i.

ε_{it} is an error term.

i is the index of location

t is the index of time.

The dependent variable used in these models is typically a measure of employment such as the employment to population ratio. Other dependent variables that have been examined in similar panel data frameworks include earnings and measures of school enrollment. Measures of the minimum wage are varied but are most often a measure of the relative minimum wage, a Kaitz ratio or the real minimum wage. Each of these measures is developed in the discussion of variables.   Typically, the set of control variables is limited as it is assumed that the fixed effects control for most of the factors affecting the dependent variable. For example, in his study of the response of teenage employment, Neumark (2001) estimated specifications that included only the prime age male unemployment rate, the prime age skilled male employment rate and the population share of teens. The assumption that few variables other than the minimum wage vary by both time and location has become an issue of increasing concern in this literature, one which we develop in the discussion of identification. The early assumption that the error term was i.i.d. (independent and identically distributed) has also turned out to be problematic, with consequences for the correct estimation of standard errors and hypothesis testing.

2.2 Quasi-Experiments

The other dominant approach used in this literature has been the construction of quasi-experiments (QEs). QEs are distinguished not necessarily by differences in techniques (the vast majority of studies use variants on regression) but by the careful specification of experimental and control groups. For example, Card's early work on fast food restaurants used before and after data on the same set of establishments to measure the impact of increases in the minimum wage on employment, using prior employment in an establishment as the control for the post change level of employment. This approach has evolved into studies which use establishments in adjacent administrative units, only one of which implements an increase in the minimum wage, to estimate the effect of the minimum wage on employment. These studies, such as those by Card and Krueger (1994) and Allegretto, Dube and Reich (2011), compare the change in employment levels in jurisdictions which raise the minimum wage – employment after the increase minus employment before it -- to the contemporaneous change in nearby jurisdictions which experienced no increase in the minimum wage. QE

studies are more varied in their methods and approaches than the canonical studies, but are identified by their attention to the definition of comparison groups.

2.3 Key Variables: The Minimum Wage and Outcome Measures

Although there has been a great broadening of research on the effects of the minimum wage in OECD countries, this has not been as marked in studies of developing countries. With notable exceptions, research on these countries has been focused on employment issues. For this reason, we start the discussion of dependent variables on employment outcomes. We follow the discussion of employment with a discussion of wage and earnings measures and measures of the minimum wage. We draw heavily on our knowledge of United States labor market data in this discussion of issues with data and variable construction. Data from other countries will have their own set of characteristics which researchers will need to consider in the construction of measures.

2.3 (a) Measures of Employment

Employment is measured in several different ways. The degree of fineness turns on whether the measure refers to the total amount of paid (employed) labor, typically the number of hours, or cruder measures, such as the number of employees. We will first look at the latter, because studies that use them are the most common.

2.3 (a1) Crude Measures of Employment

In studies of demographic groups, the most widely used measure is the *employment ratio*. This is the fraction of the group under study that is employed: for example, teenagers, young adults or married women. The teenage employment ratio is the percentage of teenagers who report having a job. In the canonical model, which labels observations by state and year, it would be the average fraction of teenagers employed in state i during year t. If at some moment all teenagers reported that they had a job, the teen employment ratio would be one. If none reported having a job, it would be zero, and if half did, it would be 50 percent. It automatically corrects for changes in the size of the teenage population, and studies that use it implicitly assume that if there were no trends and nothing changed but the size of the teenage population, a constant fraction of teenagers would always be employed.[3]

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[3] Other common measures of employment outcomes, such as unemployment, are only rarely used in minimum wage studies. The international definition of an unemployed person is an individual who is neither employed nor self-employed but is both available for work and actively seeking work. The unemployment rate is the ratio of the number of those who are unemployed to the sum of those employed and the unemployed. A problem with this measure for minimum wage studies is that the distinction between the unemployed and those without jobs who are not actively seeking work is sensitive to influences such as the current condition of the labor market, the availability of unemployment benefits, and whether respondents are in school (full time students are not classified as unemployed). Teasing out the effect of the minimum wage from other factors affecting the unemployment rate is considerably more challenging than the already difficult task of measuring the effect on the employment ratio.

Industry studies and others that use establishment data more commonly measure employment as the number of jobs (or the number of individuals employed) or the growth rate of the number of jobs. Quasi-experiments in which the unit of observation is a business establishment, perhaps a fast food restaurant, would measure the number of jobs at each establishment before and after the change in the minimum wage. Regression analyses of the restaurant industry generally use either the total number of jobs in the industry or the growth rate of the number of jobs in the industry.

2.3 (a2) Measures of Hours

Many employment measures are somewhat crude, distinguishing between neither full-time and part-time employment nor differences in the length of the workweek. Controversy about the response of employment to the minimum wage suggested to some that less crude measures might provide resolution. These tend to be variations on the number of paid hours of employment. Total hours, for an individual, for an establishment or firm, or for an industry, are a common choice. Others include average hours over all individuals in an establishment or an industry, and full-time equivalents (FTEs), that is, total hours divided by the number of hours considered to be in a full-time workweek (40 or 35, for example).

"Hours of employment" drawn from establishment data are based on actual hours that were paid for during a specified period, often a specific week. It is not uncommon for studies of demographic groups (which most often depend on household surveys) to include several measures of hours worked. There may be measures of actual hours over a particular period and a measure of usual hours.[4] Studies that use usual hours will not be entirely comparable to studies that use actual hours; they are measuring closely related but different phenomena. This is particularly true if, similar to some surveys, usual hours is coded with a qualitative outcome for those working variable hours.[5]

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[4] As an example, before 1994 the U.S. Current Population Survey asked about both total hours worked at all jobs in the previous week and usual weekly hours worked. Starting that year, and continuing through the present it asks separately for the number of hours at the primary job and at all other jobs, if any, in the previous week. The question on usual hours was changed in a parallel but somewhat problematic fashion. While before 1994 this was a simple question about "usual hours worked per week," since then this question has not only also distinguished between usual hours at the primary and all other jobs, but people who respond "variable," that is, that they do not have a usual number of hour of work per week, are coded as −4.

[5] It is useful to understand how "total hours of work," "average hours of work, conditional on employment," and "average hours of work" differ. The first is typically calculated as the product of average monthly hours and total monthly jobs. It is the total number of hours worked each month in a particular industry or location and is the obvious analog to the number of jobs. The second, common in studies that use data derived from establishment surveys, is the total number of hours that those employed have worked, divided by the number of employed. It tells us more about the length of the workweek than the amount of labor employed or paid for. While useful for some purposes—for example, determining whether the employed are actually earning more following a change in the minimum wage—it is not appropriate for examining the effect of the minimum wage on employment measured as the amount of labor paid for. Changes in the minimum wage that lead to changes in the number of individuals employed will cause this measure to vary from total hours. However, if the minimum wage does not influence the number of jobs, then it is possible to infer change in total hours from this measure. The third measure, average hours of work (sometimes referred to as the unconditional average), is the total number hours worked by the employed, divided by everyone in the same category (i.e., teenagers,

2.3 (a3) Measures of Formal and Informal Sectors

Informal employment is defined by the ILO as,

"all remunerative work (i.e. both self-employment and wage employment), that is not registered, regulated or protected by existing legal or regulatory frameworks, as well as non-remunerative work undertaken in an income-producing enterprise. Informal workers do not have secure employment contracts, worker's benefits, social protection or workers' representation."

(ILO Thesaurus, http://www.ilo.org/thesaurus/default.asp)

In 1993, the 15th International Conference of Labour Statisticians at the ILO (15th ICLS) defined the informal sector as a group of production units comprised of unincorporated enterprises owned by households, including informal own-account enterprises and enterprises of informal employers (typically small and non-registered enterprises). In 2003, the 17th ICLS defined informal employment, as including all informal jobs, i.e. jobs in the informal sector as well as informal jobs outside the informal sector, such as non-declared jobs or jobs for which labor regulations are not applied.

The model typically used to understand the effect of a minimum wage on employees in the informal sector, based on Stigler (1948), has two labor markets, only one of which is covered by the minimum wage. In this model, an increase in the minimum wage raises the wage in the covered sector but causes employees to be displaced from the covered sector to the uncovered sector. As a consequence, employment in the uncovered sector rises and wages decline. Theoretical models of the relations between covered and uncovered sectors have become more complicated as evidence of "lighthouse" effects, wage spillovers from the higher wage covered to the lower wage uncovered sector, has emerged.[6]

Although the effect of the minimum wage on the uncovered sector was potentially applicable to many developed countries in the past, the broadening of minimum wage coverage in these countries has reduced or eliminated the "uncovered" sector. In contrast, there is a robust informal economy in many developing countries, and much of the research on the effects of the minimum wage in these countries has looked at the differential effects on the formal and informal economy or sectors. A challenge in this research has been defining measures of employment in the formal and informal economy or sectors from household or establishment surveys. In some instances, data include information on coverage by the minimum wage laws, or inclusion in the social security system (Pelek, 2013). In other cases, the distinction between formal and informal is proxied by the distinction between salaried and non-salaried employment

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immigrants, etc.), whether or not they are employed or even in the labor force. For instance, the unconditional average hours of work of teenagers is the total hours that employed teenagers work divided by all teenagers. So long as the number of teenagers does not vary in response to changes in the minimum wage (and there are no large changes in its value from period to period), then this figure correlates highly with total (usual) hours of work. Where the second measure is used, it is necessary to combine the findings for hours with those for employment where possible, but this is a bit ad hoc.

[6] See, for example, Souza and Baltar (1979) or Bell (1997) for Mexico and Columbia.

(Comola & de Mello, 2011), by employment outside of a firm (Muravyev & Oshchepkrov, 2013), or by employment in specific industrial sectors, such as domestic work (Dinkelman & Rachhhod, 2012). Other research considers a more complex sectorial structure with differential effects of the minimum wage in which the labor markets are divided between large firms, small firms, self-employment and public employment (Gindling and Terrell, 2009) or between effects on state and non-state enterprises (Wang and Gunderson, 2011).

The differential effect of the minimum wage in an economy in which a large proportion of the labor force is not covered (de jure or de facto) by the minimum wage is an important issue in developing countries, particularly as they move toward implementing or substantially increasing their minimum wage. Beyond the issues with determining workers' sector of employment, efforts to distinguish between the effect of the minimum wage on covered and uncovered sectors likely should be embedded in a broader model of employment and non-employment. Individuals can be in one of three states: employed in the formal sector, employed in the informal/uncovered sector and not employed. For the most part, current research has tended to treat employment/ non-employment separately from the sector of employment. It may be better addressed in a unified model which classifies individuals in one of several types of employment or as not employed. Such models can estimated by multinomial logit or, if it is preferred to consider the choice of employment/non-employment prior to sector, with a conditional logistic model based on McFadden's work.[7]

2.3 (b) The Minimum Wage

The value of the legislated minimum wage at any moment is a nominal variable; that is, without consideration for the price of anything else, it is measured in terms of the currency unit (e.g., dollars) per unit of the item under consideration, here an hour of labor. We can say that the U.S. federal minimum wage was $5.85 (per hour) for the year beginning on July 24, 2007, and that the minimum wage in Washington, D.C., was $8.07 in January 2008. This raises two issues about measuring the minimum wage. The simpler one is "What is the measured value of the minimum wage when the data are aggregated over time?" If the unit of observation is aggregated from monthly data up to a calendar year, as is frequently the case with panels that rely on the Current Population Survey (CPS), what is the appropriate value of the federal minimum wage for 2007? The standard approach is to set it to the average value not over the course of the year but over the dates of the CPS surveys, which are monthly and refer to the week that contains the 12th of the month. The value of the federal minimum wage was $5.15 for the first seven surveys (January through July) of 2007, and $5.85 for the last five (August through September), so the annual value would be $5.44.

In some jurisdictions, there is more than one minimum wage law: for example, in the United States, not only is there a federal minimum wage, but many states have their own minimum wage. Except in special well-specified situations, for example that the firm is smaller than a certain size specified in the federal law, the higher of the two applies. The standard practice is to ignore these

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[7] See McFadden, D (1974)., "Conditional Logit Analysis of Qualitative Choice Behavior," P. Zarembka (ed.), FRONTIERS IN ECONOMETRICS, 105-142, Academic Press: New York, 1974.

special situations, because they apply to relatively few employees, and to use the higher of the applicable levels. Rather than repeatedly use the phrase "higher of federal or state minimum wage." this is commonly indicated by the phrase "effective minimum wage."

A more complicated problem pertains to inflation and the price level more generally. A minimum wage of $5.85 has a different impact in 2007, when the mean wage for U.S. teenagers was $8.20 per hour and the U.S. Consumer Price Index (CPI) had a value of 207, than in it would have 1981, when the teenage mean wage was $3.77, and the CPI was 91. The cost of living also varies between cities, states, and regions, but (in the U.S.) there is no accepted index comparing costs geographically.

To think about possible solutions, consider a panel data set where each observation refers to a specific state and year and the relevant variables are constructed from CPS data. One common way of correcting for cost differences among states and over years is to calculate the average wage (for all employees, perhaps, or for prime-age adult males or teenagers) for each state and year, and divide that into the minimum wage. This is the *relative minimum wage*. As Card, Katz, and Krueger (1994) observe, in times of prosperity, both employment and wages will rise, and the rise in wages will cause a decline in the calculated value of the relative minimum.[8] Similarly in times of recession, employment and wages will fall, and the decline in wages generates a rise in the relative minimum wage. As a result, there will be a negative correlation between employment and the relative minimum wage due only to movements in average wages, whether or not employers respond to a higher minimum wage with lower employment or hiring. An alternative is to calculate *the real minimum wage*, dividing the nominal one by a price index like the Consumer Price Index (CPI).[9] The shortcoming with this approach (at least for the United States) is that the CPI is not available at the same level of geographic disaggregation as the minimum wage.

The Kaitz index—a coverage-adjusted, relative minimum wage—is a measure of the minimum wage that once was quite common in empirical work, but is rarely used currently.[10] The relative part of this term is clear enough; *coverage adjusted* refers to the fraction of individuals employed in industries to which the minimum wage applies, industries that are *covered*. At different times in the past, different levels of the minimum wage have been relevant for different groups of individuals, and for different businesses or industries. There have been lower minimum wages for teenagers than for older workers, and minimum wages

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[8] Card, Katz, and Krueger (1994) are here extending an observation that Freeman (1982) made with reference to studies that analyze cross-sectional data.

[9] Neumark, Schweitzer, and Wascher (2004) introduced an equivalent approach, the inclusion of a distinct constant term for each year (annual fixed effects).

[10] Amendments to the Fair Labor Standards Act in 1961 and 1966 extended full minimum wage coverage to all but the smallest firms, making adjusting the minimum wage for coverage far less important. As a result, the Kaitz index has largely disappeared from minimum wage research on the United States. In addition, the Kaitz index has endogeneity issues that Card, Katz & Krueger (p. 490 ILRR 1994) identified, so even where coverage may remain relevant, another solution needs be found, perhaps instrumenting.

for smaller establishments have often been lower than the national minimum wage. Adjusting for coverage uses a messy formula that is a weighted average of minimum wages that reflects the distribution of employment across industries, establishments, and demographic groups with different values of the minimum wage[11].

Two other ways of measuring the minimum wage are the *fraction affected* (also sometimes called *fraction at risk*) and the *wage gap*. Card (1992a) introduced the fraction affected measure early in the NMWR in his cross-sectional analysis of change in employment following the 1990 increase in the federal minimum wage. Its value is the percentage of workers who, prior to an increase in the minimum wage, earn between the old and new values of the minimum wage. The intuition is that observations where this value is large are more sensitive to the minimum wage increase because it would be necessary to raise wages for a large fraction of employees to remain in compliance with the new, higher minimum wage. In Card's (1992a) study, with states as the level of analysis, it accounts for differing levels of the minimum wage across states before the federal increase. Employees initially earning below the minimum wage are excluded from the measure under the assumption that their employers are either not required to pay the minimum wage or have chosen not to comply, and this is likely to continue following the increase.

The wage gap, introduced by Currie and Fallick (1996), can be calculated for an individual worker or for a larger aggregation. For an affected individual, one who was previously earning less than the new, higher, value of the minimum wage following an increase, the wage gap is the difference between the new level of the minimum wage and her wage before the increase. It can be measured as a monetary value (e.g., in dollars) or as a percentage. For all others, those whose wage prior to the increase was already above the new, higher value of the minimum wage, the wage gap is set to zero. For establishments or regions, the wage gap is measured as the share of total payroll necessary to bring the fraction affected up to the new minimum wage.

For establishment studies,the counterpart of the wage gap variable is an exposure measure. Establishments and firms with a base period average wage below the new minimum wage are assigned the value of their average wage less the minimum wage; those with an average wage above the new minimum wage are assigned a value of zero. Exposure variables have been used by Harrison and Scorse (2010) and by Alatas and Cameroon (2008) in studies of Indonesia and by Mayneris, Poncet and Zhang (2014) in their study of China. As indicated in each of these studies, exposure variables are imperfect measures of firms' sensitivity to the minimum wage increase. Firms with average wages above the minimum wage may have employees earning below the minimum; firms with averages below the new minimum may have a substantial number of employees earning above the new minimum. It nevertheless remains a useful proxy of the degree to which the increase in the minimum wage is likely to affect a firm.

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[11] The Kaitz ratio is defined as $[\frac{minimum\ wage}{average\ wage}*Coverage]$ where the minimum wage is the applicable minimum wage, the average wage is the average hourly wage for the group of interest and coverage is the percent of the individuals in the group who are covered by the minimum wage law.

Unlike the measures that incorporate the value of the minimum wage, each of these measures reflect the size of the relevant section of the lower tail of the wage distribution, the part of the employed workforce that is potentially affected by an increase in the minimum wage. Consequently, each is more sensitive to the ex-ante facts on the ground. The wage gap and exposure measures go beyond the fraction affected in considering not only the size of this part of the tail, but the wage levels of those within it.

2.3 (c) Wages

The terms *wages* and *earnings* are used inconsistently across studies. For the purposes of this review, *wage rate* refers to the straight time hourly wage an individual is paid. Earnings commonly indicate the pretax amount in an employee's paychecks over some period. For those paid weekly (or biweekly or monthly), hourly earnings are the amount they are paid per week (or fortnight or month) divided by the number of hours they worked that week (or fortnight or month). For those paid by the hour, hourly earnings might also be their wage rate, but if they worked overtime at time and one-half or better, hourly earnings might be greater than their wage rate. While earnings can be computed for all employees, wage rates are only available for those who are paid by the hour. In this review, we use wages as a general term referring to employee pay. It encompasses both wage rates and earnings but, unlike wage rates or earnings, it is not a specific measure.

3. Emerging Issues of Methodology:

3.1 Identification

The issue identified by the phrase "Correlation is not causation" has been of interest to economics, a largely observational science, at least since Working (1927).[12] Experimental sciences can resolve the problem either explicitly by systematic variation in causal variables or implicitly by randomly assigning experimental subjects to treatment or control groups. Although these solutions have been used for the study of government participatory programs and occasionally those of private organizations, purely statistical solutions have received much attention because those of the experimental sciences are unavailable for most topics of economic interest. Prior to the 1991 conference that launched the *NMWR*, minimum wage research had not shared the increasing interest in the possibility of more nearly mimicking controlled experiments (Meyer 1995), relying on estimated conditional partial correlations from one dimensional observational data, primarily time series, and less often cross-sectional, data (Brown, Gilroy and Kohen 1982).[13]

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[12] See also Epstein (1987) and Christ (1994). Experimental sciences can resolve the problem either explicitly by systematic variation in causal variables or implicitly by randomly assigning experimental subjects to treatment or control groups.

[13] Wooldridge (2010, ch. 21) contains a more recent discussion of this quasi-experiments.

The conference papers contrasted sharply with earlier practice. Neumark and Wascher (1992) introduced panel data and models to the field, adapting the analytic framework previously applied to time-series data in the hope that greater variation in the data would allow for more careful measurement of the relationship between employment and the minimum wage. Card (1992) and Katz and Kreuger (1992) introduced what we would now recognize as early versions of quasi-experiments (QEs): the latter, a differences analysis, the former a proto-synthetic control framework. Following the conference, in perhaps the most widely known analysis of the *NMWR* and one of the most widely known analyses of its kind, Card and Krueger (1994) introduced the difference-in-differences technique to the study of the minimum wage.

In the next decade or so, panels and QEs separately became much more widely used, with Neumark and Wascher's approach coming to be referred to as the canonical model (Allegretto, Dube and Reich 2011). Each involved variations. Eventually, serious questions arose concerning the estimated standard errors and the validity of statistical inference based on them (discussed in the next section), but the most important substantive criticism of each changed little during this time. For the QEs, this was doubts about generalizing from what were essentially a few short-term case studies. For the panel model, this concerned the non-responsiveness to the objection "Correlation is not causation", eventually coming to focus on poor identification of the effect of the minimum wage because treatment and control groups were not carefully matched.

The concerns about the QEs are straightforward and easy to understand but the identification issue is a bit more subtle, so a few words of elaboration are in order. Is the minimum wage endogenous, and if so, what is an appropriate correction? In their critique of Neumark and Wascher (1992), Card, Katz and Krueger (1994) objected that the Kaitz index was endogenous and by construction would vary inversely with employment even without any correlation between employment and the minimum wage. Even without this artificial introduction of endogeneity, if both leisure and minimum wage legislation are normal goods, the minimum wage and labor supply (and thus employment) are correlated, without causation running from one to the other.

Little progress was made toward resolving either of these issues until three analyses that showed how the canonical model could be transformed, step-by-step, to one that looked like a set of QEs (Allegretto, Dube and Reich 2009, 2011; Dube, Lester and Reich 2010). Because many state policies that affect labor demand and supply are both correlated when considered contemporaneously across states and contemporaneously homogeneous within multi-state regions (Allegretto, Dube and Reich 2009), the census divisions can be understood as regional economies within which effects of the minimum wage can be disentangled from those of other factors. Two of the studies (Dube, Lester and Reich 2010 and Allegretto, Dube, and Reich 2009) take this one step further, using county level employment data to define local labor markets at the level of neighboring counties. When adjacent counties straddle a state boundary and the states in question have contemporaneously different minimum wages, different parts of the labor market sort naturally into either the treatment or control group.

In the simplest specification of both of these approaches, all variation in the minimum wage is used (along with some other control variables) to explain all variation in employment just as in the canonical model. The incorporation of one set of dummy variables transforms this specification into a set of regional economies. In the two studies that use county level employment data, a different set of dummies transforms the analysis into a collection of QEs.[14] In all three analyses, the simple, canonical model generates results that resemble those of other analyses that rely on the canonical model. In all three, the specifications that correspond to QEs have wage effects of the same size as or larger than those in the canonical model but the employment effects are uniformly not statistically significant and more often than not the point estimate is positive. The marriage of the two approaches, long-term panel and QE, responds to the major criticisms of each of the earlier approaches, that in the former the effect of the minimum wage is not well identified and in the latter, that it is a short term-case-study that cannot be reliably generalized.

In response to this line of work, Neumark, Salas and Wascher (2014) objected that the method for identifying observations to be controls and their matching to the treatment observations is *ad hoc*, and questioned whether the observations identified as controls are well suited for that function. The apparent solution is the synthetic control technique (Abadie, Diamond and Hainmueller 2010) which Sabia, Burkhauser and Hansen (2012) introduced to this literature as one of three QE analyses of the rise in New York's minimum wage in 2005 and 2006 (the other two being more conventional QEs using nearby states as controls). From a pre-specified list of untreated subjects, the synthetic control technique forms a weighted mean to be an optimal counterfactual (the synthetic control) for the treated subject. Done properly, the synthetic control closely resembles the treated subject before the treatment and it is necessary to calculate only the *ex post* difference instead of a difference-in-differences. Of the 25 states that did not experience a rise in the minimum wage during 2002-2006 (the sample period of the data used in Sabia, Burkhauser and Hansen 2012), this technique selected four to be part of the synthetic control. The two with greatest weight were among the controls that Sabia, Burkhauser and Hansen (2012) used in their more conventional analyses. Despite this, the ex-ante match was sufficiently poor that they felt it necessary to calculate the difference-in-differences using the synthetic control. The resulting point estimates were negative but not significant at a 0.05 level using their synthetic t-distribution.

The synthetic control technique is difficult to combine with the canonical framework of long panels because the minimum wage rises both frequently and asynchronously across states. Neumark, Salas and Wascher (2014) apply the technique for a subsample of about one quarter of the minimum wage changes that occurred in the U.S. from 1990q1-2011q2 but reject it because

"this subset of minimum wage increases (there are a total of 544 minimum wage increases in our sample period) appeared to be unusual in that it did not generate a significantly negative minimum wage effect using the modified panel data estimator described earlier." (p. 639)

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[14] The dummy variables effectively remove local labor markets with a uniform minimum wage from the analysis.

Instead, they develop an ad hoc technique that bears at least a superficial resemblance to that of Abadie, Diamond and Hainmueller (2010) and for which

"... the counterfactual observations could include observations with minimum wage increases; however, because these counterfactual observations contribute to both the estimated employment rate and the estimated minimum wage variables (as well as the other controls), this is not problematic." (p. 639)

By including states with minimum wage increases in the pool of potential donors to the synthetic control, they deprive their approach of much of the intuitive appeal that adheres to this technique. It also makes it difficult to understand just what its advantage is over not just a more conventional QE, but even over the canonical model. Both the qualitative similarity and the lack of a statistically significantly difference between these results and those of the canonical model, reinforce these doubts. Dube and Zipperer (2013) apply the technique of Abadie, Diamond and Hainmueller (2010) to part of the sub-sample that Neumark, Salas and Wascher (2014) rejected in favor of the whole sample. They report only three out of 19 statistically significant effects on employment at the 0.10 level (one positive, two negative) about what one would expect from a sample of this size if there is no effect.

After more than two decades of *NMWR*, the central points of methodological dispute are no longer about the appropriate analytical framework, as they were for much of that period. They are now about the best way to implement the QE framework and how best to select or construct appropriate controls for treatment observations.

3.2 Biased or Inconsistent Standard Errors

Complicating the assessment of the literature are problems with the estimated standard errors that raise serious questions about the reliability of the statistical inference it contains. The most common is serial correlation in panels and repeated cross sections (RCS) that is unaccounted for in the calculations. Bertrand, Duflo and Mullainathan (2004) is the best-known work to call attention to this issue, and Hansen (2007a, b) and Wolfson (2011) have confirmed their concern. Donald and Lang (2007) have called attention to a less common problem, inconsistent standard errors in the simple two-by-two difference-in-differences framework where it is plausible that the treatment and control dummies are picking up random shocks in addition to any effect of policy.

3.3 Static and Dynamic Modeling

Very early in the *NMWR*, Neumark and Wascher (1992) attempted to introduce dynamics into the effects of the minimum wage through inclusion of a lagged minimum wage terms among the explanatory variables. That is, the equation that they had carried over from the prior research on the minimum wage which relied on time-series data and which they modified for panel data,

$$Y_{it} = \alpha + \beta_{MW} MW_{it} + \underline{\beta}' \underline{X_{it}} + \underline{\theta}' YEAR_t + \underline{\psi}' \underline{S_i} + \varepsilon_{it} \qquad (1)$$

they further modified to

$$Y_{it} = \alpha + \beta_{MW_{(t)}}MW_{i(t)} + \beta_{MW_{(t-1)}}MW_{i(t-1)} + \underline{\beta}'\underline{X_{it}} + \underline{\theta}'YEAR_t + \underline{\psi}'\underline{S_i} + \varepsilon_{it}$$

$$(2)$$

The additional minimum wage term, $MW_{i(t-i)}$, reflect the value of the minimum wage in state i, year t-1. Neumark and Wascher (1992) explain equation (1) as a reduced form equation that accounts for the exogenous factors relevant to labor supply and demand. Purely static, it can be interpreted as reflecting an immediate adjustment of employment to any change in exogenous factors or equivalently as a long run relationship between employment and the exogenous factors on the right hand side. So long as the latter are constant, employment is as well. Equation (2) implies that the effect of the minimum wage on employment is more in the nature of a moving average, having a direct effect on employment in two consecutive years; Neumark and Wascher (1992) rationalized this specification on the basis of "either … hiring and training costs, or … an inability to adjust other inputs quickly."[15]

One way to think about the problems of equation (2) is that it is backward looking. Rather than optimizing over time in response to a changed environment, this equation models firms as being backward looking, responding to yesterday's minimum wage, whether or not it remains relevant. Consider a simple thought experiment. Suppose that starting from an economy at long run equilibrium, the minimum wage increases for one period and then returns to its previous value. According to equation (2) firms in the economy continue to respond to the previous, no longer relevant, value of the minimum wage after it has returned to its long run value. A more appropriate specification, at a slightly higher level of theoretical sophistication than the approach in equations (1) and (2) would begin by interpreting the former as an equilibrium value of employment where the economy settles if all variables on the right hand side remain unchanging,

$$Y_{it}^* = \alpha + \beta_{MW}MW_{it} + \underline{\beta}'\underline{X_{it}} + \underline{\theta}'YEAR_t + \underline{\psi}'\underline{S_i} \qquad (3)$$

It would then impose a partial adjustment mechanism:

$$Y_{it} = Y_{i(t-1)} + \lambda(Y_{it}^* - Y_{i(t-1)}) + \varepsilon_{it}, \ \ 0 < \lambda < 1 \qquad (4)$$

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[15] Neumark and Wascher (1992), page 61 for discussion of the static equation and footnote 19 for the dynamic equation.

$$= \lambda\alpha + \lambda\beta_{MW}MW_{it} + \underline{\lambda\beta'}\underline{X_{it}} + \underline{\lambda\theta'}'YEAR_t + \underline{\lambda\psi'}\underline{S_i} + (1 - \lambda)Y_{i(t-1)} + \varepsilon_{it}$$

$$(5)^{16}$$

That is, rather than a lagged term of the minimum wage as in equation (2), equation (5) has a lagged term of the dependent variable. The presence of the lagged dependent variable means that estimation of equation (5) is more complicated but the specification is more coherent and satisfactory from an optimizing perspective. In addition, it does not single out the minimum wage for special treatment among the explanatory variables. Finally, it is more in keeping with a pure time series approach, which begins by modeling the dynamics of the dependent variable before looking for other explanatory variables. An alternative approach, more in the atheoretic, purely empirical spirit of equations (1) and (2), is first to select a lag structure for the dependent variable by minimizing an information criterion. Next, include all the exogenous variables of equation (1), both contemporaneously and with the same lags as the dependent variable, and finally, pare the equation using either panel granger causality tests or the general to specific methodology of Hendry (Campos, Ericsson and Hendry 2005).

While there has not been explicit discussion of the problems associated with the use of models similar to equation (2), they have virtually vanished from the research on OECD countries. This is less the case for research on developing countries.

4. Contemporary Research on the Minimum Wage in Low Income and Developing Countries

The body of research on the minimum wage in developing countries is large and growing steadily. The substantive findings have been ably reviewed by Nataraj, Perez-Arce & Kumar (2014), Broecke, Forti, & Vandeweyer (2015), and Betcherman (2013). The current review focuses on understanding the methodological aspects of this research and suggests steps which may be taken to make this research more useful to addressing current policy issues. We draw on these reviews, and a search of JSTOR for 2014 and 2013 to find articles to include in this review. We limit ourselves to empirical research on developing countries which has been published in English since 2000, uses econometric techniques to estimate the effects of the minimum wage, and is available on line. We found twenty-five articles which meet these criteria.[17]

As our discussion of identification, standard errors and static vs. dynamic models suggested, the last twenty years of research has provided insights into

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[16] This approach was common elsewhere in economics prior to the introduction of the Rational Expectations Hypothesis and the developments in econometric and time-series technique that followed in its wake.

[17] Our search of the literature turned up more than 75 articles which listed "minimum wage" in the title, abstract or key words or appeared in the above cited reviews. Further review eliminated more than 50 because they were not accessible online, were not in English, did not include empirical estimates of the minimum wage effect, or embedded the minimum wage in an index of labor regulations or labor conditions which did not allow parsing the minimum wage effect. Research which embedded measures of the minimum wage into indices of labor regulation, but which did not allow calculation of a distinct minimum wage effect, were also not included in this review.

methodologies which provide reliable estimates as well as those which do not. Issues of inconsistently estimated standard errors, and consequent erroneous inference in certain classes of QE models with an insufficient number of "states" have been discussed by Donald and Lang (2007). Problems of downward bias in the estimation of standard errors when using panel data and not clustering errors by "state" have been identified by Bertrand, Duflo and Mullainathan (2004) and elaborated by Hansen (2007a, b) and Wolfson (2011). Faulty inference precludes knowing whether estimated effects characterize the population under study, leaving little to be learned from the research. Some of the 25 articles are therefore omitted from the discussion because of the issue identified by Donald and Lang. Another set of studies are omitted from discussion because of Bertrand et al. (2004) issue. Finally, articles which place arbitrary lags of the minimum wage in otherwise static models are unlikely to provide reliable estimates of the effect of the minimum wage. So they are omitted as well, as are studies where the small number of observations does not provide sufficient power in rejecting a null of no effect. The issues with correct inference were not known at the time when the research in many of these articles was conducted or when the articles were published. More recent studies have typically used more up-to-date methods.

The remaining ten articles are varied in their issues, methods and countries. Although they do not provide a comprehensive picture of the effect of the minimum wage across all low income and developing countries, they are a guide to successful approaches to estimating minimum wage effects. We classify and discuss these articles by outcome, starting with employment, moving on to studies of wages, and ending with the article on inflation. In those cases in which an article considers several outcomes, we discuss all of the outcomes in the initial discussion. Summary information about each study is included in the Annex (Table 1).

4.1 Articles Addressing Employment

Eight of the ten articles consider employment and employment related measures. Although studies that examine household data predominate in the minimum wage literature, both as a whole and in those that focus on low income and developing countries, more and more studies use data obtained from firm or establishment surveys. We start our discussion with three articles from this latter group, each of which uses annual data collected by the central government in national firm surveys.

Two of the studies report consequences for manufacturing firms of increases in the Indonesian minimum wage between 1990 and 1994 (Alatas and Cameron 2008; Harrison and Scorse 2010) and one (Mayneris, Poncet and Zhang 2014) reports on consequences for manufacturing, mining and public utilities of the 2004 increase in the national minimum wage in the People's Republic of China (China hereafter). Although the focus of Harrison and Scorse (2010) is anti-sweatshop activism, all three estimate the effect of the minimum wage on employment and wages, and the last two also consider its consequences for firm exit.

All three pay careful attention to the definition of treatment and control groups. Alatas and Cameron (2008), a quasi-experiment very similar to Card and Krueger's (2004) study of fast food establishments, looks at establishments in

adjacent administrative units on the Indonesian island of Java: the province of Jakarta and neighboring regions that are themselves part of greater Jakarta but are in the province of West Java, which had a lower minimum wage than Jakarta before 1996. To correct for the heterogeneity of firms in their sample (compared to the very homogeneous fast food restaurants used by Card and Krueger (1994)), Alatas and Cameron (2008) allocate firms to one of five categories based on average value added per worker and match firms in the two regions accordingly.[18] They also separately distinguish between small domestic establishments, large establishments 100% domestically owned and large establishments with some foreign ownership. Three western firms that hired Indonesian contractors, Nike, Adidas and Reebok, were the main targets of the anti-sweatshop campaign that was of interest to Harrison and Scorse (2010). They defined two treatment and corresponding control groups. The broad treatment group consisted of firms in the textiles, footwear and apparel (TFA) industries; firms in other industries made up the broad control group. They defined two treatment and corresponding control groups. The broad treatment group consisted of firms in the textiles, footwear and apparel (TFA) industries; firms in other industries made up the broad control group. The narrow treatment group consisted of TFA establishments in districts where Nike, Adidas and Reebok contractors are located; TFA establishments in other districts comprise the control group. Harrison and Scorse's measure of the minimum wage is constructed as an exposure variable, equal to the log-difference of the minimum wage between 1996 and 1998 for establishments whose 1990 average wage is less than the 1996 minimum wage, and 0 for those whose 1990 average wage exceeds the 1996 minimum wage. This captures the effect of the minimum wage on establishments which, on average, paid less than the 1996 minimum wage. Because it is not interacted with the anti-sweatshop variable, it measures the effect of the minimum wage on all low wage establishments.

The institutional situation in China is somewhat different, because the decision on minimum wage setting is shared between national and local authorities. This complexity creates useful variation in the minimum wage across metropolitan areas. Mayneris, Poncet and Zhang (2014) link firm data between 2003 and 2005 and define firms as exposed to the minimum wage if their *ex ante* average wage was below the new city minimum wage. Exposed firms comprised the treatment group, while those in the control group were firms with an *ex ante* average wage above the new minimum. The structure of the data allows comparison between exposed and control firms within metropolitan areas, as well as between exposed firms in metropolitan areas with different levels of the minimum wage, allowing a difference in difference in difference comparison. Instrumental variables are used to control for the endogeneity of the minimum wage, an issue if more successful metropolitan areas set a higher minimum wage than less prosperous metro areas.

All three studies report that at least among surviving establishments, a higher minimum wage is associated with higher wages. Harrison and Scorse (2010) find that higher minimum wages are associated with a higher average wage, especially in firms subject to anti-sweatshop campaigns. Although they do not use their firm-level data to examine the response of wages, Alatas and Cameron (2008)

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[18] The per-capita value added figures are calculated from the period when the minimum wages in the two regions were the same, 1996, so that they would not reflect differences in the minimum wage.

present evidence that wages rose more in the West Javan districts that had a lower minimum wage at the beginning of their sample period. In China, where firm exit played an important role, Mayneris, Poncet and Zhang (2014) report that wages increased among surviving firms.

The employment effects vary both across and within studies, something that should not be a surprise in light of not only the differences in institutional characteristics of the two countries but also the differences in focus across studies (both sets of differences are reflected in the analytic frameworks). Alatas and Cameron (2008) report clear evidence that employment of production workers declined in small domestically owned firms, but was unaffected in both large domestic firms and large firms with some foreign ownership; and that total employment declined in small domestic firms but rose in large, domestically owned firms. Harrison and Scorse (2010) reported a negative employment elasticity of -0.13 among surviving firms. In China, Mayneris, Poncet and Zhang (2014) report that employment rises in firms that did not exit, and that when they aggregate to the metropolitan level, no overall effect on employment is detectible.

Turning to exit and other outcomes, Alatas and Cameron (2008) report no consequences of the minimum wage on net exit (the number of firms). In contrast, Harrison and Scorse (2010) find that increases in the minimum wage did raise firm exits. In perhaps the most interesting result, Mayneris, Poncet and Zhang (2014) report no overall effect on exit, but that exposed firms are more likely to exit than control firms. The authors conclude that the rise in the minimum wage resulted in the exit of firms with low labor productivity, but that the "shock" of the increase resulted in surviving firms improving their productivity as an adjustment to the higher minimum wage. Besides a research design which takes full advantage of the structure of the data, consideration of exit, employment and wages, as well as metro area employment, provides a broad view of the outcomes of the minimum wage.

Two related themes recur in the articles that rely on household surveys: the distinction between the formal and informal sectors of the economy, and the degree of compliance with labor regulations including minimum wage laws. Gindling and Terrell (2009) consider the effect of Honduras's complex minimum wage laws on wages and employment, reporting "that higher MWs may create more unemployment and may transfer some employment from large private sector firms to small firms, where there is no compliance with MWs." (p. 291) In their study of compliance and the effect of the minimum wage on wages and employment, Strobl & Walsh (2003) explicitly use differences in firm size to distinguish the two sectors.[19] Rather than presume that firm size can proxy for the two sectors, Papps (2012) relies on whether individuals are registered with the Turkish social security to determine the sector in which they work. Dinkelman and Ranchhod (2012) limit their sample to one occupation in the informal economy, domestic workers, and report substantial compliance despite limited monitoring and enforcement. Finally, Soundararajan's (2014) study of the Indian construction industry relates labor market consequences of the minimum wage to enforcement and compliance.

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[19] "However, according to the International Labour Organization, one of the defining characteristics of firms operating in the informal sector is their size; generally, they employ fewer than 10 persons." (p. 432)

Each of these studies uses national household surveys, but in part because of differences among the surveys, they take varied approaches including in measuring the effect of the minimum wage. Gindling and Terrell (2009) aggregate data from *The Permanent Household Survey for Multiple Purposes*, a Honduran household survey typically conducted semi-annually, into an industry by time panel. Following the approach used in research with the canonical model, the minimum wage is measured as the log of the real minimum wage by sector and time. Although not formally divided into treatment and control groups, separate equations are estimated for large and small firms in the covered sector, the public sector and the self-employed. Large firms are taken as a proxy for the formal sector, small firms as a proxy for the informal sector, while the self-employed are treated as the control. The estimates allow for endogenous causation with instrumental variables and the Arellano and Bond (1991) GMM panel estimation technique.[20]

Strobl & Walsh (2003) construct a short period longitudinal data set from the *Continuous Sample Survey of Household Data* for Trinidad and Tobago from 1996 to 1998 which they use to estimate whether an individual remains employed and whether their post-implementation wage is in compliance with the minimum wage (whether they earn more than the new minimum wage after implementation of a national minimum wage in April, 1998).[21] The CSSH is a quarterly survey with individuals remaining in the sample for three quarters. With individuals observed both before and after the increase in the minimum wage, a difference in difference model is estimated for both the likelihood of employment and the likelihood of compliance. The treatment group is defined to be those who earned less than the minimum wage prior to its implementation, and the control group those earning more than the minimum in the pre-implementation period. The implementation variable is entered both by itself and interacted with a firm size measure to determine if there are different effects in the formal (large firm) and informal (small firm) sectors. The research focuses exclusively on private sector employees, with the self-employed and public employees not included in the estimates. The division of the sample by gender allows for differential effects on men and women within each sector.

Not all small firms in developing and low income countries are in the informal sector; law, engineering and similar firms are often small, but are part of the formal sector. Turkish household data, which includes a measure of individuals' participation in the social security system, is a superior measure of participation in the formal sector than the measures of firm size or sector of employment used in other studies. Papps (2012) takes advantage of this feature of *Turkish Household Labor Force Survey* to construct a QE for longitudinal data on individuals from 2002 to 2005. Papps extends Currie and Fallick's (1995) work on the minimum wage by including the effects of both the minimum wage and an increase in the social security employer tax in Turkey. Although the structure of these two systems is very different, Papps uses their computed effect on employer

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[20] The survey includes information on industry of employment for those who are employed and some information on firm characteristics.

[21] Trinidad and Tobago implemented a national minimum wage in April, 1998 in response to a World Bank report urging such action.

labor costs as a common metric. The treatment group is individuals who are registered in the social security system and whose earnings are sufficiently low to be affected by the increase in the minimum wage. Papps considers three control groups, one consisting of registered individuals earning above the new minimum wage, a second of unregistered workers who are bound by the new minimum wage, and a third of unregistered workers who are earning less than the old minimum wage.[22]

Domestic workers are proto-typical informal sector employees. Dinkelman and Ranchhod (2012) take advantage of South Africa's extension of minimum wage coverage to domestic workers in November 2002 employees, to estimate the effect on wages, employment and coverage under protective labor law. The research uses the South African *Individual Labour Force Survey*, household micro-data collected at six month intervals from September 2001 to March 2004, with a rotational structure which keeps individuals in the survey for five waves; this last feature makes it possible to estimate a QE model with individual fixed effects. The treatment group consists of women employed as domestic workers, while the control group is made up of demographically similar women employed outside of the domestic sector. The minimum wage is somewhat unusual in using a provincial wage gap, the ratio of the minimum wage to either all urban domestic workers or to male manufacturing workers in the base period. The effect of the minimum wage is estimated with both a post-implementation indicator and an interaction between that that indicator and the provincial wage gap measure. The model explicitly adjusts for the Donald and Lang issue as well as issues with clustering when there are few cross sectional units.[23]

Issues of compliance and enforcement are central to the work of Soundararajan (2014), a study of the effect enforcement of the minimum wage on wages and employment in the Indian construction industry. Using household data from 2004 to 2012 from the *Indian National Sample Survey*, he estimates a RCS model with time and state fixed effects and controls for real construction workers GDP, age, gender, urban/rural location and caste. The real minimum wage is classified into 4 quartiles as are the number of minimum wage inspectors by state and year. These dummies are interacted to create 16 outcomes, with the lowest quartile of the inspector variable used as the base group for each minimum wage classification.

Estimates of wage, employment and compliance are mixed by sector and gender, with no simple pattern across studies. Gindling and Terrell (2009) report a positive wage effect in the large firm covered sector and the public sector, and a large negative employment effect in the IV and GMM models in the large firm covered sector. There is no wage effect or employment effect in the small firm sector, which they take as evidence of non-compliance and support for the hypothesis that firm size is an accurate proxy for membership in the informal

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[22] Use of varied control groups addresses Card and Krueger's (1995) concern that comparison to groups earning above the new minimum wage may conflate the greater stability of higher wage jobs with the effect of the minimum wage.

[23] The preferred version of the model includes controls for age, education and whether the individual was African. As noted by Card and Kreuger (1994), Kaitz ratio measures such as this have a negative correlation with employment, and may have a positive correlations with wages, by construction.

sector.[24] Strobl and Walsh report that for men in Trinidad and Tobago, only those working for large firms had an increased likelihood of earning above the new minimum wage; there was no increase in the likelihood of the wages of men working for small firms rising above the minimum wage. This pattern was reversed for women. The likelihood of earning more than the new minimum wage was estimated to increase for all employed women but there was no specific large firm effect. There is no employment effect on male or female employment when a measure of whether the individual is bound by the new minimum wage is used; but a negative employment effect is found for men in large firms when the minimum wage is measured by the wage gap [25, 26] Papps, who only considers employment, reports a negative employment effect relative to the high wage control, but not relative to the low wage controls. Estimates of employment elasticities for the low wage controls are very small and not statistically significant. Dinkelman and Ranchhod (2012) find that the extension of the minimum wage raised wages for South African domestic workers but did not affect hours or employment. There is evidence of partial compliance with protective labor legislation for domestic workers. Soundararajan finds that, relative to the lowest levels of enforcement, the 2nd quartile of enforcement (i.e., number of inspectors) is associated with reduced employment and wages, but the 3rd and 4th are associated with higher employment and wages. Neither wage nor employment effects vary by the level of the minimum wage. This is counter-intuitive and suggests that the complex set of interactions between the minimum wage and the number of inspectors may proxy for other variables.[27]

4.2 The Minimum Wage and Earnings Inequality

Only one of the ten articles considers the increasingly important issue of earnings inequality. Following the methods developed by Lee (1999) and by Autor, Manning and Smith (2009), Bosch and Mancorda (2010) use a household survey of urban areas to estimate the effect of the minimum wage in urban Mexico on income inequality. The data, which cover the years from 1989 to 2001, come from a national household survey conducted by the Mexican government. The dependent variable in the panel estimates is the percentile wage gap at the 10th, 20th, 30th, 40th, 50th and 60th percentile of the municipal wage distribution, relative to the wage at the 70th percentile. The measure of the minimum wage is a quadratic function of the difference between the log of the minimum wage and the log of the actual wage at the 70th percentile for the municipality. The controls include interacted year and state dummies, the share of workers in each wage group, ad valorem taxes, the share of workers by

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[24] There are potential issues with the implicit constraints on serial correlation in the error term of the GMM model; but this is a carefully thought out approach which addresses several of the issues of panel estimates.

[25] The models which are RCS with fixed effects, do not cluster data, raising concerns about BDM issues but the brevity of the time period considered makes this problem unlikely.

[26] Unfortunately, because Stroble and Walsh do not estimate a model in which the wage, rather than an indicator of earning more than the new minimum, is the dependent variable, their estimates does not provide insight into whether the wages of those employed in the informal sector improved in response to the new minimum wage.

[27] As estimates are not provided for each these variables, it is difficult to obtain a clear understanding of the effect of the minimum wage on wages and employment.

educational group, the female share of the population and the distribution of employment by one digit industry. Estimates are obtained for the population as a whole, as well as for men and women and for those employed in the formal and informal sectors. Higher real minimum wages reduce wage inequality for both men and women, but the effect extends further up the male than the female wage distribution. Although higher minimum wages reduce earnings inequality in the formal sector, there is no impact on the informal sector. The authors report that the decline in the Mexican real minimum wage has increased the 10/50 wage difference by 1.4 to 1.6% annually. A useful feature of the article is the detailed discussion of their adaptation to Mexico's monthly minimum wage of the Lee/Autor, Manning and Smith methodology, which was originally developed for an hourly minimum wage.

4.3 The Minimum Wage and Inflation

There are periodic concerns that increases in the minimum wage may be a source of inflation in both developed and developing economies. Cuong (2011) builds a contemporary time series model of inflation, allowing for unit roots, to examine the effect of contemporary, lagged and leading minimum wage measures on inflation. Using the monthly consumer price index of the Department of Trade and Price of the General Statistics Office of Vietnam, the author systematically estimates the lag structure for prices and then considers the effect of the minimum wage in two and seven month windows. Cuong reports no evidence that the minimum wage affected inflation, but some evidence of seasonality in price levels around the new year.

5. Advancing Research on the Minimum Wage in Developing and Low Income Countries

The last two decades have seen a remarkable expansion of the literature on the minimum wage with greater variety in techniques, data and outcomes than in the preceding decades. This body of work provides insights into methods which generate reliable and precise estimates, as well as those which do not. In looking toward advancing research on the impact of the minimum wage in low income and developing countries, we make some suggestions on methodologies, on steps which can be taken to improve the quality of this research, and also on issues which are important but under-researched.

A strength of the new minimum wage research has been the blossoming of methods, data and outcomes. Once largely the domain of aggregate time series on the employment of teens, current research is notably varied in methods, data sets, measures of the minimum wage and outcomes. The growth of this literature has expanded our knowledge both of the effect of the minimum wage, and the methodologies needed to measure that effect. It has also demonstrated that there is not, and likely will never be, "the one best way" to estimate the effects of the minimum wage.

Emerging from this variety has been better understanding about what does, and does not, result in useful estimates. There is movement toward the use of quasi-experiments. This is less a matter of adopting specific techniques than of greater thoughtfulness in the construction of comparisons between experimental

and control groups. Allegretto, Dube and Reich (2009) have demonstrated that canonical panel data models can be converted into quasi-experimental models through better definition of control groups. Clearly, greater thoughtfulness in defining experimental and control groups is increasingly required of research on this issue.

The last two decades of research have also pointed toward the need for greater care in model construction. For example, the issues with measures of the relative minimum wage, and its "baked in" negative correlation with employment, have been known for more at least two decades. Unfortunately, variants on such measures have been widely used in the literature on developing and low income countries. Similarly, the introduction of arbitrary lags in the minimum wage in static panel models has largely vanished from the literature on the OECD countries, but continues to be widely used in the literature reviewed in this research. Estimates from such models are almost certainly biased by correlations with other lagged variables and the standard errors for these estimates are unreliable.

Research on developing countries has tended to follow research on the OECD, but the issues facing developing countries are somewhat different and broader than those facing the OECD countries. Developing countries are more likely to have sectors which are not covered by minimum wage laws, and those sectors are considerably larger than the uncovered sector in the OECD countries. Many of the current studies of developing countries address the issue of the effect on the uncovered sector. A central issue in these studies is the definition of the uncovered sector which is too often proxied by firm size or similarly inexact measures. Occasionally direct measures of informality/coverage are available, as in Turkish data with its indicator of inclusion in the social security system. Where they are not available, firm and establishment data may provide more accurate divisions between formal/covered and informal/uncovered sectors. As suggested by Belser and Sobeck (2012), studies of the effect of the minimum wage on the formal and informal sectors should also specifically consider the effect on wages in the informal sector. Although early theorizing about coverage and uncovered sectors emphasized that the displacement of workers from the covered to the uncovered sectors will cause wages to decline in the latter, research of the last two decades suggests a lighthouse effect. In the presence of a lighthouse effect, wages in the uncovered sector will rise in response to a legislated increase in the minimum wage in the covered sector. Whether the displacement or lighthouse effect dominates is, an empirical issue which can best be understood through additional research. It is then important that research on the effect of the minimum wage on the uncovered/informal sector include estimates of wage as well as employment effects. Another issue of considerable importance is the effect of the minimum wage on household income. This is central to evaluating the effect of the minimum wage as, if the minimum wage does not improve household income (or keep income constant while reducing hours), it does not achieve its key purpose.

A final issue is determining the level at which the minimum wage should be set. This issue is central to policy makers, both those in countries which do not have a minimum wage but are considering its implementation, and in countries which already have a minimum wage and make a choice about changing its level.

There is currently little to no research determining whether the effects of the minimum wage on employment, wages, income, and the distribution of employment between the covered and uncovered sectors is affected by the level of the minimum wage relative to the distribution of earnings of the country, state or region. We do not know if employment effects are always small, or whether they become an issue as the minimum wage rises beyond 50%, 60% or 70% of median income. Yet this is exactly the information of greatest interest to policy makers as it would allow them to set a level of the minimum wage which maximizes the social benefits.

Given both broad knowledge of what does and does not produce reliable results, and a need to broaden current research to better address issues of concern to policy makers, an issue is how to direct research toward the goals of greater policy relevance and better methods. Influencing the direction of research is challenging, particularly for organizations without large research budgets. One approach is to establish conferences to disseminate current learning, thereby pointing researchers toward the most recent methods and issues. Topical conferences which attract a mixture of established and new researchers on panels are effective in eliciting strong research, and, by disseminating current learning, improving future research and directing toward questions of current interest. A second approach is using grants to encourage good practice. This can be done through screening of grant proposals by panels of experts who not only highlight the best submissions, but also provide feedback on improvements to both those who obtain grants, and those who look toward future success.

Vetting by expert panels could also be extended as a "service" to researchers. Institutions interested in furthering research on the minimum wage could cooperate in establishing technical boards, similar to those used by U.S. Federal Agencies, to evaluate research proposals and provide guidance on research design. In the late 1990s, the journal *Industrial Relations* implemented a variant of this by having minimum wage research refereed on design, prior to estimation (Neumark, 2001). Although this experiment resulted in only one article, the approach has the promise of improving the quality of research and decreasing partisan biases. From the prospective of researchers, methodological review offers the possibility of improved research and better placement of articles. International organizations such as the ILO and World Bank could cooperate in either directly establishing a review group, or supporting a group of economists to act as a technical board.

A final point is that, until there is more careful research on developing countries, further meta-analyses of the effect of minimum wages on developing countries are not needed. There are a sufficient number currently available. What is needed is additional careful work to provide high quality estimates for future meta-analyses.

Annex

Table 1: Summary of Characteristics of Empirical Articles on the Effect of the Minimum Wage in Low Income and Developing Countries

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		Dependent Variable			Framework for Estimation			Data							Specification		
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1	Alatas, V. and L. Cameron, "The Impact of Minimum Wages on Employment in a Low-Income Country: A Quasi-natural Experiment in Indonesia, " Industrial and Labor Relations Review, (Jan, 2008), Vol. 61, n. 2, pp 201-223.	manufacturing esrablishments in Jakarta and West Java	employment	continuous	QE with careful matching of firms by employee value added	no	possible in panel estimates but the time series are relatively short	Indonesia	1990-1996	annual survey of manufacturing firms	establishment	two regions	year	longitudinal	the log of the minimum wage for models in which there is pooled data, otherwise timewise interactions	Evidence suggests that there are no effects for large domestic or foreign firms but a negative employment effect for small domestic firms.	Comparisons broken out by firm size and ownership as well as VA per employee classes some with year and establishment FE
2	Dinkelman; T & V. Ranchard, "Evidence on the Impact of Minimum Wage Laws in an Informal Sector: Domestic Workers in South Africa," Journal of Development Economics, vol 99 (2012) 27-45	All urban African and colored women aged 20 to 59 who report domestic work in the week before the survey who do not own a business, have no more than a high school level of education, and are employed or looking for work.	wages, hours, employment, benefits	discrete and continuous	QE; some estimates use IV & adjust for the Donald and Lang issue	no	uses clustering and IV	South Africa	Sept 2001 - March 2004	South African Labour Force Survey	individual	province	twice a year	RCS	ratio of the national minimum wage to the median provincial wage and median provincial wage in manufacturing	strong evidence of an effect on wages; no effect on employment or weekly hours of work; no change in labor rights	age, education, African
3	Grindling, T. H. and K. Terrell, "Minimum Wages, Wage and Employment in Various Sector in Honduras," Labour Economics, (2009), Vol. 16, pp. 291-303.	employees at large and small firms, public sector and self employed	log of the mean hourly wage by industry/sector in the wage equation; log of employment in the employment equation	Continuous	FE; IV, GMM (Arrellano-Bond)	lagged wage in the wage equation; lagged employment in the employment equation; no lagged minimum wage	requires no autocorrelation in idiosyncratic errors. See xtabond (STATA)	Honduras	1990-2004	Permanent Household Survey for Multiple Purposes	Time/industry/sector	none	semi-annual	industry/panel	The log of the real MW in the wage equation; both this and the fraction within 10% of the MW in the employment equation. Note that Honduras has many MW's	Positive effect on wages in the large firm and public sector (uncovered).Large significant negative effect on large firm employment in IV and GMM estimates. No effect on self-employed or small firm sector	industry, sector, time, average values of years of education, experience, exp2, % male, % urban, log of real GDP by industry and time. Some models include industry fixed effects and aggregate supply and demand along with survey change information
4	Harrison, A & J Scorse, "Multinationals and Anti-Sweatshop Activism," American Economic Review, Vol 100, No. 1 (March 2010) pp 247-273	Textile, Footwear and Apparel sector establishments compared to non TF&A firms, or region with Nike, Reebok or Adidas contractors vs. regions without such contractors. Some models incorporate MW measures	mfg. employment, firm exit, wages	discrete and continuous	Difference in Differences	no	Uses OLS error structure in a DID model	Indonesia	Some estimates compare 1990 to 1996; some panels estimate the effect for 1990 to 1996.	annual survey of manufacturing the Indonesian Government Statistical Agency	firm	province	annual	longitudinal	An exposure variable. For firms with a base period average wage below the post increase minimum, it is the log of the current MW less the 1990 MW ; 0 otherwise	MW is positively associated with higher wages but there are negative employment effects and increases in the likelihood of plant exit. Employment elasticity is around 0.13. Some evidence that treatment firm's wages go up more with increases in the MW.	price changes, changes in capital stock, material inputs, technology expenditures, tfp growth, change in firm size, worker characteristics
5	Mayneris, F, S. Poncet and T. Zhang, The Cleansing Effect of Minimum Wage: Minimum Wage Rules, Firm Dynamics and Aggregate Productivity in China, August, 2014, https://ideas.repec.org/p/cii/cepidt/2014-16.html.	Chinese firms in mfg., mining and public utilities	Firm exit post minimum wage; firm employment; firm survival & metropolitan employment in target industries	discrete and continuous	QE	no	Uses OLS and IV, heteroskedastic consistent	China	2003 & 2005 to span the 2004 change in national minimum wage	annual firm survey of the National Bureau of Statistics	firm	city	annual; two observations	cross section DID	The monthly minimum wage by city and year for full time workers and this interacted with 'exposure', whether the firm's initial average wage was less than the new MW. The structure allows for variation within cities between exposed and not exposed firms, and between cities as they have different MW	Higher MW associated with exit among exposed firms (firms with average wage less than new MW). It also increases average wages, employment and labor productivity among surviving exposed firms. There is no net effect on employment at the city level	Depending on the equation, the model can include FE for sector or city-sector, firm wage, employment, and labor productivity, ownership and whether the firm exports.

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6	Papps, K.L., "the Effects of Social Security Taxes and Minimum Wages on Employment: Evidence from Turkey," ILRR, vol65, no 3, July, 2012 686-707.	Low wage covered workers who are bound by the MW increase	(Change in) Employment across 3 or 9 months	dummy	QE comparing workers bound by the increase in the MW to three control groups (those immediately above the new MW in the covered sector), workers in the uncovered sector who are between the old and new MW; and uncovered workers below the old MW.	no	none beyond the usual issues with probit	Turkey	2002-2005	Household Labor Force Survey	individual	national study	quarterly	longitudinal	The measure is a measure of the change in labor costs associated with increases in the minimum wage or in social security payments . In periods where neither changes, it has a value of 0.	Both increases in the MW and Social Security tax are associated with reductions in employment, but the MW effect is about half the size of the Social Security tax effect. When decomposed by treatment group (concern with higher wage group having more stable jobs), MW is associated with reduced employment against higher wage treatment but not against low wage treatment groups. MW employment elasticities are generally very small and non-significant. Many sensitivity tests	quarter dummies, age, sex, urban status, marital status, education level, employed in unregistered job and length of gap between observations (9 vs 3 month)
7	Strobl, E. and F. Walsh, "Minimum Wages and Compliance: The Case of Trinidad and Tobago," Economic Development and Cultural Change, (January, 2003), Vol. 51, n. 2, pp. 427-450.	low wage workers in T&T	Whether individuals are employed and paid at least the minimum wage in the post implementation period	discrete and continuous	RCS with probit estimate for job loss	no	no clustering of SE but the time period is brief, reducing concerns with serial correlation	Trinidad & Tobago	1996 -1998	Continuous Sample Survey of Population	household with households surveyed 3 times, once, a year later and then one quarter later	region	annual and seasonal	RCS	QE in which experimental group is defined by period and exposure (low wage in initial period)	Men employed by large firms are more likely to be paid more than the MW in the second period, but there is no effect on men employed by small firms. There is a positive effect on all women's likelihood of earning more than the minimum wage, but there is no specific large firm effect. There is no employment effect for men bound by the new minimum wage, but there is a negative effect for men when the MW is measured by the wage gap in large firms. For women there is no employment loss with either variable.	gender, age, marital status, schooling (10 or more). There are industry, occupation, region, seasonal and year dummies.
8	Cuong, Nguyen Viet, "Do minimum Wage Increases Cause GDP Inflation? Evidence from Vietnam," ASEAN Economics Bulletin , Vol 28, No 3 (December 2011) pp 337-359	inflation	Consumer Price index	continuous	FGLS allowing for autocorrelation	lagged dependent variables in some models	test for and reject unit roots;	Vietnam	Jan., 1994 - Dec 2008	Department of Trade and Price, General Statistics Office	month	country wide	monthly	univariate time series	dummies with a two month and seven month window following a MW increase and a four month windows around monthly minimum wage was increased	No evidence of a positive relationship between MW increases and inflation; some evidence of a negative relationship	lagged inflation, annual GDP growth, annual growth of the real state budget, annual growth in the real money supply, monthly U.S. CPI, seasonality controls
9	Soundararajan, V. 'Minimum Wage Effects at Different Enforcement levels: Evidence from Employment Surveys in India," We 2014-12 (April, 2014), C.H. Dyson School of Applied Economics and Management, Cornell University.	Unskilled, illiterate construction workers	construction employment, days worked in construction during survey week and wages	discrete and continuous	OLS and IV regression	yes, lagged minimum wage is included in the MW measure and its interaction with the enforcement variable. This may be irrelevant as the MW measure is then converted into a quartile measure.		India	2004-2012	Indian National Sample Survey	individual in household	none	annual	RCS	The log of the real MW is divided into a four quartile indictor variable as is the number of minimum wage inspectors. The interaction of these two sets of indicators are interacted to create 16 categories of interaction with the lowest quartile for the number of inspectors used as the base.	Relative to the lowest quartile of enforcement, the second quartile has a negative relationship to employment but the third and fourth are positive. There is no apparent relationship to the level of the MW. Similar pattern for effect on the log wage.	Model includes state and year FE, log of real construction workers GDP, age, social group (scheduled caste), gender, and sector (rural or urban)

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10	Bosch, M. and M. Manacorda, "Minimum Wages and Earnings Inequality in Urban Mexico," *American Economic Journal: Applied Economics* , Vol. 2, n. 4 (October, 2010) pp. 128-149	Employed workers in metropolitan areas	Percentile wage gap between the nth percentile and the 70th percentile of the wage distribution	Continuous	Linear RCS regression model	No	Following Lee and Autor uses IV estimation	Mexico	1980-2001	ENEU - Ensuesta Nacional de Empleo Urbano	municipalities	Metropolitan Area	Annual - survey is quarterly but only the first quarter is used	RCS	The log of the nominal minimum wage in the municipality.	A higher minimum wage reduces inequality between lower wage deciles the and 70th decile for men & women and for both and for those employed in the formal sector. The authors find that rising inequality in the bottom of the wage distribution is due to a declining real minimum wage.	Municipal fixed effects, state by year fixed effects and municipal trends

GLOSSARY of LESS COMMON ACRONYMS & ABBREVIATIONS

DID: Difference in Differences

FE: Fixed Effects

FGLS: Feasible Generalized Least Squares

QE: Quasi-Experiment

RCS: Repeated Cross Section

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