

How Do Firms Respond to Minimum Wage Increases? Understanding the Relevance of Non-Employment Margins

Jeffrey Clemens

When analyzing the effects of minimum wages, both researchers and policymakers have long focused their attention on wages and employment as outcomes. Research on the employment effects of the minimum wage has, by itself, supported literature reviews and meta-analyses for decades (for some recent examples, see Belman and Wolfson 2019; Clemens 2019; Neumark 2019; Congressional Budget Office 2019; Dube 2019). While debate remains contentious, a rising fraction of researchers have concluded that the employment effects of moderately sized minimum wage increases are quite close to zero (Belman and Wolfson 2019). At the same time, the public and policymakers have adopted a favorable view of historically large minimum wage increases. The public's support for raising the federal minimum wage from \$7.25 to \$15 per hour has recently approached levels of support that have historically applied to much smaller minimum wage increases. A recent poll from Pew Research, for example, found 67 percent of Americans in support of a \$15/hour federal minimum wage (Davis and Hartig 2019), which is quite similar to the 71 percent support found for a \$9/hour minimum wage in a 2013 poll from Gallup (Saad 2013). As of January 2020, policymakers in California, Connecticut, Illinois, Maryland, Massachusetts, New Jersey, and New York had enacted laws that would eventually raise their states' minimum wages to \$15/hour.

Debates among economists over the employment effects of the minimum wage have been highly contentious. In a provocative essay, Leonard (2000, p. 118) suggests

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a reason why. He points to the debate's perceived intellectual stakes, writing that "it is the latest chapter in a longstanding methodological dispute over whether and in what domains neoclassical price theory can be said to properly apply." That is, estimates of employment elasticities are treated as tests of the neoclassical model itself. In this paper, I argue through a series of theoretical and empirical illustrations that this high-stakes "theory-testing" approach to evidence on the effects of minimum wages has been misguided.

Instead, I contend that controversies over the economics of minimum wages stem, to a surprising degree, from a common but under-considered assumption. The assumption of interest is that when studying labor markets, output prices and nonwage aspects of jobs (which include benefits and working conditions) can be taken as fixed. In standard diagrams of the labor market, this assumption implicitly underlies each supply or demand curve. When these curves are held fixed, output prices and nonwage aspects of jobs have also, whether implicitly or explicitly, been held fixed.

Models that implicitly reduce jobs to their wages pervade textbook analyses of the minimum wage. On one level, this is not surprising because wages and employment occupy the axes along which we draw labor supply and demand curves. Indeed, the wage will tend to be a job's single most important attribute. At the same time, however, textbook models of both perfectly and imperfectly competitive labor markets sweep many factors under the rug. Benefits, including employer-provided health insurance, account for around one-third of compensation costs (US Bureau of Labor Statistics 2020b). Working conditions, including safety measures and flexible schedules, can also have value to workers while generating costs to firms. Textbook labor market models also tend to treat output prices and production technologies as fixed. Yet for reasons detailed below, it would be natural for any number of these margins to shift in response to minimum wage changes. In the jargon of undergraduate instruction, the *ceteris paribus* assumption (that is, "other things held constant") that professors invoke when we draw labor supply and demand curves is unlikely to describe the real world.

In the following discussion, I show that margins including nonwage job attributes can have first-order implications for analyses of minimum wages. In models that account for such factors, predictions for the effects of minimum wages on unemployment and worker welfare can, perhaps surprisingly, be reversed from our basic intuitions. I also show how these results can be illustrated through minor extensions to basic diagrams of labor supply and demand.

I attempt to answer three questions. First, through what non-employment margins might firms adjust in response to minimum wage increases? Second, what has empirical research taught us about the minimum wage's effects on non-employment margins? Third, how should these margins enter our assessments of the minimum wage as a tool for improving the well-being of low-wage workers? I begin by analyzing minimum wage response margins that fit nicely into standard supply and demand diagrams. These margins include output prices, nonwage compensation, and other job attributes. I then turn to additional, firm-level factors that may be in play. How might it matter, for example, if firms design uniform health insurance

benefits for both minimum wage workers and higher wage workers? How might a firm alter its production technology, perhaps to improve the skill mix of its workers or to transition from labor- to capital-intensive production? Along what time horizons might these adjustments occur? In the conclusion, I offer some thoughts about what these issues imply for nuanced assessments of the minimum wage and for classroom pedagogy on this topic.

Analyzing the Minimum Wage within a Basic Labor Supply and Demand Framework

This section begins with the textbook, introductory-level approach for teaching the economics of the minimum wage in a perfectly competitive labor market. I use this initial discussion to highlight factors that are held constant when we draw labor supply and demand curves.

The Minimum Wage in a Textbook Diagram of a Perfectly Competitive Labor Market

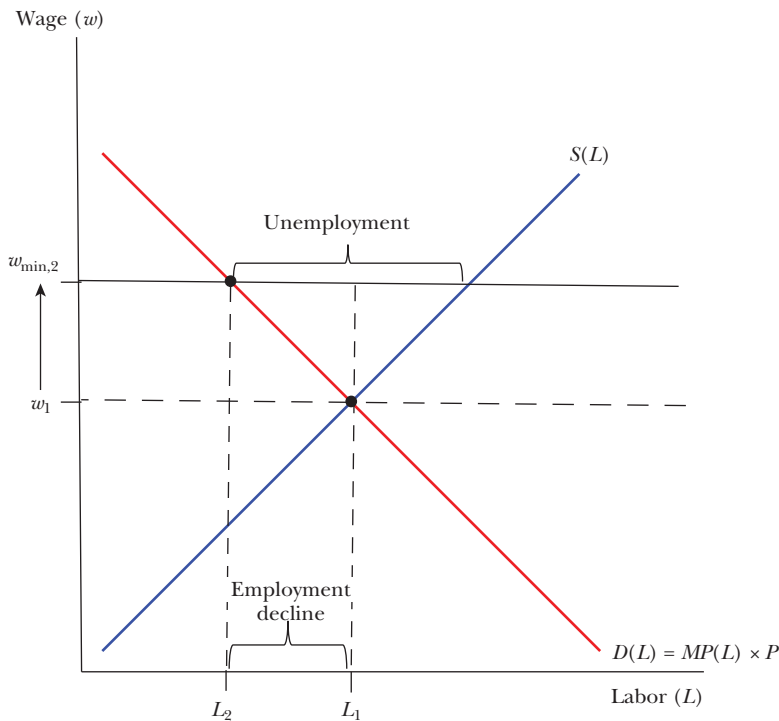
Figure 1 presents the standard textbook diagram for analyzing the effects of a binding minimum wage in a perfectly competitive labor market. The labor supply curve slopes upward, reflecting differences in workers' reservation wages (as driven by outside opportunities related, perhaps, to leisure, home production, and economic assistance that can be received while out of work). The labor demand curve slopes downward, tracing out the relationship between the quantity of labor employed and the marginal revenue product of that labor. This, in turn, reflects the assumption of a constant price (due, perhaps, to a perfectly competitive market for the firm's output) and a production function in which, holding capital and technology fixed, labor has diminishing marginal productivity.

In a perfectly competitive labor market, a freely set wage will adjust to equilibrate supply and demand. That is, the wage will adjust to the level (w_1) such that the opportunity cost of the last worker's time equals the value of that worker's output to firms. A binding minimum wage floor, as at $w_{min,2}$ in Figure 1, breaks this equilibrium. This wage floor would increase the quantity of labor supplied while decreasing the quantity demanded. The resulting labor surplus implies unemployment. The market is demand-constrained and the minimum wage of $w_{min,2}$ causes employment to decline from L_1 to L_2 .

Pass-through of Cost Increases to Consumers through Output Prices

A natural starting point for extending the traditional textbook analysis is to consider output prices. In the supply and demand diagram, the labor demand curve traces out labor's "marginal revenue product." That is, it traces the marginal product of labor, or $MP(L)$, times the output price, P . The output price is thus a shifter of the labor demand curve. Treating the output price as fixed assumes perfect competition across product markets that extend beyond the jurisdiction in which the minimum wage binds. More concretely, it is imagined that equivalent

Figure 1

Basic Supply and Demand Diagram: Fixed Non-Wage Job Attributes and No Price Pass-Through

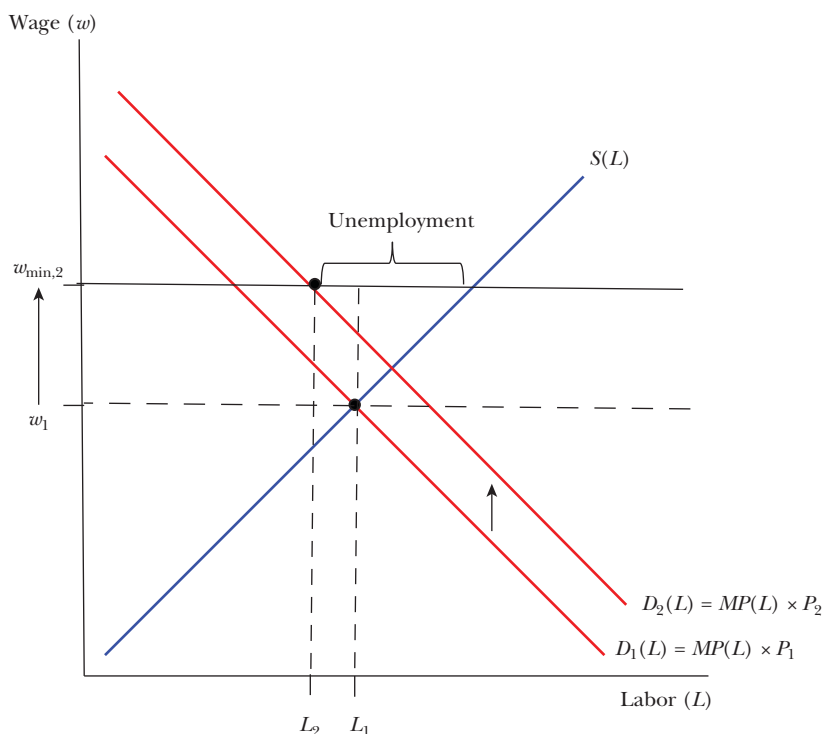
Note: The figure presents the standard textbook diagram for analyzing the effects of a binding minimum wage floor in a perfectly competitive labor market.

goods or services can be costlessly imported from producers elsewhere who are not affected by the increase in wages. As a result, any firm that raises its price will lose all of its customers.

If demand for a firm's output is not perfectly elastic, it can raise prices while losing some, but not all, of its customers. A price increase in response to a minimum wage increase is often called *pass-through*: that is, the minimum wage's cost passes through the firm to its consumers. An increase in output prices implies an outward shift of the labor demand curve, as illustrated in Figure 2. This blunts the magnitude of the decline in employment following an increase in the minimum wage, as can be seen by comparing Figure 2 with Figure 1.

A firm's ability to adjust prices depends on the elasticity of demand for its goods and/or services. This depends, in turn, on the scope of the market. Firms that produce widely traded goods or services may face large demand elasticities and thus have little capacity to raise prices. By contrast, firms that produce "non-tradable" goods and services may face smaller demand elasticities and have more

Figure 2

Partial Offset through Price Pass-Through

Note: The figure augments the standard textbook diagram for analyzing the effects of a binding minimum wage floor (see Figure 1) by allowing for the possibility that firms increase output prices in response to the cost increase associated with the minimum wage.

substantial scope for passing cost increases to consumers (Moretti 2010, 2011). Standard examples of non-tradables include beauty services, meals at restaurants, and home construction, which are more or less constrained to be provided where they are consumed. Pass-through may also depend on whether the minimum wage is increased at the city, state, or federal level. When a minimum wage increase is localized, there is greater scope for importing products from unaffected firms.

How empirically relevant is a firm's capacity to pass the cost of the minimum wage to its consumers through higher prices? Lemos (2008) reviews the literature through the mid-2000s, most of which analyzes prices in the restaurant industry. Results through that time were quite mixed. Aaronson (2001) and MacDonald and Aaronson (2000), for example, found evidence of substantial price pass-through. By contrast, analyses by Katz and Krueger (1992) and by Machin, Manning, and Rahman (2003) found no evidence of price pass-through.

Several researchers have recently returned to the issue of minimum wage pass-through using administrative data sources and recent developments in best-practice

empirical methods. In the US context, for example, Leung (forthcoming) analyzes pass-through using price data built up from individual-level purchases in the Nielsen Consumer Panel. Renkin, Montialoux, and Siegenthaler (forthcoming) analyze US grocery price scanner data. Harasztosi and Lindner (2019) analyze pass-through using firm-level price indices from Hungary. Each of these papers finds evidence of substantial pass-through. Harasztosi and Lindner, for example, estimate that roughly 75 percent of the cost of a large increase in Hungary's national minimum wage was passed onto consumers. In their analysis, Harasztosi and Lindner provide novel evidence of variations in pass-through across industries. Consistent with standard theory, they find that price responses were greater in non-tradable industries than in tradable industries. Conversely, they find that employment declines were greater among firms in tradable industries, which were less able to pass cost increases onto their consumers, than in non-tradable industries.

Pass-through depends on factors that can vary across industries, across markets, and over time. Harasztosi and Lindner's (2019) analysis, for example, focuses on differences across industries defined as "tradable" or "non-tradable" by earlier research. These categories may be malleable, however, as the scope of competition may vary meaningfully over time. Online retail, for example, increases the scope of the market for retail services. The rise of online retail may thus reduce the capacity for retailers to increase prices in response to localized increases in the minimum wage. A constructive path forward will be for this segment of the literature to develop additional evidence on the attributes of industries and markets that translate into lesser or greater price pass-through—which may also help to explain variations in pass-through estimates across earlier studies.

If costs are passed through to consumers, then the incidence of the minimum wage depends, in part, on which households consume products that require substantial input from minimum wage workers. MaCurdy (2015) provides evidence that this force will tend to be regressive, since minimum-wage-intensive products account for a disproportionately large fraction of the budgets of low-income households. This pattern is driven to a significant degree by the relative importance of groceries and food away from home in the budgets of low-income households relative to high-income households. Data from the 2019 Consumer Expenditure Survey, for example, reveal that food expenditures (combining food consumed both in and out of the home), account for roughly 15 percent of the expenditures of low-income households and just over 10 percent of the expenditures of high-income households (US Bureau of Labor Statistics 2020a). This point is also made by Renkin, Montialoux, and Siegenthaler (forthcoming).

In MaCurdy's (2015) analysis, the minimum wage appears far less progressive than one might expect, even in the absence of negative employment effects. In addition to the composition of their consumption bundles, this finding reflects the fact that many minimum wage workers live in middle- to high-income households (Congressional Budget Office 2019; Sabia and Burkhauser 2010). MaCurdy thus finds that income gains are diffused across the distribution of household incomes, while costs fall disproportionately on low-income consumers.

The distributional implications of minimum wage pass-through can depend on the empirical setting. In their analysis of data from Hungary, for example, Harasztosi and Lindner (2019) find that the goods and services consumed by the rich and poor have quite similar exposure to price increases due to increases in the minimum wage. Regardless of the net impact on progressivity, however, it is clear that price pass-through erodes the real income gains households might otherwise realize through minimum wage increases.

Noncash Compensation

In response to a minimum wage increase, a firm might adjust its noncash compensation offerings. Academics and their employers, for example, contract over the generosity of benefits including health insurance, pensions, research budgets, and travel budgets. Across all US workers, the US Bureau of Labor Statistics (2020b) documents that wages and salaries account for roughly 70 percent of total compensation costs. Benefits including health insurance, paid leave, and pensions account for much of the rest.

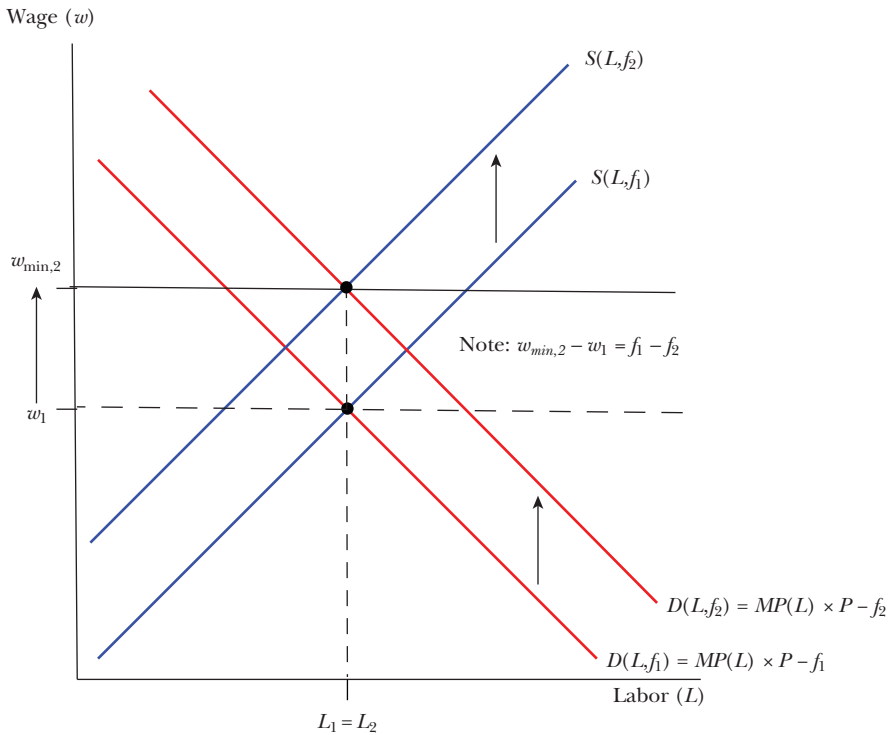
Conceptually, it is straightforward to see that offsetting changes in nonwage compensation can nullify the minimum wage's effects on compensation costs and, by extension, labor demand. While the logic is simple, however, understanding the role of noncash compensation in supply and demand diagrams requires thinking subtly about supply and demand curves. The key point, as illustrated below, is that reductions in noncash compensation can shift both the supply curve and the demand curve. The relevant theoretical points have been made in both the minimum wage literature and the literature on nonwage benefit mandates (Wessels 1980; McKenzie 1980; Summers 1989).

Figure 3 illustrates the implications of noncash compensation for labor supply and demand. A given labor supply or labor demand curve assumes a fixed level of noncash compensation (f_1 in the diagram).¹ From the perspective of firms, lower noncash compensation implies a higher labor demand curve because it increases revenues net of nonwage costs. From the perspective of workers, lower noncash compensation implies a higher labor supply curve, since a higher wage is required to make employment attractive when nonwage benefits are lower. Because f_1 is expressed as a dollar-denominated cost, it enters linearly into the labor demand curve. The marginal value of these benefits to workers may depend, however, on the quantity at which they are provided and the efficiency with which they are designed or produced by the firm. Consequently, the figure depicts the supply curve as a more general function, $S(L, f_1)$, of these benefits.

The figure illustrates the special case in which wages and nonwage benefits are perfectly substitutable on the margin, meaning their cost to firms exactly equals

¹A subtle point that can easily go unnoticed is that traditional derivations of labor demand curves assume that there is no noncash compensation—that is, not simply that it is held fixed, but that it does not exist. To be more specific, it is common for textbooks to write that firms demand labor until its marginal revenue product equals the wage rate. In the presence of noncash compensation, however, the zero profit condition is that the wage equals the labor's marginal revenue product *net of* the cost of nonwage compensation.

Figure 3

Perfect Offset through Noncash Compensation (for example, “fringe benefits”)

Note: The figure augments the standard textbook diagram for analyzing the effects of a binding minimum wage floor (see Figure 1) by allowing for the possibility that firms reduce the generosity of noncash compensation (for example, “fringe benefits” like employer-provided health insurance) in response to the cost increase associated with the minimum wage. A similar diagram is presented as Figure 1 in McKenzie (1980).

their value to workers. In this case, fringe benefits can be reduced so as to perfectly offset, and thus nullify, the minimum wage increase ($w_{\min,2} - w_1 = f_1 - f_2$). In this special case, the net cost and value of compensation are both unchanged, as is the quantity of labor transacted. However, if the minimum wage were to distort the compensation package away from its optimal mix, then the labor supply curve would shift more than the demand curve. In this case, a lower quantity of labor would be transacted in equilibrium. Although the distortion would reduce workers’ well-being, there would be no unemployment because the market would, nonetheless, be at a new equilibrium.

Research on the effects of minimum wages on nonwage compensation is relatively sparse. Because of data limitations, the primary component of nonwage compensation that can be incorporated into research on minimum wages is the margin of whether workers have employer-provided health insurance. The available data on employer-provided health insurance tends to be binary—measuring

whether a worker has such insurance or not—and thus does not capture changes in the cash value of whatever benefit might be offered.

Analyses of historical minimum wage changes in the United States tend to find weak evidence of a relationship between minimum wage increases and employer-provided health insurance (for examples, see Royalty 2001; Simon and Kaestner 2004; Marks 2011). Analyses of relatively recent minimum wage changes have tended to find negative, though modest, effects. A back of the envelope calculation by Clemens, Kahn, and Meer (2018) suggests that declines in the provision of employer-provided health insurance have offset roughly 15 percent of the cost of states' recent minimum wage increases. Additional recent work also reports negative correlations between minimum wages and employer-provided health insurance in data from both the American Community Survey and the Current Population Survey (Gooptu and Simon 2019; Eibner et al. 2017).

How do nonwage compensation margins relate to the distributional effects of minimum wage policy? Adjustments along these margins will simultaneously tend to mitigate employment effects while also blunting the wage increase's effects on a worker's well-being. Because these factors are often unmeasured, it seems appropriate to exercise humility regarding the strength of the conclusions we can draw from available data.

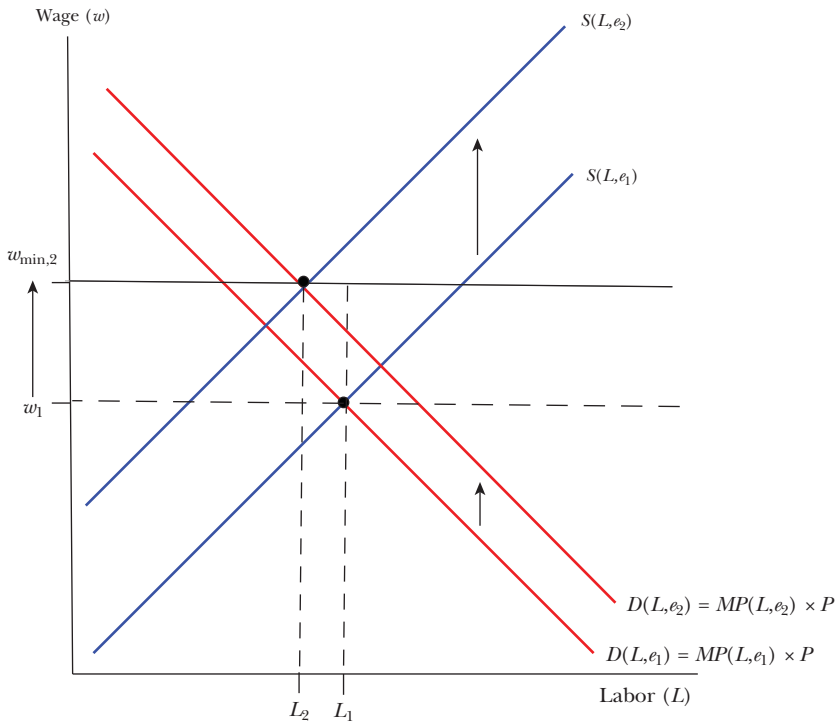
Other Job Attributes

In addition to changing noncash compensation, employers may adjust job attributes like effort requirements, schedule flexibility, and training opportunities in response to changes in minimum wages. Positive aspects of jobs are often referred to as “non-compensation amenities,” while negatives are known as disamenities. Conceptually, a firm facing minimum wage increases might seek to offset some of the increase in costs by raising productive disamenities (like effort requirements) and reducing unproductive amenities (like the quality of office furniture). As with changes in noncash compensation, these changes will shift both the supply curve and the demand curve.

Figure 4 illustrates the relevance of productive disamenities like effort requirements, denoted e . The basic theory underlying the relevance of productive disamenities for minimum wage analyses has been laid out by Ippolito (2003). The diagrammatic analysis is quite similar to the analysis of nonwage components of compensation. Increases in productive disamenities (from e_1 to e_2 in the diagram) imply upward shifts in the labor demand curve (due to an increase in marginal product) and upward shifts in the labor supply curve (due to an increase in disutility from work effort). The figure illustrates the case in which a binding minimum wage results in suboptimal levels of productive disamenities. The increase in productive disamenities thus results in a larger shift in the labor supply curve than in the labor demand curve.

A final set of conceptual points are worth noting here. In Figure 1, where we held nonwage compensation, workplace amenities, and effort requirements fixed, the minimum wage caused unemployment to rise by more than employment declines. That is, the diagram predicts job shortages linked to both a decline in the quantity demanded and an increase in the quantity supplied. In Figure 4, however, where

Figure 4

Increase in a Productive Disamenity (for example, “effort”)

Note: The figure augments the standard textbook diagram for analyzing the effects of a binding minimum wage floor (see Figure 1) by allowing for the possibility that firms increase a productive disamenity (for example, the amount of effort required from workers) in response to the cost increase associated with the minimum wage. A similar diagram is presented as Figure 3 in Ippolito (2003).

we allowed the effort requirement to rise from e_1 to e_2 in response to the minimum wage, the labor market has settled into a new equilibrium. In other words, while the diagram predicts that the minimum wage will lead employment to decline, it also predicts that there will not be an excess supply of workers looking for jobs. One prediction of the basic instructional diagram (in Figure 1) has thus been reversed, and another blunted, without deviating from a perfectly competitive framework. Finally, the shift to higher effort means that the welfare of the average worker may have fallen, in spite of the increase in wages. The conventional wisdom, which holds that a binding minimum wage improves worker welfare if it has minimal effects on employment, may no longer hold.

A wave of high-quality research has recently demonstrated the relevance of workplace amenities. Several recent papers, for example, highlight the value of worker-driven schedules (for example, Chen et al. 2017; Mas and Pallais 2017; He, Neumark, and Weng 2019). This set of papers include experimental studies as well as a study of workers' valuations of the flexibility enabled by Uber. A separate analysis

by Maestas et al. (2018) uses an experimental survey approach to quantify workers' willingness to pay for improved workplace conditions, and finds these valuations to be substantial.

While workplace amenities clearly matter, there is little research on the responsiveness of amenities to minimum wage changes. Clemens and Strain (2020a) provide an illustrative example, whereby minimum wage increases can result in shifts away from worker-driven schedules and towards employer-driven schedules. Employer-driven schedules can generate higher output per hour if, for example, they enable firms to dismiss workers during slack shifts. Lack of control over their schedules is costly for workers and thus requires compensation in the form of higher wages. A binding minimum wage may render low-wage, worker-friendly schedules illegal. In doing so, it can result in scheduling changes that mitigate the minimum wage's employment effects but leave workers worse off. As noted above, however, there is little, if any, empirical evidence on the minimum wage's effects on scheduling, workplace safety, workplace comfort, and other related margins.

How empirically important are effort requirements? The answer to this question is unlikely to be general, as the relevance of effort requirements may vary significantly across settings. The empirical connection between minimum wages and effort requirements can be traced back more than a century, to an analysis of minimum wage laws in Oregon. In that analysis, Obenauer and von der Nienburg (1915) described workers' experience in the wake of a minimum wage increase as follows: "Now, they said, they are under constant pressure from their supervisors to work harder; they are told the sales of their departments must increase to make up for the extra amount the firm must pay in wages." Recently, there are two high-quality papers on the effects of minimum wages on productivity. Ku (forthcoming) looks at data on temporary tomato pickers in Florida over the period surrounding a statewide minimum wage increase. Coviello, Deserranno, and Persico (2020) look at data from a sample of 10,000 US workers paid on a base-plus-commission basis by a nationally operating retailer. Both studies find that low-productivity workers increase their work effort in the wake of minimum wage increases. In both cases, effort responses appear to substantially offset the cost increases associated with minimum wage increases. These large impacts are likely connected to the specific settings the authors analyze. Both Ku (forthcoming) and Coviello, Deserranno, and Persico (2020) analyze workers and firms in settings where output is well-measured and where compensation has a strong piece-rate, or commission, component.

Firm Profits

If firms fail to respond to minimum wages, increases in their input costs will lead mechanically to declines in their profits. Draca, Machin, and Van Reenen (2011) analyze profitability in the wake of the UK's 1999 introduction of its national minimum wage. They find evidence that the cost of the UK's national minimum wage was, to a substantial degree, absorbed in the form of lower profits. Bell and Machin (2018) study firm value as measured using market capitalization. They do so following the July 8, 2015, announcement of an unexpectedly large increase in the UK's national minimum wage. As in the Draca, Machin, and Van Reenen study, the

decline in market capitalization is similar to what one would infer if the full cost of the minimum wage increase were to be absorbed in the form of lower profits.

Evidence that firm owners bear some of the cost of minimum wage increases raises the question of where these firm owners fall in the income distribution. Drucker, Mazirov, and Neumark (2019) provide a rare answer to this question using administrative records from Israel. They find that the owners of Israeli firms that employ minimum wage workers tend to be in the top half of the overall income distribution, but towards the bottom of the distribution of income across firm owners.

Reductions in profits also raise the question of firm exit, or of which firms survive. Patterns of exit can have implications for the products available to consumers, the jobs available to workers, and demand for commercial real estate. In a study using data from Yelp, for example, Luca and Luca (2019) find that minimum wage increases in San Francisco predict increases in exit among lower-rated restaurants. In an analysis of workers and firms in Germany, Dustmann et al (2020) find that the 2015 introduction of Germany's minimum wage led to a reallocation of workers "from small, low paying firms to larger, higher paying firms." Firm exit also has implications for the owners of land, as a reduction in demand for commercial real estate may depress rents. The incidence of minimum wage increases on land owners has not, to the best of my knowledge, been addressed by empirical research.

The full absorption of wage increases through lower profits, as found in two studies referenced above, is particular to settings in which no other margins adjust. As discussed earlier, there are settings in which margins including prices, effort, and noncash compensation have also been found to adjust, to greater or lesser degrees. When other margins prove highly flexible, as in some of the studies mentioned earlier, profits will absorb less of the burden.

This section has discussed how traditional supply and demand analysis can provide a far richer picture of firms' responses to minimum wage changes than is widely appreciated. These straightforward extensions can quite readily be brought into the supply and demand diagrams through which labor markets are taught to undergraduates. Similar insights regarding the relevance of prices, noncash compensation, and productive disamenities can also be developed within classic monopsony models. Not all of the minimum wage's potential effects, however, can be captured through supply and demand analyses within a single standard diagram. The next section turns to several such issues.

A Broader Perspective on Personnel Policies and Production Technologies

In this section, I turn to issues that push outside the limits of traditional supply and demand diagrams: decisions by firms to evade minimum wage regulation; adjustments that apply to all of a firm's personnel, such as changes to firm-wide benefits packages; and changes to firms' production functions.

Compliance

Up to this point, I have implicitly assumed that the minimum wage is enforced as intended. Noncompliance is an empirical reality, however, making it important to understand its economic determinants. An earlier generation of papers, beginning with Ashenfelter and Smith (1979), developed theoretical models of the economics of minimum wage evasion. This research drew heavily on Allingham and Sandmo's (1972) model of tax evasion, which in turn draws on Becker's (1968) classic model of the decision to participate in crime. In such models, the decision to evade is primarily a function of the gains from successful evasion, the probability of detection, and the penalties associated with being caught. A novel point from the minimum wage literature is that evasion will be more likely when it is in the joint interest of firms and workers, which can occur when a firm would not find it profitable to hire a worker at the prevailing minimum wage. In such cases, evasion of minimum wage laws can be viewed, in part, as a release valve that mitigates the wage floor's adverse effects on employment.

Empirical research on the determinants of noncompliance with the minimum wage consistently finds noncompliance to be nontrivial. Further, the extent of noncompliance varies in ways that are consistent with insights from the theoretical analyses discussed above. Goraus-Tańska and Lewandowski (2019), for example, find that violation rates in central and eastern Europe are highest when minimum wages are high relative to average wages. Violation rates have also been found to be high when firms are limited in their ability to pass labor costs on to consumers. For example, this pattern is observed by Weil (2005) in an analysis of US apparel companies with government contracts, and also by Bernhardt, Spiller, and Theodore (2013) in a survey of workers from Chicago, Los Angeles, and New York City. Following Germany's recent introduction of a statutory minimum wage, rates of noncompliance were moderately high, at least in the short run (Caliendo, Schröder, and Wittbrodt 2019).

How much has subminimum wage payment risen following recent minimum wage increases in the United States? This question is difficult to answer due to measurement error concerns in self-reported wage data. Clemens and Strain (2020b) devote significant attention to measurement error as a potential source of the appearance of subminimum wage payment in the Current Population Survey. Their analysis of recent minimum wage changes estimates that noncompliance has averaged roughly 14 to 21 cents per \$1 of realized wage gain.

The findings discussed above suggest a trade-off between enforcement and the minimum wage's effects on employment and other margins. Enforcement of minimum wage laws may reduce evasion but risks exacerbating adverse effects on workers. As Clemens and Strain (2020b) emphasize, this "trade-off between short-run economic efficiency and respect for the rule of law is not one to be taken lightly." After all, the quality of governance, or "social infrastructure," has long been understood to be an important determinant of long-run growth and economic well-being (Hall and Jones 1999).

A final point regarding estimates of noncompliance involves marginalized groups, like undocumented workers, and the role of informal economic activity. The scope for evasion will tend to be largest when informal economic activity is

common. Due to the threat of deportation, undocumented workers in informal employment arrangements may have limited recourse against an employer who pays below the minimum wage. Orrenius and Zavodny (2011) study this issue using wage and employment data from the US Current Population Survey. They report “mixed support for our hypothesis that undocumented immigrants are less likely to be affected by changes in the minimum wage.” But the issue is inherently difficult to study, as the Current Population Survey does not directly identify undocumented workers. In the following section, I turn to a broader set of issues involving the effects of the minimum wage on the compensation and employment of workers who differ with respect to their productivity and credentials.

Firm-Level Decisions Regarding the Design of Jobs and Compensation

Basic supply and demand analyses make a strong assumption about the workers under consideration. Within a given supply and demand diagram, workers are implicitly assumed to be undifferentiated, meaning they have equal productivity. As employers will readily attest, however, ostensibly similar workers employed in equivalent jobs can differ dramatically in their output. In their hiring decisions, firms face choices regarding the skill mix of workers they employ.

Firms also face decisions regarding the design of benefits packages, which may involve choices that cannot be tailored to workers of different skill levels. High- and low-wage workers may have quite different preferences over the generosity of benefits on the margin: for example, high-wage individuals might prefer a more generous insurance plan and a nicer work environment, while low-wage workers might prefer higher wages. Administrative costs may make it infeasible, however, for firms to tailor insurance benefits or workplace amenities to each worker’s desires. Many firms in the United States, for example, including a majority of small firms, use the same health insurance benefit for broad categories of workers.²

When firms offer a common benefits package to workers of multiple skill types, minimum wage increases may have the effect of altering the compensation packages offered to both minimum wage and non-minimum wage workers. As pointed out by Clemens, Kahn, and Meer (2018), changes in health insurance or other benefits can thus generate “ripple effects.” That is, they create a mechanism through which minimum wage increases can impact wages for both minimum wage workers and higher wage workers. Changes in fringe benefits may thus help us to understand spillovers that have been detected in analyses of wages.

Changes in the mix of compensation can have nuanced welfare implications. Under standard assumptions (for example, that health insurance is a “normal good” over which utility increases at a diminishing rate), a benefits package that balances the interests of high- and low-wage workers will tend to include health insurance benefits that are excessive from the perspective of low-wage workers: that

²As noted in Clemens, Kahn, and Meer (2018), for example, roughly one-half of firms that provide health insurance offer only one plan (as shown in Summary Table II.a.2.d, 2016 Medical Expenditure Panel Survey at https://meps.ahrq.gov/data_stats/summ_tables/insr/state/series_2/2016/tia2d.htm). That is, many firms design a single benefit for the entirety of their workforce, likely due to administrative costs.

is, all also equal, low-wage workers would prefer to receive additional cash and less generous health insurance. If a firm shifts from noncash towards cash compensation due to an increase in the minimum wage, the welfare of low-wage workers may thus rise, while the welfare of high-wage workers may decline. As emphasized earlier, the presence of an offset between insurance and wages implies that the welfare of low-wage workers rises less than one would infer based on the change in their wages alone.

Firms can also alter their personnel policies by substituting from low-skilled labor to higher-skilled labor. This “labor-labor substitution” can be important for assessing the welfare implications of a change in the minimum wage. Data on industry-wide wage bills and employment counts can mask changes in the types of workers that are actually employed. If the least-skilled are replaced by higher-skilled workers, industry employment counts can mask job losses for the intended beneficiaries of the minimum wage. Relatedly, employers who seek to evade the minimum wage may increase their hiring of undocumented immigrants, as discussed by Orrenius and Zavodny (2008). The empirical relevance of this evasion margin may depend crucially on immigration policy, which influences the number of undocumented workers in the labor market. The extent of informal economic activity may also be relevant in this regard.

What evidence exists on “labor-labor substitution”? One piece of evidence on how the minimum wage can affect firms’ hiring decisions is from an experiment in a real-world, online labor market (Horton 2018). The experimental sample in Horton’s study includes “nearly 160,000 job openings.” Horton finds clear evidence that minimum wage increases lead firms to shift from low-productivity workers towards higher-productivity workers. More specifically, he finds that firms shift towards workers whose job profiles show higher past wages.

In addition to Horton’s (2018) experiment, recent analyses from several settings have found evidence that firms substitute away from low-skilled workers following minimum wage increases. Clemens, Kahn, and Meer (forthcoming) find that recent increases in state minimum wages predict increases in the average age and education of workers in low-wage occupations. They also find evidence that firms altered their job vacancy postings: specifically, firms became more likely to require high school diplomas of prospective employees in the wake of recent minimum wage increases. Within food service or retail industries, Clemens and Wither (2019), Fairris and Bujanda (2008), and Giuliano (2013) all find evidence consistent with substitution across groups of low-skilled workers.³ Finally, research on the city of Seattle’s recent minimum wage increases has found disproportionately large hours reductions for those who were relatively new to their jobs relative to low-wage workers who had substantial experience in their jobs (Jardim et al. 2018).

³In an appendix analysis of food service employment, Clemens and Wither (2019) find that some of the least-skilled food service workers were displaced by slightly higher-skilled workers after the July 2009 increase in the federal minimum wage. Fairris and Bujanda (2008) find increases in employment among demographic groups for which there were skill premia after the implementation of the 1997 Los Angeles Living Wage Ordinance. At a large retail firm, Giuliano (2013) finds a shift in employment towards teenagers from affluent neighborhoods following the 1996 increase in the federal minimum wage.

How large are these adjustments to the skill mix of workers employed in low-wage occupations? In their analysis of recent minimum wage changes, Clemens, Kahn, and Meer (forthcoming) find nontrivial increases in the average age of individuals employed in particularly low-wage occupations (like food service and food preparation). This increase in age comes primarily from reductions in the probability that workers are ages 16 to 21, and is accompanied by an increase in the share of workers with at least a high school diploma. Clemens, Kahn, and Meer translate these estimates into dollar terms using coefficients from Mincer (1974)-style earnings regressions. That is, they calculate how much more one would expect the new workforce to be paid, as estimated using its demographic characteristics.⁴ In their particular context, Clemens, Kahn, and Meer find that the hypothetical earnings differential for the new skill mix relative to the old skill mix was equivalent to around one-third to one-half of the wage increase made necessary by the increase in the minimum wage.

The research discussed in this section illustrates how firm-wide personnel policy can complicate evaluations of the minimum wage. First, industry-wide wage bills and employment counts can mask changes in the composition of who is employed. Second, changes in the design of compensation can have nuanced implications for the welfare of both the low- and high-skilled members of a firm's workforce. These issues highlight that extensive data on firms' personnel and compensation can be useful for generating detailed assessments of the minimum wage's incidence.

Adjustments to Firms' Production Technologies

In response to minimum wage changes, firms may alter their production functions. That is, they may increase their reliance on capital, technology, and high-skilled labor, while reducing their reliance on low-skilled labor. Firms may also change their scope, meaning the set of functions they conduct in-house, as opposed to the functions they outsource to others.

Adjustments to capital and technology can have empirically important implications for dynamics. Consider a fast-food chain, for example, which must choose between automated ordering kiosks and employee-operated cash registers. Each choice involves an initial investment that will depreciate gradually. When wages are low, labor-intensive cash registers might minimize average production costs. When minimum wages rise, new firms might minimize average costs by acquiring automated kiosks. New firm entrants to the fast-food market may thus adopt less labor-intensive technologies soon after a minimum wage increase. By contrast, consider a continuing firm that has recently acquired new employee-operated cash registers. Such firms may continue operating with cash registers until their equipment requires replacement. The response of such firms to a minimum wage increase may thus be lagged by several years. This difference in the production functions of

⁴One interpretation of the Mincer earnings coefficients is that they represent the returns to human capital, in which case the earnings differentials correspond with differences in productivity. Whether the differentials reflect productivity or not, however, they are useful for gauging the relative costs of employing the new versus the old mix of workers prior to increases in the minimum wage.

new entrants and continuing firms highlights that the full effect of a change to the minimum wage may unfold gradually.

Several papers have analyzed minimum wages with an emphasis on firms' choice of production technology. Sorkin (2015) shows that analyses of US minimum wage changes have historically been unable to estimate truly long-run effects, meaning effects that capture changes in firms' production technologies. This reflects the inherently short-run nature of historical variation in minimum wages across US states. Aaronson et al. (2018) develop two empirical findings that connect to Sorkin's (2015) earlier insights. Using data from the Quarterly Census of Employment and Wages, they find that restaurant exit and entry both rise in the wake of minimum wage changes and that employment is stable among restaurants that remain in business. They further show that both findings make sense within a "putty-clay" model, in which a firm's production technology "hardens" following the investments the firm makes upon entry. Again focusing on the US context, Meer and West (2016) show that the effects of minimum wages may more consistently emerge as effects on job growth than as effects on employment levels—which in turn is consistent with the idea of shifting production functions.

To date, efforts to study firms' production technologies have tended to be indirect. Aaronson and Phelan (2019) and Lordan and Neumark (2018) look at data on job characteristics that reveal which jobs are more versus less replaceable by technology. Using data from the US Current Population Survey, both papers find evidence of employment declines in occupations with tasks that are readily replaced by technology in the wake of minimum wage increases. Baek, Lee, and Park (2019) analyze establishment-level data on the wages, output per worker, and capital utilization of firms in South Korea. In an analysis of repeated cross-sectional data on new firms, they find that minimum wage increases are met with higher wages, lower employment, and more capital per worker among new firms in low-wage sectors relative to new firms in high-wage sectors.

As noted earlier, the dynamics of firms' technology choices imply that the effects of the minimum wage on employment may take time to unfold. That said, some analyses find dynamic null effects. In an analysis of 138 state-level minimum wage changes in the United States, for example, Cengiz et al. (2019) find no decline in the number of lower-wage jobs over a time horizon of several years. Several other recent studies, however, which span contexts including Germany, the city of Seattle, and recent state-level minimum wage increases in the United States, find evidence that is consistent with gradually unfolding dynamic effects. In their analysis of Seattle's minimum wage ordinance, Jardim et al. (2018) find that hours were reduced disproportionately for recently hired low-wage workers, relative to more experienced low-wage workers. In the broader US context, Gopalan et al. (forthcoming) analyze employment records from Equifax, which cover millions of employees from over 2,000 firms. Over the short run, they find that low-wage employment has declined in the wake of recent minimum wage increases. This has occurred through reductions in hiring, rather than increases in firing. In a summary of research on the 2015 introduction of Germany's minimum wage, Caliendo, Schröder, and Wittbrodt (2019) similarly observe that evidence of

employment declines has involved “reduced hiring” rather than “displacements.” During the last decade’s economic expansion, the evidence thus suggests that the exit margin has been muted and that employment effects have been concentrated on labor-market entry.

Research on the dynamic effects of minimum wage changes may take an interesting turn in coming years. The minimum wage increases recently enacted in a number of US states are large by historical standards, and differences across states have now been in place for a number of years. In addition, the COVID-19 pandemic led to a dramatic, temporary halt to a great deal of economic activity, which included unprecedented job losses in a number of minimum-wage-intensive industries. In the post-pandemic recovery, it will be interesting to see whether viable firms differ in their labor and capital intensity in states with high minimum wages compared to states with low minimum wages.

Conclusion

Disagreement and uncertainty over the effects of the minimum wage raise important policy questions. For academics, questions of pedagogy also arise: How should the minimum wage be taught? Pedagogical commentaries from Krueger (2001) and Dolar (2013) point out that research finding small or null employment effects create teaching opportunities. Specifically, these authors highlight an opportunity to supplement the “neoclassical” economics of the minimum wage with insights from monopsony and search models. More recently, Dolar (2020) raises the issue of a “conservative”/“liberal” divide in how the minimum wage is taught. In Dolar’s survey of instructors, self-described conservatives tend to believe that the minimum wage reduces employment and is an undesirable policy. Self-described liberals, by contrast, tend to believe that the minimum wage is desirable and that it does not, at historical levels, reduce employment.

I emphasize that both of these views are incomplete. Contra the conservative view, a binding minimum wage need not reduce employment. But contra the liberal view, the minimum wage can harm its intended beneficiaries even when it has no effect on employment. This paper has highlighted the teaching opportunities offered by theory and evidence on a rich set of firms’ decision margins. These margins include output prices, nonwage compensation, and job attributes like effort requirements, safety measures, and the overall quality of the working environment. My central point is that accounting for these decision margins can substantively alter the conclusions one draws when using basic theory to analyze the minimum wage’s effects. As shown above, these nuances are intuitive, tractable, and readily taught through straightforward extensions to standard supply and demand diagrams.

When one thinks intuitively about the responses firms might make to minimum wages, the potential relevance of health insurance benefits, effort requirements, safety measures, and schedule flexibility are obvious. Yet these nonwage dimensions of jobs pose challenges for empirical researchers. I conclude by discussing several of these empirical challenges and their implications.

A first challenge posed by nonwage job attributes involves heterogeneity. Nonwage job attributes are numerous. This introduces a “many margins” problem, in which the relevance of various attributes may vary substantially across settings. Variations may result from characteristics of industries, the nature of specific jobs, or the preferences of the workers a firm happens to employ. This implies that heterogeneous effects should be expected. Prices, for example, may adjust readily in some settings, while effort and fringe benefits may adjust more readily in others. In advance of an empirical analysis, it may not be possible to predict which margins ought to adjust most readily in a given context. In the face of many adjustment margins, it becomes an absurdity to expect quantitatively similar estimates across settings.

Second, many nonwage job attributes pose problems of measurement. For example, the data one can use to analyze the flexibility of workers’ schedules or the aesthetic qualities of their workstations range from limited to nonexistent. Margins like effort can only be measured in settings where output itself is well-measured. Employee benefits are also less fully catalogued than researchers might wish. Even employer-provided health insurance, on which substantial data exist, tends to be described by binary variables, rather than in terms of the benefit’s cash equivalent value.

Third, problems of measurement translate into problems of aggregation. Aggregating the value of all nonwage job attributes is infeasible because researchers lack data on all relevant margins. This fact is humbling. At the same time, further research on nonwage attributes of jobs can help us make progress in filling gaps in the available evidence.

Estimates of how a higher minimum wage affects wages and employment are not, as is commonly presumed, sufficient to assess its desirability. It is unfortunate that standard textbook analyses convey an erroneous intuition on this important point. Fortunately, there is a constructive path forward. Straightforward extensions to basic supply and demand diagrams can readily incorporate such empirically grounded possibilities as the minimum wage’s effects on prices, working conditions, and noncash compensation. These diagrams provide a practical pedagogical approach to conveying important nuances about real world labor markets.

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