Unions and robots: International competition, automation and the political power of organized labor

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Abstract

International economic competition has led to the increasing adoption of labor-replacing technology. What are the consequences of this development for the political influence of organized labor? I posit that robots make (skilled) workers more productive, increasing the opportunity cost of rent-seeking behavior via union activities. Consequently, the political influence of organized labor falls in response to robot adoption because unionization declines. I provide evidence for my claims using data from the U.S. (2004-2014) and a shift-share that leverages quasi-exogenous variation in international competition in the exposure to robots, at the congressional district level. An increase in one robot per a thousand workers reduces the likelihood that congresspeople vote with unions' interests by two percentage points. This effect is larger in areas with higher portions of skilled workers, lending support to the hypothesized opportunity-cost mechanism. Reductions in unionization, union activities and in campaign contributions in response to the exposure to robots explain this finding. Using demediation analysis I demonstrate that my findings are driven especially by lower unionization rates and not by the potentially competing effect of robots on unemployment.

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1 Introduction

One of the fundamental global economic shifts of the last 50 years has been the automation of work. This development has raised many concerns thanks to machines' ability to replace human labor. In this regard, Frey and Osborne (2017) and Bughin et al. (2018) estimate that machines are projected to take over millions of jobs across the world. In the U.S., for instance, exposure to manufacturing robots has already been responsible for important reductions in employment and wages in the private sector (Acemoglu and Restrepo, 2020). Scholars have also found links between automation and political polarization, the rise of the radical-right and anti-globalization sentiment, as workers seek to protect their livelihoods from global economic change by endorsing economic nationalism (Wu, 2018; Anelli, Colantone and Stanig, 2018; Thewissen and Rueda, 2019).

I contribute to this emerging literature by proposing a novel mechanism linking automation with the decline in unions' strength over recent decades,[1] and show that automation has important consequences for politics and policy through its effect on unions. Specifically, I posit that automation diminishes the incentives of employed individuals to unionize, reducing unions' political power and their capacity to sway public policy in their favor. I also show that the potentially negative effect of automation on employment—while important—is not the main driving force in union-strength decline.

Theories of political participation emphasize the role of labor unions: Unions act as grassroots movements that help voters, both union members and nonmembers, acquire costly political knowledge (Ahlquist and Levi, 2013; Kim and Margalit, 2017); they also coordinate voters and get them registered and then delivered to the polls, increasing the turnout of low- and middle-income individuals; they facilitate pooling resources from workers, which are often used for making campaign donations and for lobbying, to further the collective interests of organized labor (Bennett and Kaufman, 2007; Leighley and Nagler, 2007; Rosenfeld, 2014). Strong unions are important because they are a counterbalance to private political interests, by advocating for redistributive policies in favor of workers, and by promoting legislation aimed at improving working conditions and job security (Frank R. Baumgartner, 2010; Western and Rosenfeld, 2011; Schlozman, Verba and Brady, 2012; Macdonald, 2019). When unions are weak, legislators can afford to ignore unions' for policy making, otherwise doing so entails meaningful political costs.

The fundamental role of a union is to bargain for better wages and job conditions for its members (Freeman and Medoff, 1984). When this bargaining process breaks down, unionized workers strike, generating a cost for their employer by reducing output in the firm. They also generate a

[1] For example, OECD data shows that unionization rates have declined from approximately 35% to 17% between 1970 and 2014 in its member countries.

cost for themselves because *strike pay* is lower than workers' wages.[2] Automation affects the cost of union activity, especially in the private sector, because when tasks are automated, strikes become less costly for the employer since machines replace manual labor, thereby reducing unions' bargaining power.[3] As a result, the benefits from joining a union versus working fall, and thus the *opportunity cost* of union versus productive activities increases because workers are better of by investing their effort working rather than rent-seeking.

I theorize that the extent to which automation affects union strength depends on the composition of the workforce. The tasks performed by skilled labor are harder to automate unlike the tasks performed by unskilled labor, which are more routinary (Autor, Levy and Murnane, 2003). Therefore while automation may substitute unskilled individuals' labor, it can act as a complement to skilled labor, increasing its productivity. Higher productivity in turn offsets the benefits from striking. This reduces the incentives of skilled labor to unionize because unions compress the wages between skilled and unskilled labor through bargaining (Acemoglu, Aghion and Violante, 2001). This in turn reduces unions' bargaining power and makes unionization more costly for workers as automation increases. Hence an increase in the supply of skilled labor can further reduce unionization and union activities in response to automation.

As unionization falls, unions' resources for political participation diminish. Thus unions become less effective at trading grassroots mobilization and contributions for politicians, for political influence in the policy making process. Consequently, legislators responsiveness to unions' interests declines in response to automation, especially where the supply of skilled labor has increased.

I test the previous claims using data from the U.S. from 2004-2014. I analyze the impact of exposure to robots on government responsiveness to unions' interests using the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) legislative scorecard, which measures how lawmakers vote on issues that are important for workers.[4] Further, I investigate the causal impact of automation on a number of mechanisms mapping the causal chain from automation to policy responsiveness, namely unionization rates, union activities such as collective bargaining and strikes, and also political participation from workers via campaign donations. [5]

[2] Workers pay a union fee. This fee is used to pay union members during strikes to incentivize their participation.

[3] Automation is less likely to affect unions in the public sector because tasks in this sector cannot be easily automated given that they have a lower routine-task content (Adamczyk, Monasterio and Fochezatto, 2021).

[4] The AFL-CIO is the largest and most important federation of workers in the United States. It advocates for policies seeking to improve redistribution, public spending, working conditions, job security, and retraining programs in industries affected by global economic change. It represents both public and private sector unions, and millions of workers in manufacturing, where automation has had big impacts (AFL-CIO, 2019).

[5] Unemployment and lobbying are other potential mechanisms. I don't investigate the effect of automation on the former mechanism because it has been examined elsewhere (Acemoglu and Restrepo, 2020). However, in Section 7.1 I show that the effects of automation are only partly explained by unemployment and mostly driven by unionization. Regarding lobbying, data isn't sufficiently disaggregated for performing a meaningful empirical analysis.

Since workers and policy makers can strategically react to the prospect of automation in firms to forestall or promote robot adoption (Kochan et al., 2013; Milner and Solstad, 2021), causality may actually run in the opposite direction. To address this problem as well as omitted variable bias, I use a shift-share design to leverage exogenous variation coming from improvements in technology in the private sector to instrument exposure to robots in the United States. The shift-share corresponds to the exposure to robots in European countries that are ahead of the U.S. in robotics (*the shift*), weighted by *the shares* of private industries in total local employment. These improvements increase the level of competition between firms at a global scale, forcing local firms to automate.

The identification assumption requires that those areas in the U.S. adopting more robots, do so in response to technological innovations that increase the level of competition amongst firms. Moreover, robot usage in European countries that are ahead of the U.S. in robotics should not be caused by economic trends affecting U.S. industries. Acemoglu and Restrepo (2020) seminal work on automation demonstrates that these assumptions have both theoretical and empirical support. Further, I control for a battery of confounding variables to address any concerns with the identification assumption, and perform several robustness tests to reassure the reader about my findings.

I demonstrate that automation has political implications by reducing public policy to unions interests: I find that one robot per a thousand workers reduces by 1.3 percentage points the chance that a member of congress votes in accordance to unions' interests. Second, I show that one robot per a thousand workers is related to a 2.6 percentage point reduction in the number of unionized workers, or about 700 workers, and a 0.07 percentage points reduction in the share of unionized workers. This shock is also related to a drop in 139 workers in collective bargaining agreements, but I don't find an effect on strikes. Thirdly, I also show that the same shock reduces campaign contributions from workers by 3.6 percentage points. The effects are stronger in those places with a more educated labor force, consistent with the hypothesized opportunity-cost mechanism. These findings are robust to estimating the reduced form effect of the shift-share.

Importantly, the effect of automation on unionization can compound with a negative effect of automation on employment. Indeed, machines can affect union's strength by replacing workers, generating higher unemployment. I decouple the relevance of unionization against unemployment in the causal chain, to evaluate the relative relevance of unionization as a potential mechanism. Using demediation analysis to asses the importance of a mediator in the effect of automation on my main outcomes (Acharya, Blackwell and Sen, 2016), I show that the effect of automation subsists robustly after demediating for employment but that this is not the case after demediating for unionization. Therefore, although employment is a theoretically-relevant mechanism, I find that union membership is the main mechanism linking automation to public policy making.

My results are robust to controlling for pre-treatment changes in the composition of the labor force and the industry, import competition and task routinization, as well as changes in legislation governing unions such as Right-to-Work laws, and pre-treatment changes in union activity. My results are also robust to a placebo test about the effect of automation on public sector unions insofar as I find a null effect for automation in this case. I also test whether Right-to-Work laws exacerbate the effect of automation on unions since they can potentially increase the opportunity cost of unionization (Feigenbaum, Hertel-Fernandez and Williamson, 2018),[6] but find no evidence in favor of this alternative moderator.

The findings herein contribute to the vast literature on the political economy of both unions and automation (Wallerstein and Western, 2000; Wu, 2018; Anelli, Colantone and Stanig, 2018; Gallego, Kurer and Schöll, 2018; Thewissen and Rueda, 2019; Alhquist and Downey, 2021). I show that automation affects public policy responsiveness to the interests of organized labor through their negative impact on unionization, union activity and political participation from workers—especially when the opportunity cost of unionization is high. I also demonstrate that automation has structural political ramifications on public policy through the incentives to unionize, echoing the notion that economic change affect interests groups that are essential in policy making (Bennett and Kaufman, 2007; Schlozman, Verba and Brady, 2012; Rosenfeld, 2014; Bartels, 2018).

2 The problem of union decline

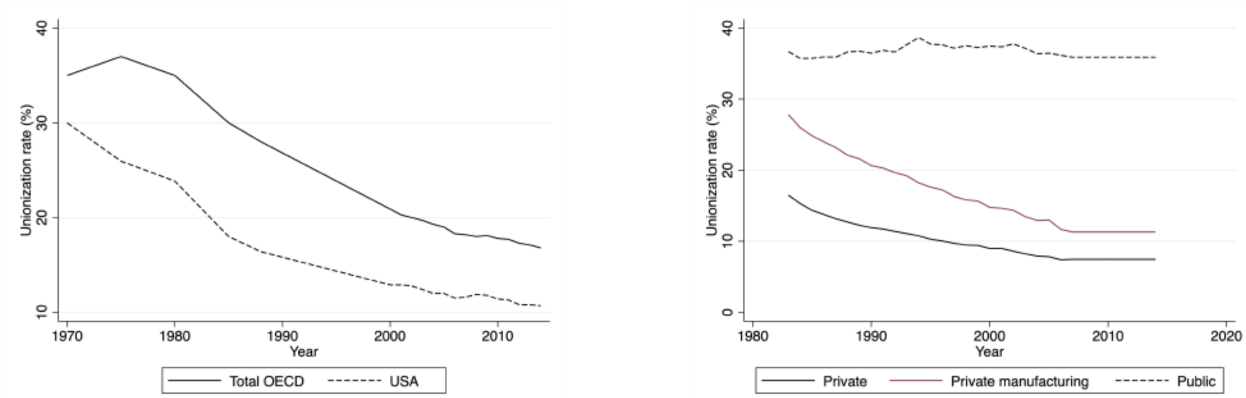
Unionization rates have been declining across the world. Data from the OECD shows that while nearly 35% of workers were unionized in 1975, this number fell below 20% by the mid 2010s (Figure 1, panel a). In the U.S. specifically, unionization fell from 30% in 1975 to around 10% in 2014—a decrease that was driven especially by the private sector (Figure 1, panel b).

Union decline has been politically consequential. Unions are the institutions where workers interact with each other on a regular basis, in the workplace and after work, and these interactions create strong foundations for the political mobilization of workers (Olson, 1965). Unions are grassrots organizations that pool resources to participate in politics; they also help voters acquiring political knowledge, coordinate them and mobilize them to the polls (Bennett and Kaufman, 2007; Leighley and Nagler, 2007; Rosenfeld, 2014; Ahlquist, 2017). When unions are weak, legislators are less willing to trade influence in their legislative agendas for grassroots mobilization and campaign support from unions. Becher, Stegmueller and Käppner (2018), for instance, show for

[6] Right-to-Work laws increase the opportunity cost of unionization because new hires can free ride union workers since they are not forced to join the union and pay union dues (Macdonald, 2019).

Figure 1: Unionization rates over time

(a) OECD **(b) United States**



Source: OECD union statistics and Current Population Survey.

the U.S., that in congressional districts where unionization rates in the private sector are lower, labor contributions to congresspeople decline, and members of congress are less likely to vote in accordance with the official preferences of organized labor—consistent with the previous idea.

Union decline is also consequential for social welfare because when unions weaken, poverty and inequality increase (Brady, Baker and Finnigan, 2013; Farber et al., 2018; Collins and Niemesh, 2019). Unions advocate for policies that improve workers' well-being and reduce inequality, such as more redistribution through taxes; increased public spending; improved working conditions and job security; and retraining programs for industries affected by global economic change. Union grassroots activities also shape the consciousness of workers toward supporting more social egalitarianism (Mosimann and Pontusson, 2017; Kim and Margalit, 2017). Thus strong unions fulfill an essential role in society, helping workers to overcome collective actions issues for participating in politics and for improving social welfare.

2.1 Why unions decline?

Unions are primarily rent-seeking organizations, and secondarily grassroots movements. The main job of a union is to bargain for better wages and job conditions with firms' managers and owners (Freeman and Medoff, 1984). To this end, unions use the threat of strike to force their counterparts to the bargaining table in a process called *collective bargaining*.[7] The threat of strike is effective

[7] Collective bargaining is a process of negotiation between employers and union representatives. The collective agreements reached by these negotiations usually set out wage scales, working hours, training, health and safety, overtime, grievance mechanisms, and rights to participate in workplace or company affairs.

if a work stoppage can reduce substantially a firm's output, because if workers can generate a high cost for employers with a strike, the latter would be more willing to accommodate unions' demands to prevent such an event. Hence unions can obtain a higher *union membership premium* when they have more bargaining power.[8]

The problem for firms is that union activities increase the cost of labor, and this can reduce firms' efficiency and competitiveness. This cost constraint is relevant because firms with unions have higher debt and lower levels of debt restructuring, making it difficult for firms to address the problems imposed by unions by borrowing (Hirsch, 2008). As a result, unionized firms have lower output and grow less vis-á-vis firms that are not unionized (Hirsch, 2017).

The literature on labor unions posits three main explanations behind union decline stemming from the aforementioned problem: First, the *institutional thesis* stresses the role of legislation governing unions, in union decline. Employers, private interest groups (companies, investors, etc.), and policy makers have incentives to reduce unionization to cut firms' production costs, prevent strikes, and boost economic growth (Bennett and Kaufman, 2007; Hacker and Pierson, 2010). Right-to-Work Laws (RWLs) are classic examples of this: RWLs have been adopted by 28 states in the U.S., seeking to prohibit union security agreements between employers and labor unions, which require employees who are not union members to contribute to the costs of union representation. Backers of these laws claim that these laws protect workers against being forced to join a union. However, these laws have instead undermined unions' bargaining strength by creating a free rider problem, whereby workers don't contribute union fees but benefit from union activities, making it harder for worker organizations to sustain themselves financially (Feigenbaum, Hertel-Fernandez and Williamson, 2018).[9]

Second, the *structural thesis* emphasizes that union decline is explained by shifts in employment away from occupations, industries, and regions where union density has traditionally been high—e.g., manufactures—toward sectors with lower density such as the service sector, where organization is more expensive. Indeed, manufacturing has shed employment over the past decades, which has shifted toward service-providing industries (Berlingieri, 2013). Unionization in the services sector is more difficult vis-á-vis the manufacturing sector thanks to decentralized bargaining, where the firm may negotiate with individual employeers; a low degree of corporatism because atomized bargaining can eliminate the benefits of collective bargaining; and lower benefits to labor organization because shop floors are smaller and often prohibit union access (Scruggs and Lange,

[8]Strikes are costly for union members too, offsetting the benefit of the union premium to a degree.

[9]Another prominent example comes from the Professional Air Traffic Controllers Organization (PATCO) strike in 1981. After PATCO disobeyed a federal court order to end a strike, President Reagan fired the traffic controllers who had ignored the order, banned them from federal service, appointed ant-union chairmen to lead the National Labor Relations Bureau, and shaped Republicans' discourse to be generally anti-union (McCartin, 2011).

2002; Visser et al., 2019; Schnabel, 2020).

Finally, the *market competition* thesis states that firms prosper as long as their competitors face similar production costs. Since unions rent-seeking activities impose higher labor costs on firms, their competitors can produce at lower costs and sell at lower prices. Hence firms with unions need to find a way to cut costs to sustain the demand for their products. The problem is that unions cannot credibly commit to not rent-seek to reduce labor costs because their primary purpose is to do exactly that (Kochan et al., 2013), thus firms have incentives to reduce labor costs by laying off workers;[10] or by relocating shops to places where unionization is more difficult (such as RWL states);[11] or by reducing workers' incentives to unionize by undermining union's bargaining power. Otherwise, market forces can force firms to close shop, forcibly reducing the number of unionized workers through a negative effect on employment.

The competitive thesis is especially relevant, because companies naturally operate in an competitive environment affected by domestic and international pressures, and organized labor need firms to prosper and new jobs to lend themselves to organization. Firms' competitiveness is the underlying driving force shaping firms' incentives to oppose unions, workers' incentives to unionize, and politicians' incentives to regulate unions. Indeed, the evidence shows that sectors of traditional union strength—such as manufactures—had already contracted substantially before the wave of sharp deunionization started (Pencavel, 2007; Hirsch, 2008). Furthermore, the key economic forces undermining unions were already under way when the legal framework turned unfavorably against unions (Acemoglu, Aghion and Violante, 2001; Bennett and Kaufman, 2007). Hence the competitive thesis precedes the causes behind the institutional and structural explanations. I will adopt this thesis going forward.

2.2 International competition, automation and union decline

Under the competitive thesis there are essentially two forces driving union decline: i) Unemployment and ii) A reduction in the incentives to unionize. Scholars have argued that automation has been perhaps one of the most important sources behind these two forces (Kennedy et al., 1982; Gil, 1986; Acemoglu, Aghion and Violante, 2001; Bennett and Kaufman, 2007; Minchin, 2017). For example, manufacturing unions in the U.S. were strong worker force during the early 70s, despite corporate leaders were seeking to reform labor laws to limit union power. This changed during the late 70s and early 80s, as U.S. experienced unprecedented levels of domestic and international

[10]Unionized workers usually cannot be fired in retaliatory or discriminatory way. Unions protect workers from arbitrary employer actions and provide them with legal support in the event of a workplace issue.

[11]This would still translate into higher local unemployment (Mankiya et al., 2017). Thus this mechanism has essentially the same effect as laying off workers.

competition owing to the increasing levels of automation in Japan and Western Europe, and also within the U.S.

One prominent example is the automotive industry. Japanese firms had adopted a strong mechanization process of their assembly lines, reducing the production costs of automobiles.[12] As a result, Japanese companies increased their market share from 11 percent in 1978 to 21 percent in 1980. These international pressures, also came from within the United States. Multinational companies, like Hyundai and Toyota, opened subsidiaries in the U.S., with high levels of automation and strong anti-union stances, further increasing competition in the local markets through lower prices. The same occurred in other manufacturing industries such as micro-components, light steel manufactures, printing and textiles.

To address increased competition, local companies were forced to retool and restructure their production process, investing in labor-saving technologies. In the manufacturing industry, this process targeted the processes that were friendly towards automation. As a result, mechanization triggered a deskilling process that made many workers dispensable because managers and owners needed machine operators and repairmen to generate output. This process towards automatizing the tasks previously performed by workers, allowed companies to layoff hundreds of thousands of workers over the years (Kennedy et al., 1982).

Interestingly, unions generally did not oppose the process of automation, and instead negotiated new bargaining agreements with employers to avoid plant closures and layoffs. However, the prospect of automation reduced unions' bargaining power, because firms could automate to replace workers. As a result unions were forced to accept wage cuts and lower benefits, reducing union membership premiums. Ironically, these concessions helped subsidize the introduction of robots in firms' operations, further reducing the need for manual labor, forcing unions to renegotiate their bargaining agreements more often with decreasing bargaining power.

Automation thus had the dual quality of both replacing labor and reducing unions' bargaining power. However, whereas the prospect of being laid off was under the purview of market forces shaping the supply and demand for labor, the decision to unionize belonged to the worker. Thus as the union premium declined with the bargaining power of unions, so did workers' incentives to unionize, resulting in lower unionization rates (Bennett and Kaufman, 2007; Rosenfeld, 2014; Minchin, 2017).[13]

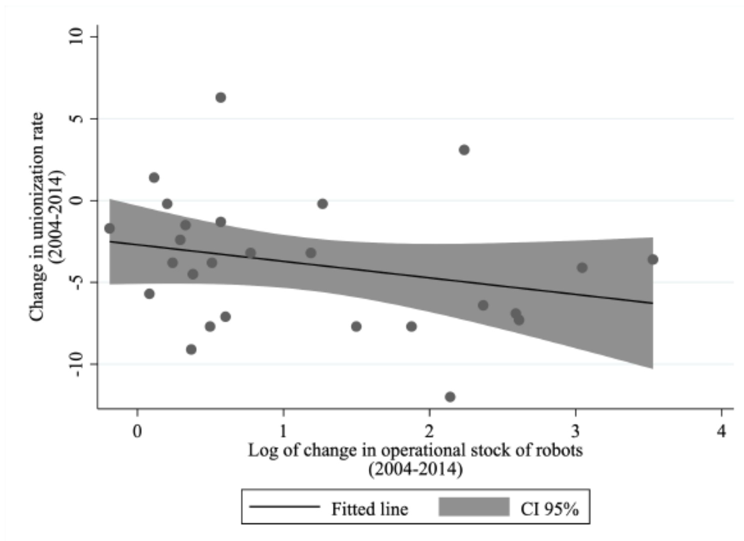
In general, the trends toward more automation and international competition have continued

[12]Kennedy et al. (1982) notes that Japan used more than 30% of all robots in the production of manufactures, whereas the U.S. only used 10%.

[13]Workers decision to unionize depends substantially on the non-wage benefits the receive from unionization (Gospel and Wood, 2003).

over the years, as manufacturing production has become more automatized in European countries and East Asian countries (Autor and Dorn, 2013; Acemoglu and Restrepo, 2020). The negative impact of automation on unions has not been exclusive to the United States. Unions have continued lose ground in the past decades across the world (Bennett and Kaufman, 2007; Rosenfeld, 2014; Visser et al., 2019). In fact, we observe a negative correlation between the change in the adoption of manufacturing robots and unionization rates across the world, stemming from negative changes in union rates and positive changes in robot adoption (Figure 2).

Figure 2: Changes in unionization rates and robot adoption in OECD countries



Source: Author's compilations.

3 Automation and unions' political power

In the previous section I discussed evidence indicating that firms' decision to adopt labor saving technologies in response to increased competition, affects unions through i) the positive effect of automation on unemployment and ii) the negative effect of automation on unions' bargaining power because this reduces workers' incentives to unionize. These two forces are also politically consequential: When unions lose members and their union membership premiums decline, it is harder for them to generate successful grassroots movements. Smaller unions have less manpower and financial resources to carry out unions' political activities. With lower de facto power, it is increasingly difficult for unions to influence politics and policy because legislators can ignore unions' preferences at a lower political cost. Thus as automation weakens unions, it also weakens the political power of organized labor. I thus establish the first two testable hypotheses of this manuscript:

H1. *An increase in automation reduces the level of political participation from workers.*

H2. *An increase in automation reduces public policy responsiveness to the interests of organized labor.*

A problem with the aforementioned mechanisms (unemployment and workers' incentives to unionize), is that they compound each other to generate lower unionization. Hence it is hard to distinguish between them and their relative relevance to better characterize the role of automation on unions' political power. I address this conundrum next, and demonstrate that the second mechanism is theoretically powerful.

3.1 Unemployment

Automation affects unemployment by replacing workers with machines. Higher unemployment in turn reduces the amount of manpower and the resources unions can tap into because the *number* of unionized workers falls in response. Thus I define *hypothesis 3*.

H3. *An increase in automation reduces the number of unionized workers.*

An essential characteristic of this mechanism is that automation is more likely to replace unskilled labor vis-á-vis skilled labor, because the tasks performed by the latter type of labor are much harder to automate (Autor, Levy and Murnane, 2003). Hence I also define *hypothesis 3*, and *hypothesis 4*—which follows from the rationale behind *hypothesis 2*.

H4. *An increase in automation reduces the number of unionized workers, especially where the supply of unskilled labor is high.*

H5. *An increase in automation reduces public policy responsiveness to unions, especially where the supply of unskilled labor is high.*

3.2 Incentives to unionize

Workers' incentives to unionize depend essentially on the benefit of participating in rent-seeking through the union vis-á-vis using that time and effort in productive activities (Castillo, 2018). The relative benefit of unionization may fall when workers' bargaining power declines because unions' can extract less rents from the employer, reducing the union premium, or when the relative value of the outside option (working) is higher because rent-seeking is inherently unproductive. Automation can affect both of these incentives.

First, automation reduces the bargaining power of unions because the threat of strike weakens as a result of automation. Employers can replace manual labor with machines, keeping production high and costs low despite the possibility of a work stoppage. As a result, the benefit from rent-seeking versus productive activities (such as wage premiums) declines, increasing the *opportunity cost* of unionization. Workers thus have less incentives to join the union in response to automation, reducing the *share* of workers that are unionized—see *hypothesis 1*, below.

H6. *An increase in automation reduces the unionization rate.*

Second, automation affects the incentives of skilled and unskilled labor differently: The tasks performed by unskilled labor are easier to automate because they have a high routine content, whereas those performed by skilled labor are not because they have a low routine content. Thus, while machines substitute the work of unskilled labor, they can complement the work of skilled labor. As a result, automation can increase the wage differences between unskilled labor and skilled labor, because skilled labor becomes relatively more productive per unit of labor vis-á-vis its unskilled counterpart. Therefore automation can increase the opportunity cost of unionization for skilled workers because their non-union wages are higher vis-á-vis their union wages.

Altogether, this implies that unskilled labor has incentives to unionize because the union membership premium increases in response to automation, but skilled labor does not because the benefit of unionization falls because their market wages are higher. These divergent preferences for unionization hamstring worker organization, thereby reducing unions' bargaining power. As a result, workers' incentives to unionize should fall more sharply in response to automation as workers become more skilled, as well as legislators' responsiveness to the interests of unions—see *hypothesis 5* and *hypothesis 6*, below.[14]

H7. *An increase in automation reduces unionization, especially where the supply of skilled labor is high.*

H8. *An increase in automation reduces public policy responsiveness to unions, especially where the supply of skilled labor is high.*

[14] While automation can boost the bargaining power of skilled labor because they can generate more harm with a strike, unions compress the wage differences between skilled and unskilled labor, countervailing this effect (Acemoglu, Aghion and Violante, 2001). In this regard, the evidence suggests that the latter effect dominates (Betcherman, 1991; Lemieux, MacLeod and Parent, 2009),. Further, my empirical findings below are consistent with this evidence.

Note that hypotheses **H3** to **H5** are different from hypotheses **H6** to **H8**. First of all, **H6** is more demanding than **H3** because the opportunity cost mechanism requires that the number of unionized workers changes faster than the number of workers in response to automation. That is, automation must affect workers' incentives to unionize and not only the demand for labor. Secondly, the unemployment mechanism predicts that automation should reduce unionization wherein the supply of unskilled workers is higher because machines replace unskilled labor (hypothesis **H4**); the opportunity cost mechanism predicts the opposite (hypothesis **H7**); we can make a similar arguments for hypotheses **H5** and **H8**, which are associated to the reduced form effect of automation on unions' political power. Therefore we can potentially disentangle the effects of automation on the outcomes herein by looking at the moderating effect of workers' skill. In my empirical analysis, however, I address additional concerns in this regard by decoupling the importance unionization against unemployment using demediation analysis (Acharya, Blackwell and Sen, 2016).

4 Data and variables

Exposure to robots

Data on exposure to robots comes from the International Federation of Robotics (IFR). I use the Bartik measure of industrial exposure to robots from Acemoglu and Restrepo (2020), which combines industry-level variation in the usage of robots (the *shift*) and baseline employment shares (the *share*). This *shift-share* measures the local industry level of robot adoption predicted by interacting local industry employment shares with national industry changes in robot adoption.

The shift is the measure of robot adoption adjusted by industry growth defined by

$$A^{US}_{i,(t_0,t_1)} = \frac{M^{US}_{i,t_1} - M^{US}_{i,t_0}}{L^{US}_{i,1990}} - g^{US}_{i,(t_0,t_1)} \frac{M_{i,t_0}}{L^{US}_{i,1990}},$$

where M^{US}_{i,t_0} is the number of robots in industry i at time t_0 in the U.S., similarly for M^{US}_{i,t_1}; $g^{US}_{i,(t_0,t_1)}$ is the growth rate of output of industry i between t_0 and t_1;[15] $L^{US}_{i,1990}$ is the baseline employment level in industry i in 1990. The share, $\mathscr{L}^{1990}_{ci}$, corresponds to the share of industry i in the total employment of commuting zone c in 1990,[16] which is a time period that predates the onset of rapid advances in robotics technology and the acceleration of robot adoption in the world.[17]

[15]This term is relatively unimportant because 96% of the variation in the adjusted penetration of robots across industries between 1993 and 2007 is driven by the increase in robot density.

[16]A commuting zone is bounded by its local economic and social characteristics (Tolbert et al., 1987).

[17]Global robot adoption increased by 50% from the early 90s to the early 2000s, and doubled by the early 2010s.

Putting the shift and the share together, the measure of exposure to robots is given by

$$\mathrm{R}^{US}_{c,(t_0,t_1)} = \sum_i \mathscr{L}^{1990}_{ci} \cdot \mathrm{A}^{US}_{i,(t_0,t_1)}.$$

I aggregate this measure to the congressional district level by finding the correspondences between commuting zones and their counties in the 1990 census, and the congressional districts from 1992 to 2014, accounting for redistricting, using data from the Michigan Population Studies Center. I denote this district-level measure by $\mathrm{R}^{US}_{d,(t_0,t_1)}$, where d is the congressional district.

Since this *shift-share* is sourced in first differences, attrition from redistricting generates 24 missing congressional districts out of 435. Despite these data limitations, my results below are robust to numerous statistical tests and are in line with my theoretical expectations. Further, since the scope conditions I defined in the previous section are broad, they should limit additional concerns about the external validity of my findings for the U.S.

Policy responsiveness unions

To measure policy responsiveness to unions' interests I use data from the AFL-CIO, which is the largest and most important federation of workers in the United States. The AFL-CIO tracks the voting record of legislators on "issues important to working families, including strengthening Social Security and Medicare, freedom to join a union, improving workplace safety and more." I use the federation's legislative scorecard to measure the percentage of votes by each congressman that are in line with unions' revealed preferences, in each session of congress. For example, in the first session of the 109th congress, the AFL-CIO's official position was to vote *Nay* on the "Job-Training Reauthorization–H.R. 27" bill, which cut overall funding for critical job-training programs. Thus if a congressperson voted in agreement with half of the AFL-CIO official positions in every bill during 2005, her score for that year would be 50%.

For the analysis herein, I use data from the 2005 onwards because in early 2005 some unions split from the AFL-CIO.[18] By restricting the data in this way, I make sure the AFL-CIO's power remains largely unaffected by changes in its composition. This decision is also empirically consistent with the fact that data on exposure to robots in the U.S. starts in 2004—before the data on policy is realized. Despite this, Minchin (2017) indicates that the aforementioned event didn't affect the federation in the years thereafter.

The bills (or bill amendments) that unions support cover a wide range of topics (Appendix,

[18] In Table B1 in the Appendix, I list the unions affiliated with the AFL-CIO, and include notes about the unions that disaffiliated, and those that despite disaffiliating in 2005, re-affiliated at a later date.

Table B2). But most bills are concerned with legislation on the economy, workers wellbeing and social welfare policy (Appendix, Figure B1).

Union membership and union activities

Data on union membership comes from the Labor Organization Annual Financial Reports and Constitutions and Bylaws. Specifically, I use the harmonized data from Becher, Stegmueller and Käppner (2018). Becher and company collect data from more than 300,000 individual (mandatory) reports, filed annually with the U.S. Department of Labor by more than 30,000 local unions. Then they harmonize this data at the congressional district level, and validate it against union estimates in the Current Population Surveys. This data is highly accurate because failure to report, and to report truthful information, has steep fines and can be punishable with jail time.[19]

Additionally to union membership, I also compute the ratio of union members to workers. However, the denominator for the unionization rate is defined at the state level because extant data does not provide a representative measure of the number of workers at the congressional district level. Therefore this variable is measured with some random error owing to survey design, and underestimates the true unionization rate because the denominator is bigger than it should.

To measure union activities I collect data on collective bargaining process and strikes. Employers and labor unions are required by law to collectively bargain a contract when there are disagreements; they must also agree on the duration of such contract; they most also notify the National Labor Relations Board. When the contract expires, or one of the parties breaks the contract, the parts have to collectively bargain another contract. If they the parts involved do not reach an agreement, workers can go on strike.

The data on work stoppages and collective bargaining notices come from the Bureau of Labor Statistics and the U.S. Federal Mediation and Conciliation Service. I obtain congressional-district-level aggregates for the number of workers participating in these union activities. I measure these variables for the private sector and the public sector separately because the public sector exhibits a different production structure, which makes it less susceptible to automation vis-á-vis the private sector (Adamczyk, Monasterio and Fochezatto, 2021).[20]

[19] The legal basis for these reports is the Labor-Management Reporting and Disclosure Act (LMRDA) of 1959. This act introduced a comprehensive system of reporting: unions have to file an initial report with the Office of Labor-Management Standards (OLMS) followed by a yearly report using a so-called LM form. For the public sector, the Civil Service Reform Act (CSRA) of 1979 created a similar system.

[20] Although I can measure union membership at the industry level using the CPS, I refrain from doing so because IFR's industry classification does not match well the industry classifications in the CPS (be that CIC or NAICS). In fact, the match results in only seven industries and I cannot perform any meaningful statistical analysis with this data.

Political participation

To measure political participation I use two sources of data.[21] First, I use data on campaign contributions from the Center of Responsive Politics (CRP). This data corresponds to contributions from labor, aggregated at the congressional district level, in constant U.S. dollars of 2009.

Second, I obtain data on individual political donations to candidates, campaigns, or political organizations from the Cooperative Congressional Election Study (CCES). This variable is measured as a dummies—where one indicates that the individual donated, zero otherwise. I also collect data on the observable characteristics of the respondents, including level of education, work status and union-membership status.

Additional covariates

I also obtain data on a number of variables that could affect both the exposure to robots, union activities and my political outcomes: i) Data on population sizes, employment and demographics drawn from the American Community Survey and the 1970 and 1990 population censuses, ii) Data on industry-level changes obtained from County Business Patterns and NBER-CES Manufacturing Industry Database, iii) Data on exposure to Chinese imports, offshoring, and susceptibility to technology.[22] Altogether, this data comes from (Autor, Dorn and Hanson, 2015) and (Acemoglu and Restrepo, 2020); I transform these variables to congressional district aggregates using spatial correspondences. Additionally, I collect data on changes in unionization at the state level from from the CPS predating automation, and data regarding the adoption of Right-to-Work laws.

Table A1 in the Appendix shows the summary statistics. All variables are measured as annualized changes. Overall, in places with high robot exposure, we can observe negative changes on employment, campaign contributions and measures of union activity, accompanied by lower policy responsiveness to unions.

[21] I do not use data on lobbying because I cannot map lobbying activities from labor unions to an specific geographical location within the congressional district. Thus I cannot perform a meaningful empirical analysis using this data.

[22] Susceptibility is measured as the degree to which routine-intensive occupations follow a set of precisely prescribed rules and procedures that make them readily subject to computerization.

5 Empirical strategy

My objective is to estimate the impact of the exposure to robots on union outcomes and political outcomes. However, workers, industries and lawmakers could anticipate automation and forestall or even promote robot adoption through a number of mechanisms (e.g., union activities, investment, political participation and legislation). Thus causality may actually go in the direction opposite to the one I hypothesize.

Additionally, unobserved characteristics of the local socio-economic structure could shape the incentives of industries to adopt robots, and the incentives of workers to participate in union activities and politics. For instance, the existence of strong bonds in local communities can improve workers' ability to organize, to forestall (or promote) robot adoption, and (or) to participate in union actitivities and in politics. This could generate bias in OLS estimates.

Building on Acemoglu and Restrepo (2020), I address the previous problems by using an instrumental variable corresponding to the measure of exposure to robots attributable to industry-leaders in robotics. Thus define the Bartik instrument

$$\mathrm{R}_{c,(t_0,t_1)} = \sum_i \mathscr{L}_{ci}^{1970} \cdot \overline{APR}_{i,(t_0,t_1)}.$$

For this instrument, the shift is

$$\overline{A}_{i,(t_0,t_1)} = \frac{1}{5} \sum_{j \in EURO5} \left[\frac{M^j_{i,t_1} - M^j_{i,t_0}}{L^j_{i,1990}} - g^j_{i,(t_0,t_1)} \frac{M_{i,t_0}}{L^j_{i,1990}} \right],$$

with $EURO5 = \{\text{Denmark, Finland, France, Italy, Sweden}\}$.[23] In this expression, M^j_{i,t_0} is the number of robots in industry i in country j at time t_0, similarly for M^j_{i,t_1}; $g^j_{i,(t_0,t_1)}$ is the growth rate of output of industry i in country j between t_0 and t_1, and $L^j_{i,1990}$ is the baseline employment level in industry i and country j.

The share, $\mathscr{L}_{ci}^{1970}$, corresponds to the share of industry i in total commuting zone employment in 1970, in the United States. Thus I focus on the historical, persistent differences in the industrial specialization of areas that predated the modern age of industrial robots, which starts in the 1980s.[24] This period of time also allows me to avoid mechanical correlations or mean reversion as-

[23] Acemoglu and Restrepo indicate that these countries account for a substantial percent of the world industrial robot market. Furthermore, although the IFR reports data for Japan, the IFR's recommendation is to exclude Japan from the analyses because the japanese data underwent a major reclassification during the period of interest.

[24] The first industrial robot was designed in 1954. However it was only until the 1980s that industrial robots began to be made in large numbers, with a new robot being introduced in the market at the rate of one a month.

sociated with temporary changes in industry employment in the 1980s, and changes in anticipation to the subsequent introduction of industrial robots.

This *shift-share* measures the local industry level of robot adoption predicted by interacting local industry employment shares with industry changes in robot adoption in leaders in automation. I aggregate this variable to the congressional district using spatial correspondences and denote the district-level measure by $\mathrm{R}^{EURO5}_{d,(t_0,t_1)}$.

In the first stage I estimate the following regression:

$$\mathrm{R}^{US}_{d,(t_0,t_1)} = \gamma + \delta \mathrm{R}^{EURO5}_{d,(t_0,t_1)} + \Delta\mathbf{X}'_d\theta + \Delta\mathbf{Z}'_{d,(t_0-1,t_1-1)}\psi + \varepsilon_{d,(t_0,t_1)}, \tag{1}$$

where $\Delta\mathbf{X}'_d$ is a rich vector of pre-treatment confounders in first-differences; $\mathbf{Z}'_{d,(t_0-1,t_1-1)}$ includes pre-treatment changes in union bargaining processes and strikes to account for the possibility that workers could anticipate task automation; $\varepsilon_{d,(t_0,t_1)}$ is the idiosyncratic error term.

Importantly, a shift-share instrument needs an element of exogenous variation in order to provide statisitcally identification of the effect of exposure to robots on the outcomes analyzed herein (Goldsmith-Pinkham, Sorkin and Swift, 2020; Borusyak, Hull and Jaravel, 2021). The identification assumption rests on the fact that areas adopting more industrial robots do so thanks to technological innovations occurring across industries, which trigger changes the choices to automate by local industries, to remain competitive. Moreover, changes in robot usage in other advanced economies must not correlated with other trends such as common shocks to import competition or rising wages, or respond to the decline of an industry in the United States.[25] In this regard, Acemoglu and Restrepo (2020) verify that there is no substantive correlation between robot adoption and any of the other major trends affecting U.S. local labor markets, such as: import competition from China and Mexico; offshoring; the decline of routine tasks; investments in information technology (IT) capital; and overall capital deepening. Furthermore, exposure to robots is unrelated to past trends in labor market outcomes from 1970 to 1990, which is the period that predated the onset of rapid advances in robotics technology.

In the second stage, I proceed to estimate the effect of exposure to robots on union membership:

$$\Delta(\mathrm{y}_d; t'_0, t'_1) = \alpha + \beta \widehat{\mathrm{R}}^{US}_{d,(t_0,t_1)} + \Delta\mathbf{X}'_d\delta + \mathbf{Z}'_{d,(t_0-1,t_1-1)}\phi + \varepsilon_{d,(t_0,t_1)}, \tag{2}$$

where $\Delta(\mathrm{y}_d; t'_0, t'_1)$ is the post-treatmnet change in the outcome of interest; $\widehat{\mathrm{R}}^{US}_{d,(t_0,t_1)}$ is the predicted exposure to robots from the first stage regression. We can interpret the main coefficient of interest,

[25]These identification assumptions are similar to those in the literature about chinese import shocks and economic and political outcomes, and are standard in the empirical literature using shift-share designs.

β, as the annualized change in the outcome when exposure to robots increases in one robot per a thousand workers in response to international pressures regarding automation.

Importantly, shift-share instruments may conflate the short- and long-run responses to robotization shocks (Jaeger, Ruist and Stuhler, 2018). First, local shocks may trigger adjustments that gradually offset their local impact, with a period of positive employment and wage growth—a *reinstatement effect*—following the potentially negative effect on the demand of labor of a local technological shock—a *substitution effect*.[26] However, by controlling for long-run changes in the structural composition of the economy, I disentangle the (presumably negative) short-run wage impact of automation from the (presumably positive) movement towards equilibrium in response to changes in technology. In this sense, I exploit quasi-exogenous changes in robot adoption to estimate the short-run response of my outcomes to automation.

6 Effect of exposure to robots on unions

I start by investigating the effect of exposure to robots on union membership. I focus on private sector activity because automation is most likely to affect this sector in contrast to the public sector, where tasks are harder to automate (Adamczyk, Monasterio and Fochezatto, 2021). I also provide a basis for this choice via placebo tests on public sector unions (Section 6.4).

Table 1 below reports the effect of exposure to robots on union membership (panel A) and on the unionization rate (panel B): Columns (1) to (3) report the naive (OLS) effect of exposure to robots on union membership, whereas columns (4) to (6) report the instrumental variables (2SLS) estimate. Columns (1) and (4) do not include controls while columns (2) and (5) include the full set of controls except pre-treatment collective bargaining and strikes; columns (3) and (6) control for pre-treatment bargaining and strikes. Standard errors are clustered at the state level. Note that the first-stage F-test of excluded instruments is above standard reference values, indicating that the Bartik instrument is indeed strong. Importantly, since columns (3) and (6) reduce the number of observations, my preferred specifications do not control for pre-treatment collective bargaining and strikes.

The point estimates for the 2SLS regression are bigger than those of the OLS, however they are very similar statistically. Further, notice that once I control for the confounders the effect of robots is much stronger. This occurs because controls capture any potential long-run responses to

[26] Automation can create opportunities that reabsorb workers displaced by technological change. A prominent example is the fact that although the introduction of ATMs substituted the tasks performed by bank tellers, they also reduced the costs of banking, encouraging banks to open more branches, raising the demand for bank tellers that could perform the tasks that ATMs did not automate (Mokyr, Vickers and Ziebarth, 2015).

robotization shocks, allowing us to focus in the short-run response to automation. Moreover, when I control for pre-treatmnet union activities (column 6), my results remain fairly stable.

My results in panel A indicate that an increase in one robot per a thousand workers per year is related to a 2.6 percent point reduction in the number of unionized workers—about 700 union members. The results in panel B indicate that an increase in one robot per a thousand workers per year reduces the share of unionized workers by 0.07 percentage points. This effect is large and relevant considering that union density has decreased at about 0.3 percentage points per year between the 1950s and 2014 (Hirsch, Macpherson and Vroman, 2018), and considering that union rates herein are underestimated (Section 4). This finding also gives credence to the idea that robots reduce workers' incentives to unionize because we are looking at the effect of robots on the employed. Altogether, these results provide evidence in support of hypotheses **H3** and **H6**.

6.1 Union activities

If robots reduce unionization, do they also affect union activities, such as collective bargaining processes or strikes? I find that exposure to robots has a negative effect on strikes and a negative and statistically significant effect on collective bargaining (Table 2). Specifically, I find that an increase in one robot per a thousand workers reduces by 139 the number of workers in collective bargaining agreements. Hence union members in places with more exposure to robots are less likely to part of of the collective that bargains with their employers.

This effect of automation on union activity is relevant because if a collective bargaining process doesn't fail, there cannot be a strike. Therefore these results suggest that robot adoption isn't associated with bargaining failure. This is consistent with the observation that automation forces workers to negotiate with their employers with reduced bargaining power (Section 2.2).

6.2 Political participation

Automation may also affect political participation through its effect on unions (hypothesis **H2** in Section 3). I evaluate this hypothesis by looking at campaign contributions and voter turnout from workers as outcomes.

First, I estimate the effect of exposure to robots on total campaign contributions from labor, but I find that the effect (although negative) is not statistically significant (Appendix, Table A2).[27]

[27] Interestingly, I find that the ratio of labor-to-corporate contributions falls in response to automation, suggesting that automation may redistribute de facto power from labor to capital.

Table 1: Effect of exposure to robots on union membership

	OLS			*2SLS*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. % change in no. of unionized workers					
US exposure to robots	-0.635*	-2.340***	-2.007***	-0.580*	-2.600**	-2.188**
	(0.352)	(0.627)	(0.619)	(0.339)	(1.017)	(1.015)
Observations	412	412	400	412	412	400
	Panel B. Change in unionization rate (%)					
US exposure to robots	-0.031**	-0.054**	-0.042	-0.034**	-0.069**	-0.055*
	(0.012)	(0.022)	(0.025)	(0.014)	(0.030)	(0.032)
Observations	412	412	400	412	412	400
Demographic controls	No	Yes	Yes	No	Yes	Yes
Industry controls	No	Yes	Yes	No	Yes	Yes
Other shocks	No	Yes	Yes	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes	No	No	Yes

	Panel C. First stage regression		
Exposure to robots	1.184***	1.033***	1.021***
	(0.068)	(0.073)	(0.066)
F for excluded instruments	304	203	242
Observations	412	412	400
Demographic controls	No	Yes	Yes
Industry controls	No	Yes	Yes
Other shocks	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor.

Table 2: Effect of exposure to robots on collective bargaining and strikes

	OLS			*2SLS*		
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Change in no. of workers in collective bargaining (thou.)					
US exposure to robots	-0.034	-0.114**	-0.107*	-0.042	-0.139**	-0.131**
	(0.034)	(0.053)	(0.056)	(0.037)	(0.059)	(0.062)
First stage F				303	212	250
Observations	401	401	401	401	401	401
	Panel B. Change in no. of workers striking (thou.)					
US exposure to robots	-0.000	0.007	0.007	-0.001	0.006	0.006
	(0.001)	(0.006)	(0.006)	(0.001)	(0.005)	(0.005)
First stage F				303	212	250
Observations	401	401	401	401	401	401
Demographic controls	No	Yes	Yes	No	Yes	Yes
Industry controls	No	Yes	Yes	No	Yes	Yes
Other shocks	No	Yes	Yes	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes	No	No	Yes

	Panel C. First stage regression		
Exposure to robots	1.184***	1.033***	1.021***
	(0.068)	(0.073)	(0.066)
F for excluded instruments	304	203	242
Observations	413	413	401
Demographic controls	No	Yes	Yes
Industry controls	No	Yes	Yes
Other shocks	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor.

Second, I estimate the impact of robot exposure on he likelihood that individual workers donate to political campaigns (Appendix, Table 3). I find that exposure to robots is negatively related to the likelihood of voting and observe that the likelihood of donating falls by 3.6% for an increase in a robot per a thousand workers.[28] Therefore I find suggestive evidence that automation has a (reduced form) effect on political participation from labor.

6.3 Heterogenous effects

My theory states that the negative impact of robot exposure is driven by a high opportunity cost of union participation. Specifically, skilled workers face a higher opportunity cost of joining the union in response to automation because they become more productive. Hence the negative impact of robots must be bigger in those place with a bigger share of skilled labor pre-treatment.

To evaluate this hypothesis, I estimate the moderating effect of pre-treatment changes in the share of workers with college education or above. I consider the following regression:

$$\Delta(\mathrm{y}_d;t_0',t_1') = \alpha + \beta_1 \widehat{\mathrm{R}}^{US}_{d,(t_0,t_1)} + \beta_2 \widehat{\mathrm{R}}^{US}_{d,(t_0,t_1)} \times \Delta \mathrm{S}_d + \Delta \mathbf{X}_d' \delta + \mathbf{Z}'_{d,(t_0-1,t_1-1)} \phi + \varepsilon_{d,(t_0,t_1)}, \tag{3}$$

where S_d is the change in the share of skilled labor between 1970 and 1990; β_1 corresponds to the effect of exposure to robots when $\Delta \mathrm{S}_d = 0$, while $\beta_1 + \beta_2 \times S_d$ is the estimated effect of tariff revenues for different values of change in the share of skilled labor.

Figure 3 below displays my results. We observe a negative and statistically significant effect of automation on unionization rates in places where the labor force became more skilled pre-treatment. This negative effect exists for a substantive portion of the distribution of the moderator (dashed bars in figure). The marginal effect of robots for union membership exhibits the same decreasing pattern, but it is statistically much weaker.

These results are in line with the theoretical expectation in hypothesis **H7**, because the effect of robots on unionization is visible and more negative in places with increased shares of skilled labor. These results do not provide support for hypothesis **H4**, which indicates that the mechanism linking automation with union decline is unemployment because the slope in the estimated marginal effect should instead be positive.

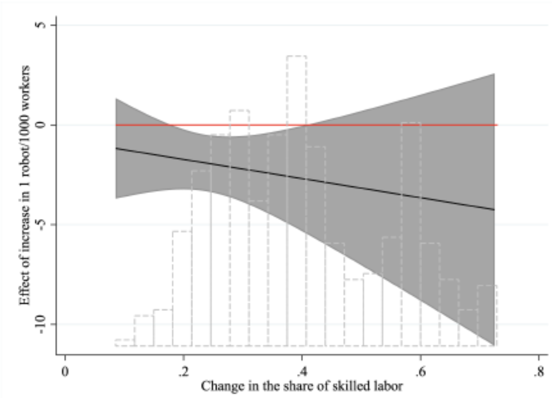
Looking at union activities and political participation, I find evidence for a heterogeneous effect of exposure to robots on individual contributions to politics by workers (Appendix, Figure A1). First, I find that automation reduces the likelihood of campaign contributions for skilled la-

[28] I also explore the effect of exposure to robots on vote shares for democrats, but I do not find evidence of a statistically significant effect of automation on this quantity (not shown).

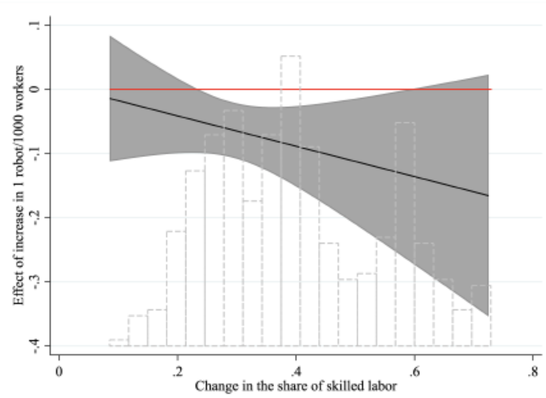
bor (panel e). Second, automation should not affect the incentives of unionized labor to donate, regardless of their skill level—which is what I find (panel f).

Figure 3: Heterogenous effects of exposure to robots on union activity (conditional on changes in the share of skilled labor)

(a) % change in no. of unionized workers



(b) Change in unionization rates



Source: Author's calculations.
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor.

To further evaluate the mechanisms herein, I look at the heterogenous effect of automation on both employment and wages (Appendix, Figure A3). I find that employment is more likely to fall in areas with an increased share of skilled labor but it is not statistically significant, and that wages are higher in areas with an increased share of skilled workers. These results are consistent with the opportunity cost mechanism discussed in Section 3.

Altogether, these results provide suggestive evidence that skilled workers face a higher opportunity cost in response to automation as theorized.

Right-to-work laws

In Right-to-Work laws states new hires can free ride union workers since they are not forced to join the union and pay union dues (Macdonald, 2019). Theoretically, this free-riding increases the opportunity cost of unionization because it generates a collective action problem. If RWL states have bigger shares of skilled labor as plants are more likely to relocate to this areas to save on union costs, the previous results could be confounded by the moderation effect of RWL. I thus investigate the moderating effect of being a district in a RWL state, pre-treatment.

In general, I do not observe an statistically different effect of automation on union places with RWL, except for political donations (Appendix, Figure A4). Therefore there is not enough evidence to support the idea that Right-to-Work confounds the moderating effect of workers' skill on my main outcomes. This is not unexpected because places with Right-to-Work laws gained less educated labor force over time. Indeed, I find that the correlation between Right-to-Work laws and changes in the share of skilled labor between 1970 and 1990 is -0.18.

6.4 Placebos

The public sector has, in general, a very different production structure than the private sector and thus workers' tasks are less susceptible to automation (Adamczyk, Monasterio and Fochezatto, 2021). Hence I do not expect an effect for automation on labor unions in the public sector.

My results are shown in Figure 4. I do not find an statistically significant effect of exposure to robots on union or political activity by public workers. However, notice that I do not provide evidence for campaign donations from public workers due to data limitations, because I cannot distinguish public from private sector contributions from labor in my data.

6.5 Reduced form effect

I also study the reduced form effect of robot exposure, to focus only the exogenous component of robot exposure. That is I estimate the following equation:

$$\Delta(\mathrm{y}_d;t_0,t_1) = \alpha_2 + \beta_2 \mathrm{R}^{EURO5}_{d,(t_0,t_1)} + \Delta\mathbf{X}'_d \boldsymbol{\delta_2} + \mathbf{Z}'_{d,(t_0-1,t_1-1)} \boldsymbol{\phi_2} + \nu_{d,(t_0,t_1)}.$$

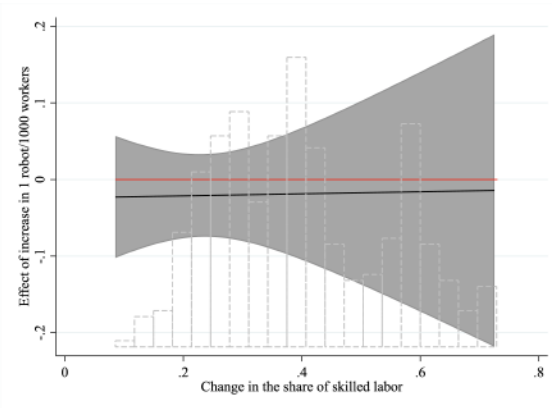
Since my theory establishes that international pressures owing to robot adoption are what drive the local effects on unions and politics, I expect similar results to those I previously obtained.

My findings are in line with previous results as expected (Appendix, Tables A4 to Table A7, and Figure A5). Specifically, I find that an increase in one robot per a thousand workers from industry leaders is associated to a robust decline in about 2.7 percentage points in union membership, in 0.07 percentage points in the share of unionized workers, and to a fall in collective bargaining. Furthermore, the associated heterogenous effects also indicate that the effect of exposure to robots on union membership and donations is stronger when workers' skill increases.[29]

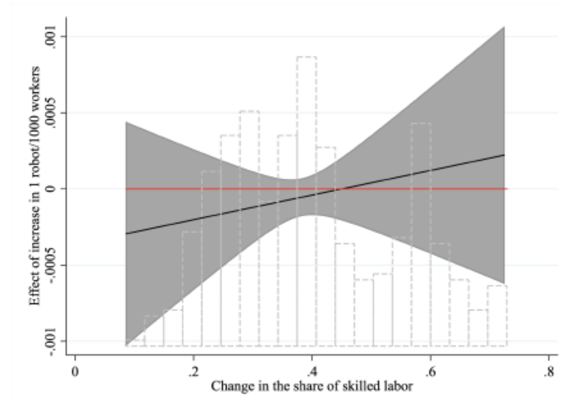
[29] For the reduced form effect, I find no effect of exposure to robots on public union activity (not shown).

Figure 4: Heterogenous effects of exposure to robots on public unions' activity (conditional on changes in the share of skilled labor)

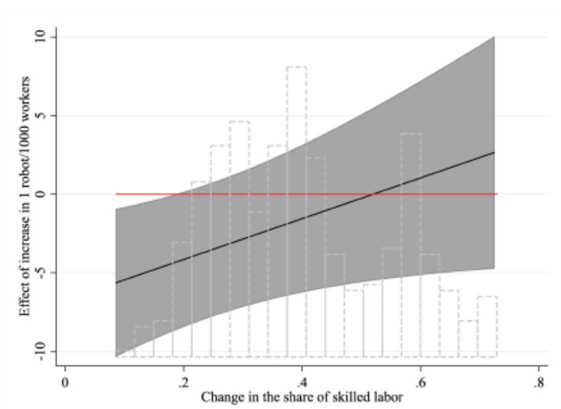
(a) % change in no. of unionized workers



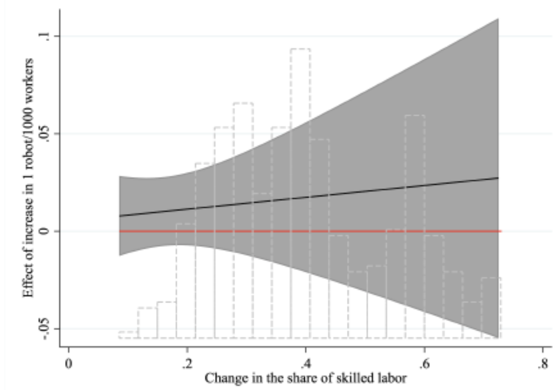
(b) Change in unionization rates



(c) Change in no. of workers in collective bargaining (thou.)



(d) Change in no. of workers striking (thou.)



Source: Author's calculations.

Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

7 Effect of automation on policy responsiveness

I have established that automation affects unionization, union activities and political participation. According to my theory, if unions weaken then elected officials can disregard unions' advice for public policy making (hypothesis **H1**). Hence we should observe a negative impact of exposure to robots on legislative responsiveness as measured by the AFL-CIO scorecard.

In this case it is unwise to use the two-stage least squares. Policy making is a complex process that involves a back and forth between groups with diverse interests and strategic considerations. Thus policy is not only subject to the direct consequences from production choices, but to a myriad of other phenomena that can take place directly (or indirectly) as a result of automation. Therefore the exclusion restriction for instrumental variables is likely violated for this outcome.

To address this issue, I focus on exploring the reduced form effect of exposure to robots on public policy responsiveness to union's interests. The main results are presented in Table 3 and indicate the existence of a robust and negative reduced-form link between automation and legislators' responsiveness to unions' preferences. Specifically, I find that an (exogenous) increase in one robot per a thousand workers is associated to a decline in about 1.2 percentage points in the likelihood that legislators vote in line with workers' interest.

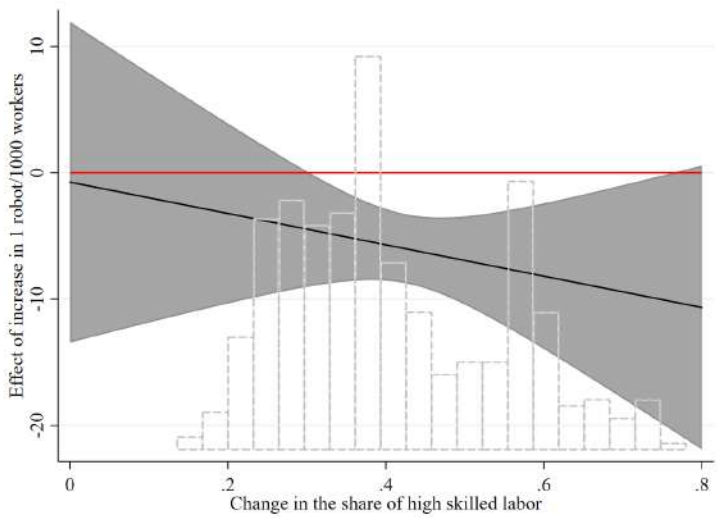
Table 3: Effect of exposure to robots on public policy responsiveness to unions' interests

	(1)	(2)	(3)	(4)	(5)
	Panel A. OLS				
US exposure to robots	-0.665***	-0.391	-0.431	-0.767**	-0.719*
	(0.223)	(0.312)	(0.296)	(0.354)	(0.416)
Districts	412	412	412	412	400
	Panel B. Reduced form regression				
Exposure to robots	-0.870***	-0.659	-0.804*	-1.247***	-1.834**
	(0.271)	(0.434)	(0.420)	(0.451)	(0.469)
Districts	412	412	412	412	400
Demographic controls	No	Yes	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes	Yes
Other shocks	No	No	No	Yes	Yes
Col. bargain and stoppages	No	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

On top of this, I also evaluate the heterogenous effect of exposure to robots (hypotheses **H5** and **H8**). Figure 5 shows that in those places where labor became more skilled there is less public policy responsiveness to workers' interests. These results are consistent with the opportunity-cost mechanism, providing further support for my theory.

Figure 5: Heterogenous effects of exposure to robots on public policy responsiveness



Source: Author's calculations.
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

7.1 Demediation analysis

In Section 3 I indicated that the effect of automation on union activity through workers' incentives to unionize may compound with a potentially negative effect of automation on unemployment. The evidence so far has provided support for the former mechanism. However, to further disentangle these two mechanisms I depart from the assumption that unemployment is a mediator in the causal chain from robot penetration to unionization; thus unemployment is caused before the decision to unionize. Then I determine which mechanism is mediating my results.

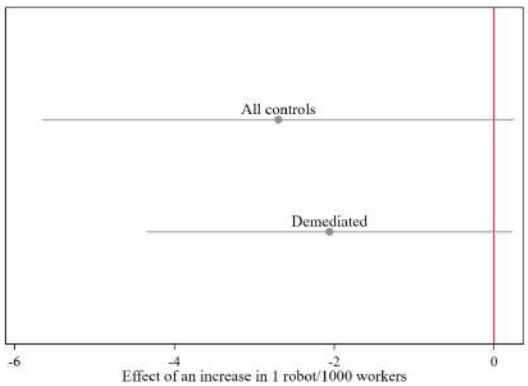
First, I corroborate that automation affects employment (Appendix, Table A8). I find a statistically significant reduction in the employment rate of about 0.8 percentage points. Then, I proceed to demediate the effect of employment on the reduced form impact of exposure to robots on both union membership and public policy responsiveness to unions' interests. Finally, I demediate the effect of union membership on the reduced form impact of exposure to robots on public policy responsiveness to unions interests.

Demediating a regression equation involves a process of *blipping down* the left hand-side of the equation. This entails to residualize the outcome on a regression wherein every covariate and the treatment are interacted with the mediator, to then regress the treatment including all covariates on the demediated outcome (Acharya, Blackwell and Sen, 2016).

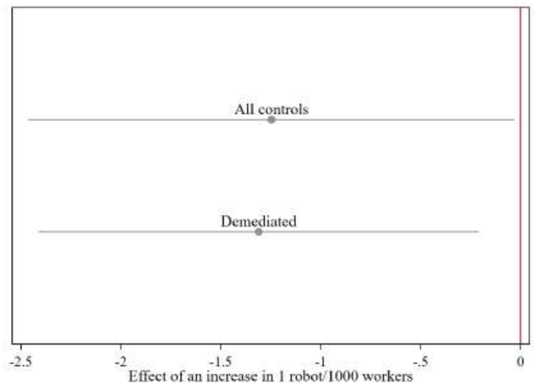
The figure below shows the results of the analysis. It shows that employment is an important mechanism mapping automation to unionization because automation reduces the number of unionized workers (panel a). However, it is not the essential mechanism in the causal chain from automation to public policy responsiveness to unions' interests. Indeed, panels b and d show that unionization rates are an essential mechanism in the aforementioned causal chain because the effect of robots on automation is no longer statistically significant after demediating for this outcome. I provide further evidence for the hypothesized opportunity-cost mechanism by showing that wages also demediate the effect of automation on unionization and policy responsiveness. This is consistent with my previous results (Section 6.3) and the idea that automation affects unions' political power by increasing the opportunity cost of unionization.

Figure 6: Demediation analysis of the effect of exposure to robots

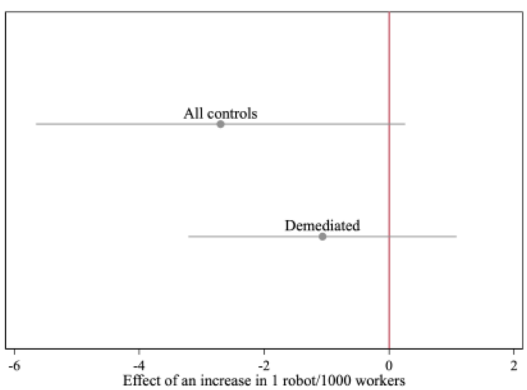
(a) % change in no. of unionized workers after demediating by employment



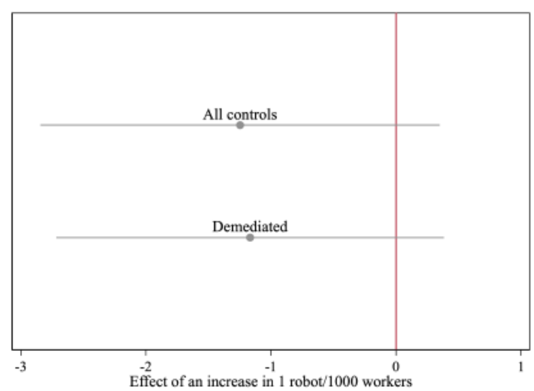
(b) Public policy responsiveness to workers' interests after demediating by employment



(e) % change in no. of unionized workers after demediating by unionization rates



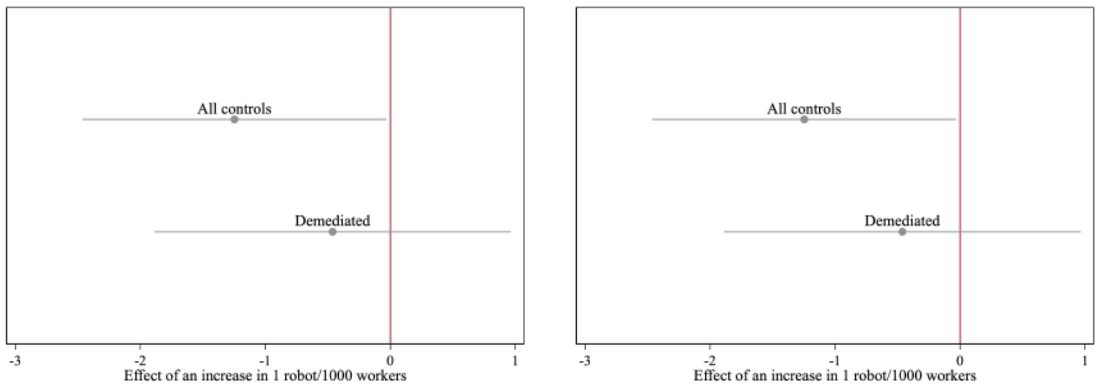
(f) Public policy responsiveness to workers' interests after demediating by unionization rates



8 Conclusions

One of the fundamental global economic shifts of the last 50 years has been the automation of work. I couple the insights from the literature on unions and the economics of automation, to uncover a novel mechanism linking automation with unions' strength, and the political consequences behind this phenomenon. I posit that workers can become more efficient thanks to automation, and as a result they may prefer to invest their effort into productive activities rather than into rent-seeking through union participation. Specifically, I theorize that automation makes skilled workers more productive, increasing the opportunity cost of union activities because they are better off working than participating in politics. Consequently, as industries automate and workers become more skilled, union strength dwindles and politicians respond less to unions' interests.

(a) % change in no. of unionized workers after demediating by wages **(b) Public policy responsiveness to workers' interests after demediating by wages**



Source: Author's calculations.

Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

I evaluate my theory using data from the U.S., finding a connection between automation and public policy responsiveness to unions interests, through the negative effect of automation on unionization. I also find evidence of a decline in political activities by workers, consistent with the idea that weaker unions may translate into lower political participation by workers. Consequently, I find that higher exposure to robots reduces public policy responsiveness to unions' interests from congresspeople. Furthermore, I show that the effect is larger in districts with higher shares of skilled workers, lending support for the hypothesized opportunity-cost mechanism.

Additionally, I address the problem of a compounded effect of exposure to robots on my outcomes insofar as robots reduce employment, and this may affect unionization in turn. First, I show that my main findings are generally inconsistent with the previous mechanism. Second, I use demediation analysis to show that my findings are mainly explained by the effect of automation on union decline, and not by the competing effect of automation on employment.

As more automation becomes a reality of today's economic environment, the findings herein help us understanding the political consequences of the future of work. Specifically, my findings indicate that while automation may lead to economic progress, it may also undermine social progress because it reduces the responsiveness of policy makers to the preferences of collectives that advocate for policies that protect workers in an era of economic change. Although much work remains to be done to understand the political consequences of automation at a global scale, both the theory and findings herein are one step forward in this regard.

References

Acemoglu, Daron and Pascual Restrepo. 2020. "Robots and jobs: Evidence from US labor markets." *Journal of Political Economy* 128(6):2188–2244.

Acemoglu, Daron, Philippe Aghion and Giovanni L Violante. 2001. Deunionization, technical change and inequality. In *Carnegie-Rochester conference series on public policy*. Vol. 55 Elsevier pp. 229–264.

Acharya, Avidit, Matthew Blackwell and Maya Sen. 2016. "Explaining causal findings without bias: Detecting and assessing direct effects." *The American Political Science Review* 110(3):512.

Adamczyk, Willian Boschetti, Leonardo Monasterio and Adelar Fochezatto. 2021. "Automation in the future of public sector employment: the case of Brazilian Federal Government." *Technology in Society* 67:101722.

AFL-CIO. 2019. AFL-CIO Commission on The Future of Work and Unions. Technical report AFL-CIO.

Ahlquist, John and Margaret Levi. 2013. "In the interests of others: Leaders, governance, and political activism in membership organizations.".

Ahlquist, John S. 2017. "Labor unions, political representation, and economic inequality." *Annual Review of Political Science* 20:409–432.

Alhquist, John and Mitch Downey. 2021. "The Effects of Import Competition on Unionization." UCSD mimeo.

Anelli, Massimo, Italo Colantone and Piero Stanig. 2018. We were the robots: Automation and voting behavior in western europe. Technical report Bocconi University–Mimeo.

Autor, David and David Dorn. 2013. "The growth of low-skill service jobs and the polarization of the US labor market." *American Economic Review* 103(5):1553–97.

Autor, David H, David Dorn and Gordon H Hanson. 2015. "Untangling trade and technology: Evidence from local labour markets." *The Economic Journal* 125(584):621–646.

Autor, David H, Frank Levy and Richard J Murnane. 2003. "The skill content of recent technological change: An empirical exploration." *The Quarterly journal of economics* 118(4):1279–1333.

Bartels, Larry M. 2018. *Unequal democracy: The political economy of the new gilded age*. Princeton University Press.

Becher, Michael, Daniel Stegmueller and Konstantin Käppner. 2018. "Local Union Organization and Law Making in the US Congress." *The Journal of Politics* 80(2):539–554.

Bennett, James and Bruce Kaufman. 2007. *What do unions do? A twenty-year perspective*. Transaction Publishers.

Berlingieri, Giuseppe. 2013. "Outsourcing and the Rise in Services.".

Betcherman, Gordon. 1991. "Does technological change affect union wage bargaining power?" *British Journal of Industrial Relations* 29(3):447–462.

Borusyak, Kirill, Peter Hull and Xavier Jaravel. 2021. "Quasi-experimental shift-share research designs." *Review of Economic Studies* .

Brady, David, Regina S Baker and Ryan Finnigan. 2013. "When unionization disappears: State-level unionization and working poverty in the United States." *American sociological review* 78(5):872–896.

Bughin, Jacques, Eric Hazan, Susan Lund, Peter Dahlström, Anna Wiesinger and Amresh Subramaniam. 2018. "Skill shift: Automation and the future of the workforce." *McKinsey Global Institute. McKinsey & Company* .

Castillo, Martin. 2018. "Technological change, rising inequality and union decline in Democratic Capitalism." New York University Working Paper.

Collins, William J and Gregory T Niemesh. 2019. "Unions and the Great Compression of wage inequality in the US at mid-century: evidence from local labour markets." *The Economic History Review* 72(2):691–715.

Farber, Henry S, Daniel Herbst, Ilyana Kuziemko and Suresh Naidu. 2018. Unions and inequality over the twentieth century: New evidence from survey data. Technical report National Bureau of Economic Research.

Feigenbaum, James, Alexander Hertel-Fernandez and Vanessa Williamson. 2018. From the bargaining table to the ballot box: political effects of right to work laws. Technical report National Bureau of Economic Research.

Frank R. Baumgartner, Jeffrey M. Berry, Marie Hojnacki David C. Kimball Leech Beth L. 2010. "Lobbying and Policy Change: Who Wins, Who Loses, and Why.".

Freeman, Richard B and James L Medoff. 1984. "What do unions do." *Indus. & Lab. Rel. Rev.* 38:244.

Frey, Carl Benedikt and Michael A Osborne. 2017. "The future of employment: how susceptible are jobs to computerisation?" *Technological forecasting and social change* 114:254–280.

Gallego, Aina, Thomas Kurer and Nikolas Schöll. 2018. "Not so disruptive after all: how workplace digitalization affects political preferences." Barcelona GSE Working Paper Series Working Paper.

Gil, Avishai. 1986. "Some labour implications of technological change in rail and air transport." *Int'l Lab. Rev.* 125:1.

Goldsmith-Pinkham, Paul, Isaac Sorkin and Henry Swift. 2020. "Bartik instruments: What, when, why, and how." *American Economic Review* .

Gospel, Howard F and Stephen Wood. 2003. *Representing workers*. Routledge London.

Hacker, Jacob S and Paul Pierson. 2010. *Winner-take-all politics: How Washington made the rich richer–and turned its back on the middle class*. Simon and Schuster.

Hirsch, Barry T. 2008. "Sluggish institutions in a dynamic world: Can unions and industrial competition coexist?" *Journal of Economic Perspectives* 22(1):153–176.

Hirsch, Barry T. 2017. What do unions do for economic performance? In *What do unions do?* Routledge pp. 193–237.

Hirsch, Barry T, David A Macpherson and Wayne G Vroman. 2018. "Estimates of union density by state." *Monthly Labor Review* 124(7):51–55.

Jaeger, David A, Joakim Ruist and Jan Stuhler. 2018. Shift-share instruments and the impact of immigration. Technical report National Bureau of Economic Research.

Kennedy, Donald et al. 1982. "Labor and Technology: Union Response to Changing Environments.".

Kim, Sung Eun and Yotam Margalit. 2017. "Informed preferences? The impact of unions on workers' policy views." *American Journal of Political Science* 61(3):728–743.

Kochan, Thomas A, Eileen Appelbaum, Jody Hoffer Gittell and Carrie R Leana. 2013. "The human capital dimensions of sustainable investment: What investment analysts need to know." *Available at SSRN 2222657* .

Leighley, Jan E and Jonathan Nagler. 2007. "Unions, voter turnout, and class bias in the US electorate, 1964–2004." *The Journal of Politics* 69(2):430–441.

Lemieux, Thomas, W Bentley MacLeod and Daniel Parent. 2009. "Performance pay and wage inequality." *The Quarterly Journal of Economics* 124(1):1–49.

Macdonald, David. 2019. "Labor unions and support for redistribution in an era of inequality." *Social Science Quarterly* 100(4):1197–1214.

Mankiya, J, S Lund, M Chui, J Bughin, J Woetzel, P Batra, R Ko and S Sanghvi. 2017. Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages. Technical report Mckinsey Global Institute.

McCartin, Joseph A. 2011. *Collision course: Ronald Reagan, the air traffic controllers, and the strike that changed America*. Oxford University Press.

Milner, Helen V and Sondre Ulvund Solstad. 2021. "Technological Change and the International System." *World Politics* 73(3):545–589.

Minchin, Timothy J. 2017. *Labor under fire: A history of the AFL-CIO since 1979*. UNC Press Books.

Mokyr, Joel, Chris Vickers and Nicolas L Ziebarth. 2015. "The history of technological anxiety and the future of economic growth: Is this time different?" *Journal of Economic Perspectives* 29(3):31–50.

Mosimann, Nadja and Jonas Pontusson. 2017. "Solidaristic unionism and support for redistribution in contemporary Europe." *World Politics* 69(3):448–492.

Olson, Mancur. 1965. *The Logic of Collective Action*. Harvard University Press.

Pencavel, John. 2007. *The Surprising Retreat of Union Britain*. University of Chicago Press.

Rosenfeld, Jake. 2014. *What unions no longer do*. Harvard University Press.

Schlozman, Kay Lehman, Sidney Verba and Henry E Brady. 2012. *the unheavenly chorus: unequal political voice and the broken promise of american democracy*. Princeton University Press.

Schnabel, Claus. 2020. *Handbook of Labor, Human Resources and Population Economics*. Springer chapter Union membership and collective bargaining: Trends and determinants, pp. 1–37.

Scruggs, Lyle and Peter Lange. 2002. "Where have all the members gone? Globalization, institutions, and union density." *the Journal of Politics* 64(1):126–153.

Thewissen, Stefan and David Rueda. 2019. "Automation and the welfare state: Technological change as a determinant of redistribution preferences." *Comparative Political Studies* 52(2):171–208.

Tolbert, Charles M et al. 1987. "Labor Market Areas for the United States." U.S. Department of Agriculture.

Visser, Jelle et al. 2019. "Trade unions in the balance." *Geneva, International Labour Organization' Bureau for Workers' Activities (ACTRAV)* .

Wallerstein, Michael and Bruce Western. 2000. "Unions in decline? What has changed and why." *Annual Review of Political Science* 3(1):355–377.

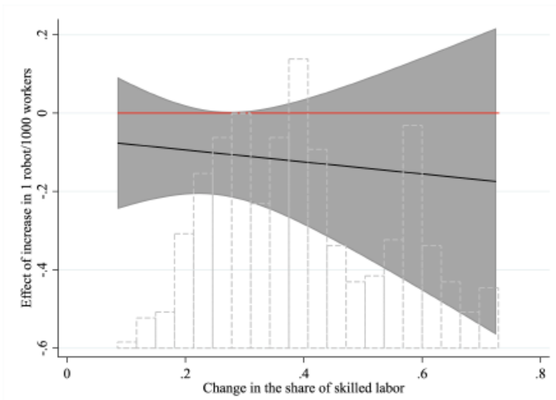
Western, Bruce and Jake Rosenfeld. 2011. "Unions, norms, and the rise in US wage inequality." *American Sociological Review* 76(4):513–537.

Wu, Nicole. 2018. "Misattributed blame? Attitudes toward globalization in the age of automation." *Political Science Research and Methods* pp. 1–18.

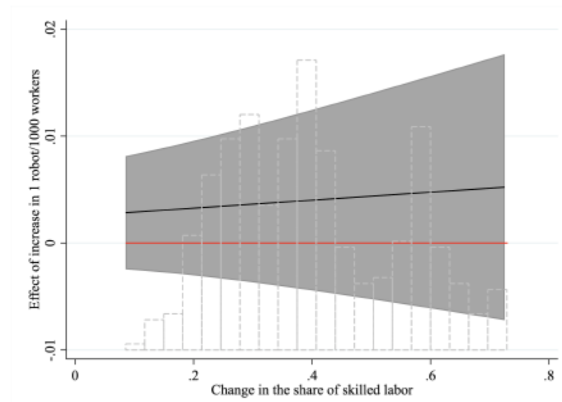
A Empirical Appendix

Figure A. 1: Heterogenous effects of exposure to robots on union and worker activities (conditional on changes in the share of skilled labor)

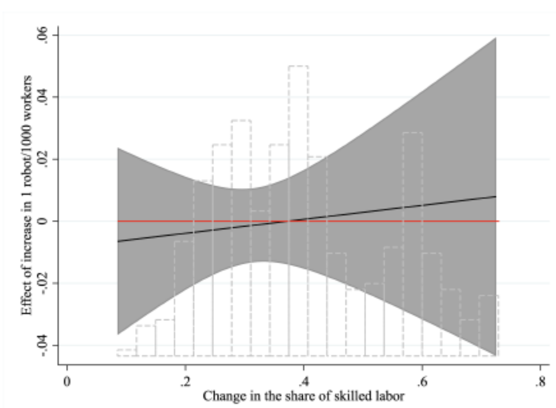
(a) Change in no. of workers in collective bargaining (thou.)



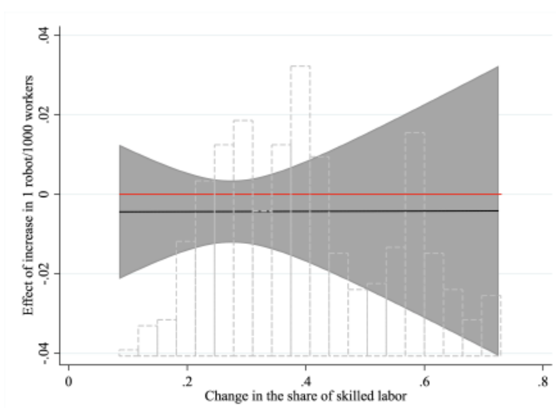
(b) Change in no. of workers striking (thou.)



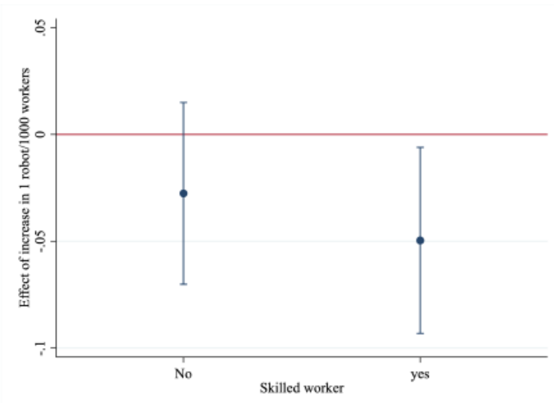
(c) Changes in labor contributions (USD. Mill, 2009=100)



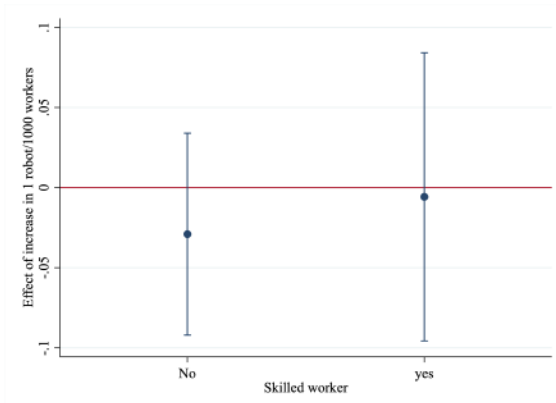
(d) Ratio of labor contributions to corporate contributions



(e) Likelihood of donating to a political campaign



(f) Likelihood of donating to a political campaign

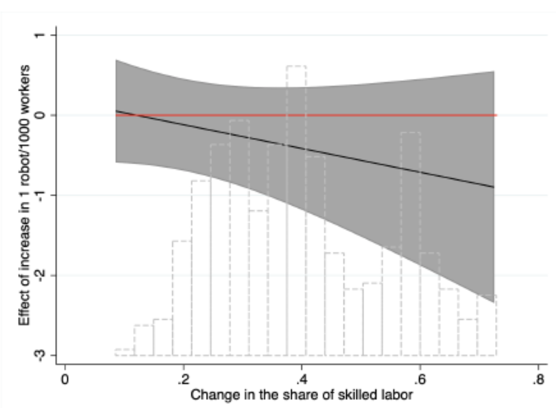


Source: Author's calculations.

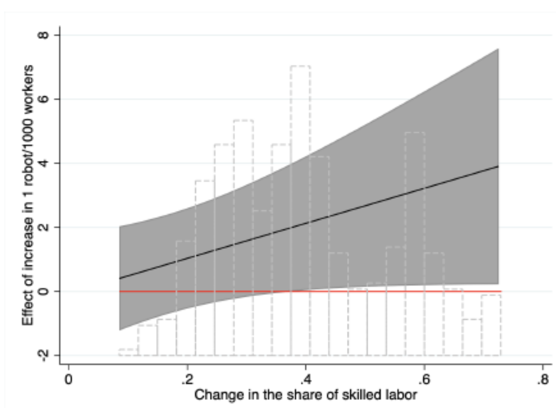
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. In panels (e) and (f) I also include gender, age and ethnicity.

Figure A. 3: Heterogenous effects of exposure to robots on employment and wages (conditional on changes in the share of skilled labor)

(a) Change in the employment rate



(b) Changes in hourly wages

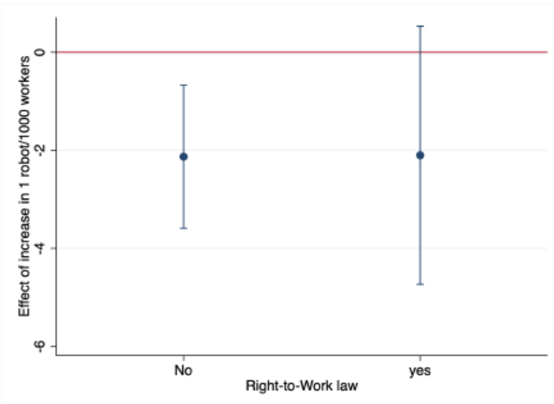


Source: Author's calculations.

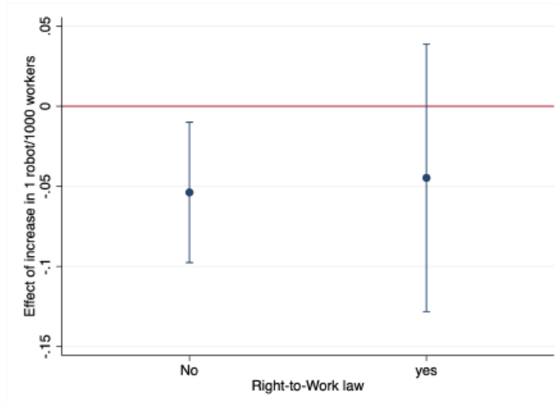
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. In panels (e) and (f) I also include gender, age and ethnicity.

Figure A. 4: Heterogenous effects of exposure to robots on union and workers activities (conditional on Right-to-Work laws)

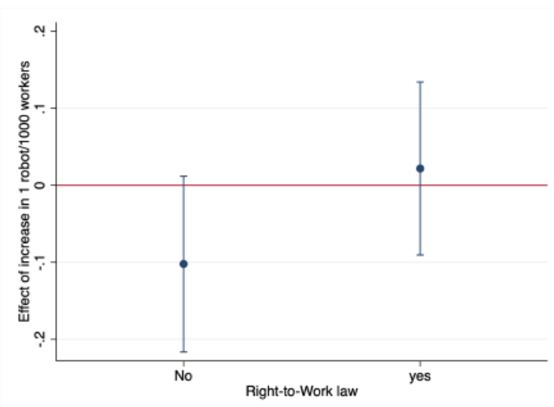
(a) % change in no. of unionized workers



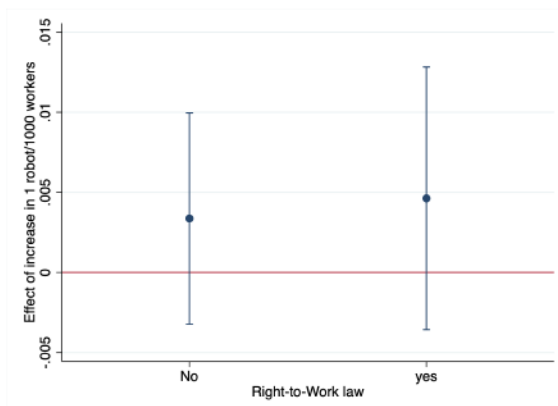
(b) Change in unionization rates



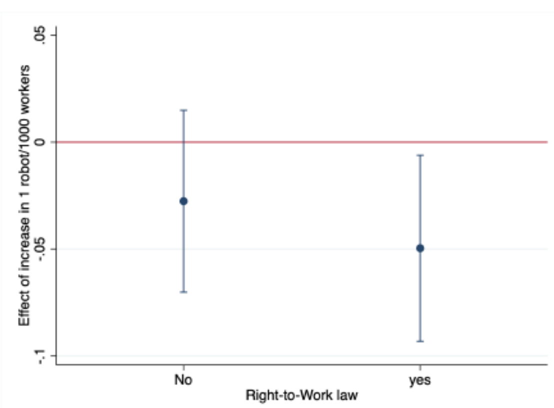
(c) Change in no. of workers in collective bargaining (thou.)



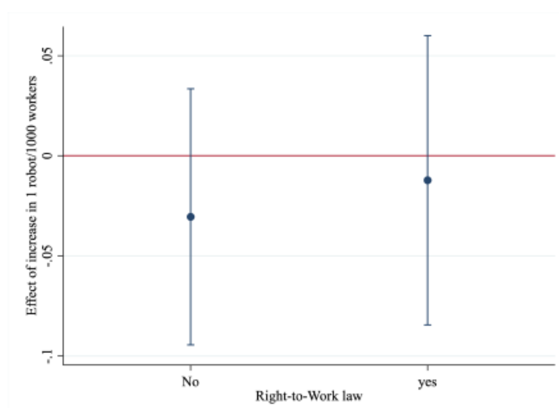
(d) Change in no. of workers striking (thou.)



(e) Likelihood of donating to a political campaign



(f) Likelihood of donating to a political campaign

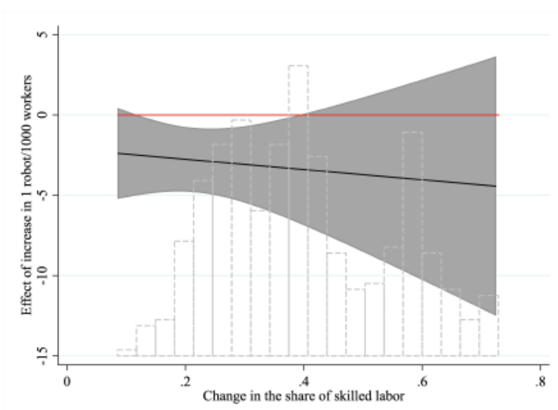


Source: Author's calculations.

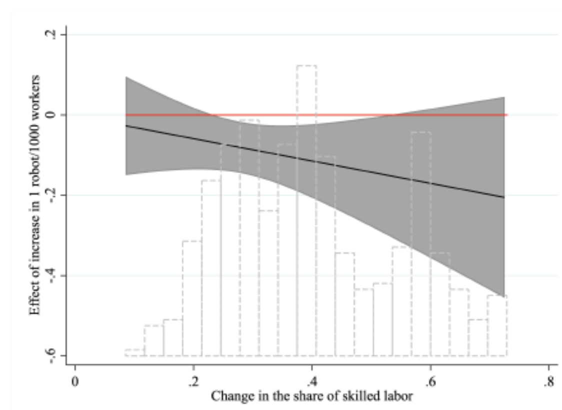
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Figure A. 5: Heterogenous effects of exposure to robots on unions and worker activities, reduced form (conditional on share of high-skilled labor)

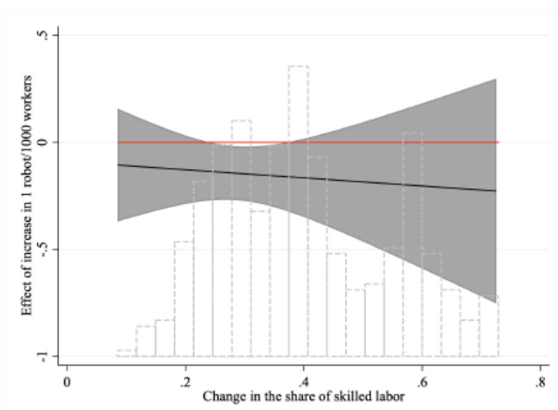
(a) % change in no. of unionized workers



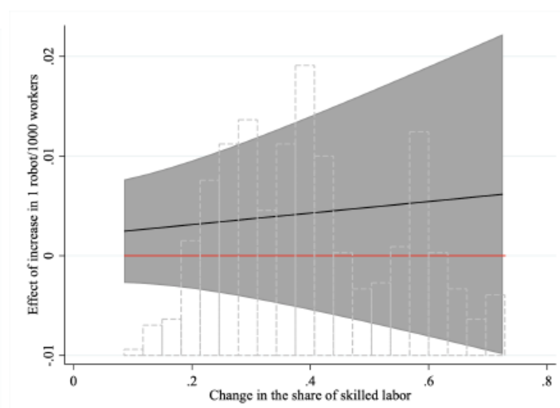
(b) Change in unionization rates



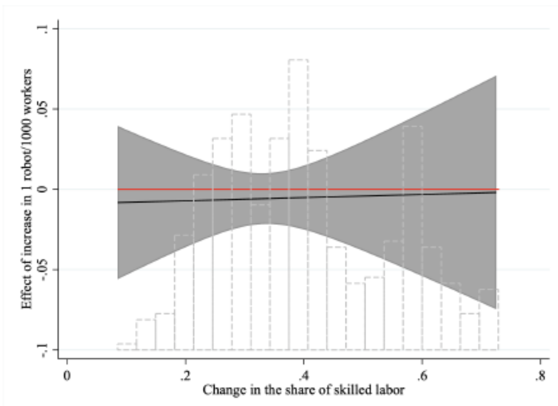
(c) Change in no. of workers in collective bargaining (thou.)



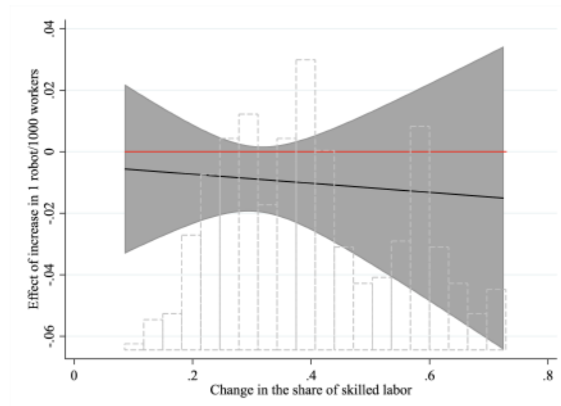
(d) Change in no. of workers striking (thou.)



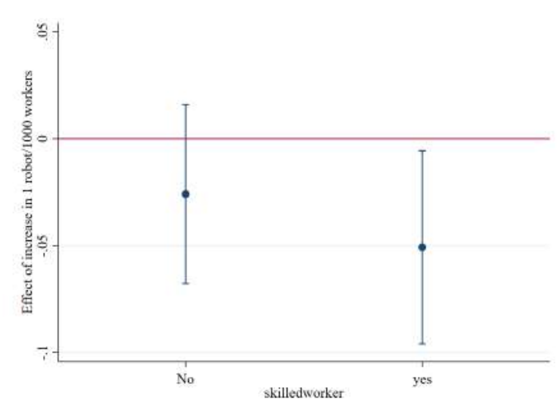
(e) Changes in labor contributions (USD. Mill, 2009=100)



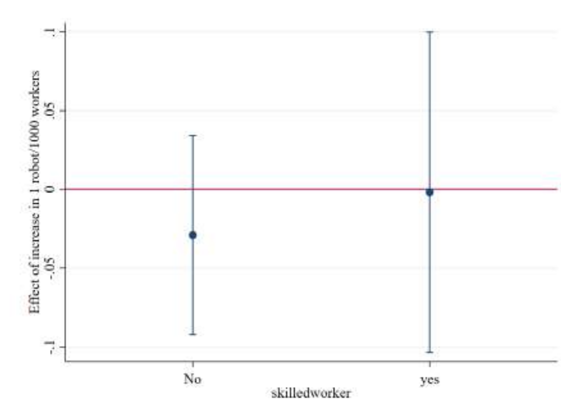
(f) Ratio of labor contributions to corporate contributions



(g) Likelihood of donating to a political campaign



(h) Likelihood of donating to a political campaign

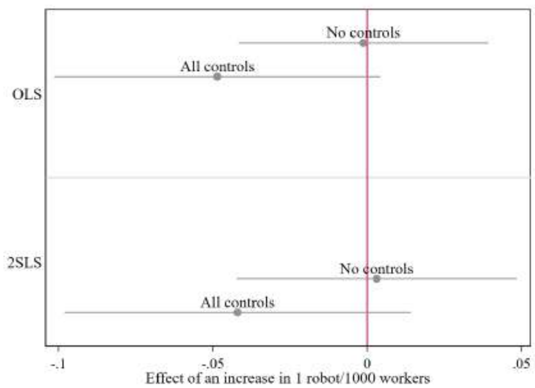


Source: Author's calculations.

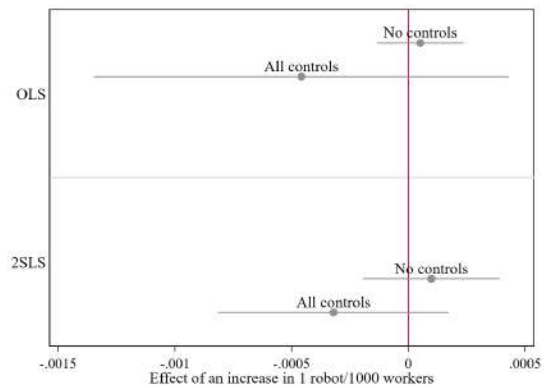
Note: 95% confidence intervals, clustered at state level, in the shaded area. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. In panel (d) we also include gender, age and ethnicity.

Figure A. 7: Effects of exposure to robots on public unions' activity

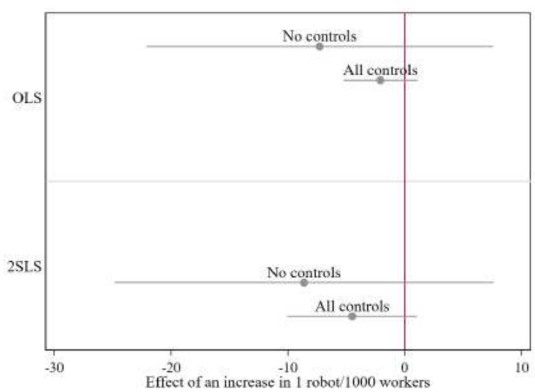
(a) % change in no. of unionized workers



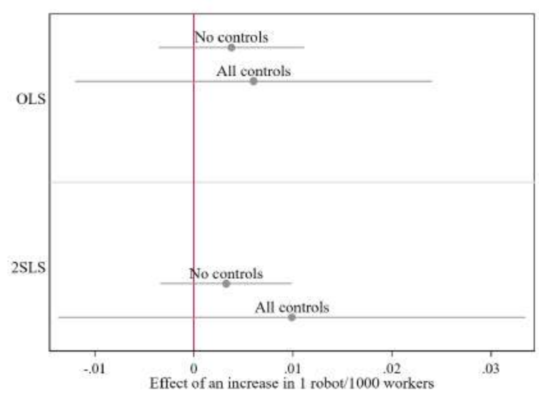
(b) Change in union density



(c) Change in no. of workers in collective bargaining (thou.)



(d) Change in no. of workers striking (thou.)



Source: Author's calculations.

Note: 95% confidence intervals, clustered at state level, are added. Controls include changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with 65 years of age and above, as well as changes in the share of manufacturing and light manufacturing in industry, import shocks and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 1: Summary statistics

	All districts				Average by quartiles of exposure to US robots				
	Average	Sd.	Min	Max	Q1	Q2	Q3	Q4	Q5
Outcomes (as changes between 2004 and 2014):									
Exposure to robots in the US (bartik)	0.53	0.59	0.03	4.08	0.08	0.15	0.31	0.63	1.50
Exposure to robots (bartik)	0.46	0.48	0.02	2.92	0.07	0.15	0.28	0.59	1.20
Union size (%)	-2.09	10.95	-52.03	38.73	-1.08	-2.06	-2.97	-1.79	-2.56
Union density (%)	-0.04	0.36	-2.97	3.17	0.01	-0.04	-0.05	-0.07	-0.05
Workers in collective bargains (thou.)	-0.07	0.44	-3.81	3.29	-0.02	-0.09	-0.04	-0.07	-0.13
Workers in strikes (thou.)	0.00	0.03	-0.40	0.00	0.00	0.00	0.00	0.00	-0.01
Labor contributions (mill. USD, 2009=100)	-0.02	0.05	-0.22	0.11	-0.01	-0.02	-0.02	-0.04	-0.03
AFL-CIO score	-0.13	3.83	-8.93	9.66	1.33	0.54	-0.25	-1.10	-1.17
Employment rate (2000-2014)	0.57	1.82	-5.24	5.25	2.06	0.96	0.31	0.13	-0.63
Covariates (as changes between 1970 and 1990):									
Population (thou.)	45.01	67.70	-27.98	343.48	68.00	51.83	68.09	17.59	18.45
Share of female workers (%)	0.00	0.04	-0.10	0.17	-0.02	0.00	-0.01	0.01	0.00
Share of hispanic workers (%)	0.19	0.26	-0.83	1.45	0.40	0.21	0.17	0.08	0.06
Share of white workers (%)	-0.15	0.19	-1.09	0.40	-0.29	-0.18	-0.12	-0.08	-0.06
Share of black workers (%)	0.03	0.13	-0.46	0.66	0.10	0.04	-0.01	0.03	0.01
Share of asian workers (%)	0.09	0.11	-0.03	0.55	0.18	0.13	0.10	0.03	0.03
Share with highschool degree or less (%)	0.02	0.07	-0.29	1.10	0.01	0.01	0.03	0.02	0.02
Share with some college (%)	-0.92	0.18	-1.38	-0.43	-0.97	-1.03	-0.94	-0.87	-0.78
Share with college degree (%)	0.52	0.10	0.27	0.83	0.47	0.54	0.53	0.54	0.51
Share with graduate studies (%)	0.36	0.13	0.08	0.66	0.46	0.45	0.37	0.29	0.25
Share that is foreign born (%)	0.04	0.04	-0.06	0.16	0.04	0.04	0.03	0.04	0.03
Share 65 yo. Or more (%)	0.13	0.08	-0.04	0.54	0.11	0.13	0.14	0.15	0.14

	All districts				Average by quartiles of exposure to US robots				
	Average	**Sd.**	**Min**	**Max**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
Share employed in manufactures (%)	-0.46	0.30	-1.20	0.29	-0.50	-0.49	-0.40	-0.48	-0.43
Share employed in light manufacturing (%)	-0.13	0.16	-0.98	0.23	-0.10	-0.09	-0.16	-0.16	-0.14
Share in routine task activities (%)	0.10	0.12	-0.36	0.47	0.04	0.08	0.12	0.12	0.13
Import competition index	15.44	16.04	0.75	110.02	3.29	5.32	11.26	19.95	37.52
Pre-treatment col. bargain and strikes (as changes between 2003 and 2013):									
Workers in collective bargains (thou.)	-0.04	0.31	-1.63	4.63	426.00	0.00	-0.03	-0.04	-0.07
Days on collective bargain	45.07	315.33	-100.12	3793.60	426.00	28.66	10.65	36.34	69.01
Workers in strikes (thou.)	-0.02	0.17	-2.33	0.46	426.00	0.00	-0.07	-0.01	-0.02
Days on strike	-0.79	9.90	-89.30	105.14	426.00	-0.49	-2.92	0.57	0.47

Note: Standard errors clustered at year and country levels are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%.

Table A. 2: **Effect of exposure to robots on campaign contributions, 2SLS**

	(1)	(2)	(3)	(4)
	Panel A. Changes in labor contributions (USD. Mill, 2009=100)			
US exposure to robots	-0.012***	-0.007	-0.007	-0.005
	(0.004)	(0.006)	(0.006)	(0.008)
First stage F	313	162	172	221
Districts	402	402	402	402
	Panel C. Ratio of labor contributions to corporate contributions			
US exposure to robots	-0.010***	-0.009***	-0.009***	-0.008*
	(0.002)	(0.003)	(0.003)	(0.005)
First stage F	313	161	172	222
Districts	401	401	401	401
Demographic controls	No	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes
Other shocks	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 3: Effect of exposure to robots on individual donations, employed, 2SLS

	OLS			*2SLS*		
	(1)	(2)	(3)	(4)	(5)	(6)
US exposure to robots	-0.044***	-0.023	-0.018	-0.048***	-0.036*	-0.035*
	(0.009)	(0.015)	(0.016)	(0.011)	(0.021)	(0.021)
Observations	16507	16507	11605	16507	16507	11605
Demographic controls	No	Yes	Yes	No	Yes	Yes
Industry controls	No	Yes	Yes	No	Yes	Yes
Other shocks	No	Yes	Yes	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes	No	No	Yes

	Panel C. First stage regression		
Exposure to robots	1.192***	1.039***	1.047***
	(0.074)	(0.085)	(0.086)
F for excluded instruments	235	143	142
Observations	16507	16507	11605
Demographic controls	No	Yes	Yes
Industry controls	No	Yes	Yes
Other shocks	No	Yes	Yes
Col. bargain and stoppages	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 4: Effect of exposure to robots on union membership, reduced form

	(1)	(2)	(3)	(4)
	Panel A. % change in no. of unionized workers			
Exposure to robots	-0.687*	-1.358	-1.499*	-2.686**
	(0.405)	(0.817)	(0.788)	(1.111)
Districts	412	412	412	412
	Panel B. Change in unionization rate (%)			
Exposure to robots	-0.040**	-0.032	-0.039	-0.072**
	(0.017)	(0.024)	(0.025)	(0.034)
Observations	412	412	412	412
Demographic controls	No	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes
Other shocks	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 5: Effect of exposure to robots on collective bargaining and work stoppages, reduced form

	(1)	(2)	(3)	(4)
	Panel A. Change in no. of workers in collective bargaining (thou.)			
Exposure to robots	-0.050	-0.045	-0.062	-0.142**
	(0.045)	(0.046)	(0.046)	(0.064)
Districts	401	401	401	401
	Panel B. Change in no. of workers striking (thou.)			
Exposure to robots	-0.001	0.002	0.002	0.006
	(0.001)	(0.003)	(0.002)	(0.005)
Observations	401	401	401	401
Demographic controls	No	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes
Other shocks	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 6: Effect of exposure to robots on campaign contributions, reduced form

	(1)	(2)	(3)	(4)
	Panel A. Changes in labor contributions (USD. Mill, 2009=100)			
Exposure to robots	-0.014***	-0.008	-0.009	-0.005
	(0.005)	(0.008)	(0.008)	(0.009)
Districts	402	402	402	402
	Panel C. Ratio of labor contributions to corporate contributions			
Exposure to robots	-0.012***	-0.010**	-0.011**	-0.008
	(0.003)	(0.004)	(0.004)	(0.005)
Districts	401	401	401	401
Demographic controls	No	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes
Other shocks	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: gender, ethnicity, age, changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

Table A. 7: Effect of exposure to robots on individual donations, employed, reduced form

	(1)	(2)	(3)	(4)
	Panel A. Donates to party or candidate (2006-14)			
Exposure to robots	-0.057***	-0.029*	-0.028*	-0.037*
	(0.011)	(0.014)	(0.014)	(0.020)
Districts	16507	16507	16507	16507
Demographic controls	No	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes
Other shocks	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

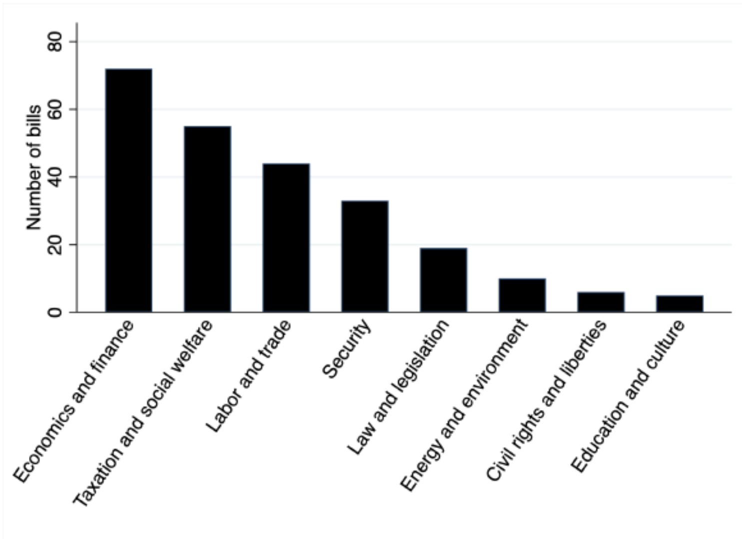
Table A. 8: Effect of exposure to robots on private sector employment

	(1)	(2)	(3)	(4)	(5)
Exposure to robots	-1.496***	-1.095***	-1.164***	-0.831***	-0.756**
	(0.348)	(0.276)	(0.297)	(0.272)	(0.282)
Districts	412	412	412	412	401
Demographic controls	No	Yes	Yes	Yes	Yes
Industry controls	No	No	Yes	Yes	Yes
Other shocks	No	No	No	Yes	Yes
Col. bargain and stoppages	No	No	No	No	Yes

Note: Standard errors clustered at state level are in parentheses. Coefficients that are significantly different from zero are denoted by the following system: *10%, **5%, and ***1%. Demographic controls include: changes in size of the population, in the share of female labor, hispanic, white, black and asian groups, changes in the share of people with high school, college and masters degrees, and in the share of people with 65 years of age and above. Industry controls include, changes in the share of manufacturing and light manufacturing in industry. State level controls include pre-treatment changes in unionization and Right-to-Work Laws. Shocks include the China import shock and changes in the share of routine task labor. State level controls include pre-treatment changes in unionization and Right-to-Work Laws.

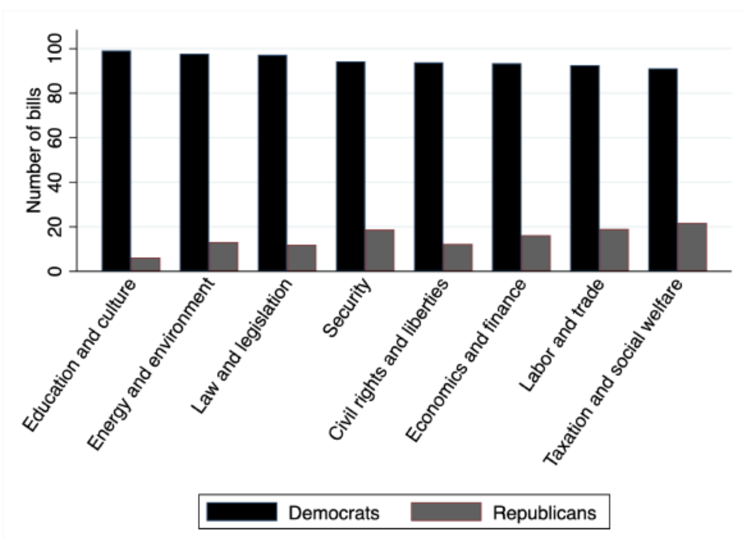
B AFL-CIO and bills

Figure B. 1: Number of bills with an official position from the AFL-CIO, by topic (2001-2014)



Source: Author's compilations.
Note: The AFL-CIO is the most important union federation of labor unions in the U.S. Information about the bills' topics is available in Table B2 below.

Figure B. 2: Average legislative scorecard, by topic and party (2001-2014)



Source: Author's compilations.
Note: Information about the bills' topics is available in Table B2 below.

Table B. 1: List of unions affiliated with the AFL–CIO

Union name	
Actors' Equity Association (AEA)	International Alliance of Theatrical Stage Employees, Moving Picture Technicians, Artists and Allied Crafts of the United States, Its Territories and Canada (IATSE)
Air Line Pilots Association (ALPA)	International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers (Ironworkers)
Amalgamated Transit Union (ATU)	International Association of Fire Fighters (IAFF)
American Federation of Government Employees (AFGE)	International Association of Heat and Frost Insulators and Allied Workers
American Federation of Musicians of the United States and Canada (AFM)	International Association of Machinists and Aerospace Workers (IAM)
American Federation of School Administrators (AFSA)	International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART)
American Federation of State, County and Municipal Employees (AFSCME)	International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers (IBB)
American Federation of Teachers (AFT)	International Brotherhood of Electrical Workers (IBEW)
American Postal Workers Union (APWU)	International Federation of Professional and Technical Engineers (IFPTE)
American Radio Association (ARA)	International Longshore and Warehouse Union (ILWU)
American Train Dispatchers Association (ATDA)	International Longshoremen's Association (ILA)
Associated Actors and Artistes of America (4As)	International Organization of Masters, Mates & Pilots (MMP)
Bakery, Confectionery, Tobacco Workers and Grain Millers' International Union (BCTGM)	International Plate Printers, Die Stampers and Engravers Union of North America
Brotherhood of Railroad Signalmen (BRS)	International Union of Allied Novelty and Production Workers (Novelty and Production Workers)
California School Employees Association (CSEA)	International Union of Bricklayers and Allied Craftworkers (BAC)
Communications Workers of America (CWA)	International Union of Elevator Constructors (IUEC)
Farm Labor Organizing Committee (FLOC)	International Union of Operating Engineers (IUOE)
Gay and Lesbian Labor Activists Network (GALLAN)	International Union of Painters and Allied Trades (IUPAT)
Glass, Molders, Pottery, Plastics and Allied Workers International Union (GMP)	Laborers' International Union of North America (LIUNA)

Laborers' International Union of North America (LIUNA)	Seafarers International Union of North America (SIU)
Marine Engineers Beneficial Association (MEBA)	Transport Workers Union of America (TWU)
National Air Traffic Controllers Association (NATCA)	UNITE HERE
National Association of Letter Carriers (NALC)	United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA)
National Education Association	United Auto Workers (UAW)
National Football League Players Association (NFLPA)	United Automobile, Aerospace and Agricultural Implement Workers of America International Union (UAW)
National Nurses United (NNU)	United Food and Commercial Workers (UFCW)
National Taxi Workers' Alliance (NTWA)	United Food and Commercial Workers
National Women's Soccer League (NWSL)	United Mine Workers of America (UMWA)
Office and Professional Employees International Union (OPEIU)	United Steelworkers (USW)
Operative Plasterers' and Cement Masons' International Association of the United States and Canada (OPCMIA)	United Union of Roofers, Waterproofers and Allied Workers (Roofers and Waterproofers)
Professional Aviation Safety Specialists (PASS)	Utility Workers Union of America (UWUA)
Screen Actors Guild-American Federation of Television and Radio Artists (SAG-AFTRA)	

Notes: The ILWU disaffiliated in August 2013 over policy and other differences; LIUNA disaffiliated with AFL-CIO in 2005, but re-affiliated in 2010; UNITE HERE disaffiliated with AFL-CIO in 2005, but re-affiliated in 2009; United Food and Commercial Workers disaffiliated with AFL-CIO in 2005, but re-affiliated in 2013. The Service Employees International Union, International Brotherhood of Teamsters, United Farm Workers of America and United Brotherhood of Carpenters and Joiners of America disaffiliated from the AFL-CIO in 2005 and never rejoined—these four unions are excluded from the list above.

Table B. 2: Description of bills' topics

Area	Topic	Description
Civil rights and liberties	Civil Rights and Liberties, Minority Issues	Primary focus of measure is discrimination on basis of race, ethnicity, age, sex, gender, health or disability; First Amendment rights; due process and equal protection; abortion rights; privacy. Measures concerning abortion rights and procedures may fall under Health policy area.
	Immigration	Primary focus of measure is administration of immigration and naturalization matters; immigration enforcement procedures; refugees and asylum policies; travel and residence documentation; foreign labor; benefits for immigrants. Measures concerning smuggling and trafficking of persons may fall under Crime and Law Enforcement policy area. Measures concerning refugees may fall under International Affairs policy area.
	Native Americans	Primary focus of measure is matters affecting Native Americans, including Alaska Natives and Hawaiians, in a variety of domestic policy settings. This includes claims, intergovernmental relations, and Indian lands and resources.
Economics and finance	Agriculture and Food	Primary focus of measure is agricultural practices; agricultural prices and marketing; agricultural education; food assistance or nutrition programs; food industry, supply, and safety; aquaculture; horticulture and plants. Measures concerning international trade in agricultural products may fall under Foreign Trade and International Finance policy area.
	Commerce	Primary focus of measure is business investment, development, regulation; small business; consumer affairs; competition and restrictive trade practices; manufacturing, distribution, retail; marketing; intellectual property. Measures concerning international competitiveness and restrictions on imports and exports may fall under Foreign Trade and International Finance policy area.
	Economics and Public Finance	Primary focus of measure is budgetary matters such as appropriations, public debt, the budget process, government lending, government accounts and trust funds; monetary policy and inflation; economic development, performance, and economic theory.
	Finance and Financial Sector	Primary focus of measure is U.S. banking and financial institutions regulation; consumer credit; bankruptcy and debt collection; financial services and investments; insurance; securities; real estate transactions; currency. Measures concerning financial crimes may fall under Crime and Law Enforcement. Measures concerning business and corporate finance may fall under Commerce policy area. Measures concerning international banking may fall under Foreign Trade and International Finance policy area.
Education and culture	Arts, Culture, Religion	Primary focus of measure is art, literature, performing arts in all formats; arts and humanities funding; libraries, exhibitions, cultural centers; sound recording, motion pictures, television and film; cultural property and resources; cultural relations; and religion. Measures concerning intellectual property aspects of the arts may fall under Commerce policy area. Measures concerning religious freedom may fall under Civil Rights and Liberties, Minority Issues policy area.
	Education	Primary focus of measure is elementary, secondary, or higher education including special education and matters of academic performance, school administration, teaching, educational costs, and student aid.
	Science, Technology, Communications	Primary focus of measure is natural sciences, space exploration, research policy and funding, research and development, STEM education, scientific cooperation and communication; technology policies, telecommunication, information technology; digital media, journalism. Measures concerning scientific education may fall under Education policy area.
	Social Sciences and History	Primary focus of measure is policy sciences, history, matters related to the study of society. Measures concerning particular aspects of government functions may fall under Government Operations and Politics policy area.
	Sports and Recreation	Primary focus of measure is youth, amateur, and professional athletics; outdoor recreation; sports and recreation facilities. Measures concerning recreation areas may fall under Public Lands and Natural Resources policy area.

Area	Topic	Description
Energy and environment	Animals	Primary focus of measure is animal protection; human-animal relationships; wildlife conservation and habitat protection; veterinary medicine. Measures concerning endangered or threatened species may fall under Environmental Protection policy area. Measures concerning wildlife refuge matters may fall under Public Lands and Natural Resources policy area.
	Energy	Primary focus of measure is all sources and supplies of energy, including alternative energy sources, oil and gas, coal, nuclear power; efficiency and conservation; costs, prices, and revenues; electric power transmission; public utility matters.
	Environmental Protection	Primary focus of measure is regulation of pollution including from hazardous substances and radioactive releases; climate change and greenhouse gases; environmental assessment and research; solid waste and recycling; ecology. Measures concerning energy exploration, efficiency, and conservation may fall under Energy policy area.
	Public Lands and Natural Resources	Primary focus of measure is natural areas (including wilderness); lands under government jurisdiction; land use practices and policies; parks, monuments, and historic sites; fisheries and marine resources; mining and minerals. Measures concerning energy supplies and production may fall under Energy policy area.
	Water Resources Development	Primary focus of measure is the supply and use of water and control of water flows; watersheds; floods and storm protection; wetlands. Measures concerning water quality may fall under Environmental Protection policy area.
Labor and trade	Foreign Trade and International Finance	Primary focus of measure is competitiveness, trade barriers and adjustment assistance; foreign loans and international monetary system; international banking; trade agreements and negotiations; customs enforcement, tariffs, and trade restrictions; foreign investment. Measures concerning border enforcement may fall under Immigration policy area.
	Labor and Employment	Primary focus of measure is matters affecting hiring and composition of the workforce, wages and benefits, labor-management relations; occupational safety, personnel management, unemployment compensation. Measures concerning public-sector employment may fall under Government Operations and Politics policy area.
Law and legislation	Congress	Primary focus of measure is Members of Congress; general congressional oversight; congressional agencies, committees, operations; legislative procedures; U.S. Capitol. Measures concerning oversight and investigation of specific matters may fall under the issue-specific relevant policy area.
	Government Operations and Politics	Primary focus of measure is government administration, including agency organization, contracting, facilities and property, information management and services; rulemaking and administrative law; elections and political activities; government employees and officials; Presidents; ethics and public participation; postal service. Measures concerning agency appropriations and the budget process may fall under Economics and Public Finance policy area.
	International Affairs	Primary focus of measure is matters affecting foreign aid, human rights, international law and organizations; national governance; arms control; diplomacy and foreign officials; alliances and collective security. Measures concerning trade agreements, tariffs, foreign investments, and foreign loans may fall under Foreign Trade and International Finance policy area.
	Law	Primary focus of measure is matters affecting civil actions and administrative remedies, courts and judicial administration, general constitutional issues, dispute resolution, including mediation and arbitration. Measures concerning specific constitutional amendments may fall under the policy area relevant to the subject matter of the amendment (e.g., Education). Measures concerning criminal procedure and law enforcement may fall under Crime and Law Enforcement policy area.

Area	Topic	Description
Security	Armed Forces and National Security	Primary focus of measure is military operations and spending, facilities, procurement and weapons, personnel, intelligence; strategic materials; war and emergency powers; veterans? issues. Measures concerning alliances and collective security, arms sales and military assistance, or arms control may fall under International Affairs policy area.
	Crime and Law Enforcement	Primary focus of measure is criminal offenses, investigation and prosecution, procedure and sentencing; corrections and imprisonment; juvenile crime; law enforcement administration. Measures concerning terrorism may fall under Emergency Management or International Affairs policy areas.
	Emergency Management	Primary focus of measure is emergency planning; response to civil disturbances, natural and other disasters, including fires; emergency communications; security preparedness.
Taxation and social welfare	Families	Primary focus of measure is child and family welfare, services, and relationships; marriage and family status; domestic violence and child abuse. Measures concerning public assistance programs or aging may fall under Social Welfare policy area.
	Health	Primary focus of measure is science or practice of the diagnosis, treatment, and prevention of disease; health services administration and funding, including such programs as Medicare and Medicaid; health personnel and medical education; drug use and safety; health care coverage and insurance; health facilities. Measures concerning controlled substances and drug trafficking may fall under Crime and Law Enforcement policy area.
	Housing and Community Development	Primary focus of measure is home ownership; housing programs administration and funding; residential rehabilitation; regional planning, rural and urban development; affordable housing; homelessness; housing industry and construction; fair housing. Measures concerning mortgages and mortgage finance may fall under Finance and Financial Sector policy area.
Taxation and social welfare	Social Welfare	Primary focus of measure is public assistance and Social Security programs; social services matters, including community service, volunteer, and charitable activities. Measures concerning such health programs as Medicare and Medicaid may fall under Health policy area.
	Taxation	Primary focus of measure is all aspects of income, excise, property, inheritance, and employment taxes; tax administration and collection. Measures concerning state and local finance may fall under Economics and Public Finance policy area.
	Transportation and Public Works	Primary focus of measure is all aspects of transportation modes and conveyances, including funding and safety matters; Coast Guard; infrastructure development; travel and tourism. Measures concerning water resources and navigation projects may fall under Water Resources Development policy area.

Notes: The topics and their descriptions come from https://www.congress.gov/browse/policyarea. I built groupings of these areas to facilitate analysis (first column).