Minimum Wage, Informality, and Gender Gaps: Evidence from Morocco*

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Abstract

This paper examines how minimum wage policies affect gender gaps in employment and wages in a setting characterized by a large informal sector and wide initial gender disparities. Focusing on the Moroccan manufacturing sector, I leverage matched formal employer-employee data to analyze the impacts of a 24% real increase in the national minimum wage between 2009 and 2015. During that period, the raw gender pay gap in the formal sector narrows from 28% to 22%. Using difference-in-differences designs, I find that this decline is driven by direct wage increases for workers previously below the new minimum wage and to spillover effects for workers higher up in the wage distribution. Both direct and spillover effects are larger for women. Female workers who remain in formal employment are also more likely to transition to larger, higher-paying firms. However, I also document a displacement effect: women directly affected by the minimum wage increases are 22% more likely to exit formal employment, while men and women in higher wage brackets remain unaffected. Most displaced women transition to the informal sector, where wages are substantially lower. Firm closures, which disproportionately affect firms employing more women, account for 40% of this displacement effect. Examining heterogeneity across local labor markets, I further show that the displacement effect is larger when women have a reduced set of formal sector outside options. Despite this increased job vulnerability for low-wage women, bounding exercises suggest that, on net, the minimum wage increases still contribute to a reduction in the gender pay gap.

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1 Introduction

Minimum wage policies and union-negotiated wage floors are designed to protect vulnerable workers and ensure a minimum standard of living. Existing evidence suggests that, beyond improving pay conditions, these policies can also contribute to narrowing wage disparities across groups (Blau and Kahn, 1992; DiNardo, Fortin and Lemieux, 1996; Wursten and Reich, 2021; Derenoncourt and Montialoux, 2021). In particular, if women are overrepresented in low-wage jobs, by increasing wages at the bottom of the wage distribution, minimum wage policies may help narrow gender pay gaps (Autor, Manning and Smith, 2016; Caliendo and Wittbrodt, 2022; Blau et al., 2023).

In recent years, several countries have adopted or strengthened their minimum wage scheme, including low- and middle-income countries. Almost 90% of African countries now have a minimum wage policy in place, with recent introductions in countries such as Cape Verde, Mauritius, and Egypt. [1] Yet, there is relatively limited evidence of their impact on pay inequality and gender gaps in low- and middle-income contexts. In these settings, labor markets exhibit distinct dynamics (e.g. large informal sector, low female labor force participation, exacerbated search frictions). Consequently, the impact of minimum wage policies, especially on women, might differ from that documented in higher-income settings.

Given these distinct characteristics, how effective are minimum wage policies in reducing pay inequality and gender wage gaps in the formal sector in low- and middle-income countries? How do they impact overall formal employment and potential reallocation to the informal sector? And, how do the initial distribution of female and male workers across firms and gender differences in outside options help explain potential differential gender impacts?

This paper delves into these questions, focusing on the Moroccan manufacturing sector. Morocco provides an ideal setting. First, it is a lower middle-income country with a labor market characterized by large and persistent gender disparities. As in most countries in the Middle East and North Africa (MENA),[2] the female labor force participation (FLFP) in Morocco remains low: 22% vs. 71% for men in 2008. Before the period of sustained increase in the minimum wage, the daily wage of female workers was on average 28% lower than their male counterparts. Furthermore, in the Moroccan context, hiring through informal networks and referrals, as well as mobility barriers exacerbate unequal access to reliable employment opportunities, particularly for female workers (Calvo-Armengol and Jackson, 2004; Beaman, Keleher and Magruder, 2018; Bolte, Immorlica and Jackson, 2020). These constraints on women's work also constitute conditions for employers to have greater monopsony power over female workers, another driver of gender pay gaps (Sharma, 2023). Consequently, Morocco is a context in which the tradeoff

[1] In Africa, 48 of the 54 countries have a minimum wage policy in place. A national minimum wage was introduced in 2014 in Cape Verde and Suriname, in 2015 in Myanmar, and in 2018 in Mauritius. Egypt had a minimum wage that applied only to the public sector, and in January 2022 introduced its first private sector minimum wage. Of the 48 African countries with minimum wages, only Namibia and Zimbabwe rely on collectively agreed minimum wages. Other countries set their minimum wage by government decrees.

[2] Gender gaps in labor force participation are the most severe in the MENA region, where FLFP reaches a mere 19%. But other low- and middle-income countries also face low FLFP (e.g., in South Asia, FLFP only reaches 25%).

between the minimum wage impacts on the intensive and extensive margins is particularly salient. On the one hand, stark gender pay gaps and concentrated labor markets create an opportunity for minimum wage policies to boost female workers' incomes. On the other hand, the already low FLFP and the amplified search and matching frictions make any potential job loss among female workers especially detrimental.

Second, 65% of Morocco's non-agricultural workers are informally employed. The presence of a large informal sector, a common feature in many lower-income countries, implies that any labor market regulation will *de facto* pertain only to a segment of the workforce. When the minimum wage is raised, employers may be tempted to bypass the law by transitioning their workers to informal work arrangements within the firm (Ulyssea, 2018). Alternatively, they may terminate contracts, forcing workers into informal jobs, unemployment, or out of the workforce.[3] My survey evidence shows that informal jobs pay on average 34% less than formal jobs and, by definition, do not give access to any social security benefits (sick leave, maternity leave, health insurance, etc.). Evaluating the overall impact of minimum wage policy in settings featuring a large informal sector requires accounting for these potential substitution and spillover effects.

Between 2009 and 2015, Morocco raised its minimum wage five times, resulting in an overall increase of 24% (+39%) in real (nominal) terms. In 2008, 67% of female and 40% of male workers had a daily real wage below the 2015 minimum wage. As I show below, the policy reforms were binding as most firms comply with minimum wage policies. To study the impact of these policies, I use rich administrative data that exist on the Moroccan labor market. I rely on two main data sources. My primary data source is an administrative employer-employee match dataset that covers the universe of registered private formal firms and formal workers in Morocco. It allows for the tracking of formal workers and firms over time. I complement it with large-scale representative labor force surveys to examine potential substitution and spillover effects on the informal sector.

The analysis proceeds in three stages. First, I document the impact of minimum wage increases on wage growth and gender pay gaps. Second, I examine the impact on formal employment and potential displacement to the informal sector. Finally, I introduce a theoretical framework to analyze how factors such as the initial sorting of employees across firms, firm closures, and gender differences in outside options contribute to observed gender differences in minimum wage increase impacts.

As a first step, I examine the impact of increases in the Moroccan national minimum wage by comparing two sets of formal workers: those directly affected by these increases (initially earning less than the 2015 minimum wage in real terms) and those presumably not affected (initially earning significantly more, with initial wages 60% higher than the 2015 minimum wage). Following Dustmann et al. (2022), the outcome of interest is a two-year change[4] and this comparison is made across years of increases in the minimum wage relative to a reference period prior to any increase (2006 to 2008). This research design differs

[3]The degree of integration between formal and informal labor markets determines the magnitude of these substitution and spillover effects (Meghir, Narita and Robin, 2015).

[4]E.g. two-year wage growth or two-year probability to exit formal employment.

from earlier ones in that, for low- and high-wage workers, it compares wage growth and employment changes before and after minimum wage increases. This helps to account for the natural trend of low-wage workers experiencing higher wage growth and turnover, even in the absence of any policy change (Ashenfelter and Card, 1982). Under the assumptions of stable mean reversion patterns over time and constant macroeconomic time effects over the wage distribution, this approach yields causal estimates of the direct impact of minimum wage increases on incumbent formal workers.

I find that setting a higher minimum wage has a significant impact on boosting the incomes of low-wage manufacturing workers, particularly benefiting women who remain employed. In the manufacturing sector, the initial unadjusted gender pay gaps are wide. In 2008, low-wage female manufacturing workers earned 28% less than their male counterparts and experienced 5% lower two-year wage growth. I find that the changes in minimum wage significantly increase the wage growth of low-wage workers, relative to workers unaffected by these changes (those who were initially further up the wage distribution). This is true for both female and male low-wage workers, but women benefit more: their two-year wage growth increases, by 10 percentage points and 7 percentage points, respectively. This positive effect on wage growth extends beyond the wage bins directly targeted by the minimum wage. Post-increase levels of daily wage growth surpass pre-increase levels for wage bins up to 1.6 times the 2015 minimum wage.

I corroborate these findings with a labor market exposure strategy and show that the more exposed local labor markets experience a greater reduction in the gender pay gap than the less exposed ones. This reduction is mainly driven by workers at the bottom and middle of the wage distribution. As a result, the gender pay gap in the formal sector narrows, reducing from 28% to 22% during the period of increases in the national minimum wage.

However, following increases in the minimum wage, low-wage female workers are also more likely to transition from formal to informal work arrangements. To offset the costs associated with a higher minimum wage, employers may decide to reduce their workers' work hours or terminate their contracts. I first show that there is no increase in the probability of transitioning from full-time to half-time work contracts, suggesting limited employers' adjustment on the intensive margin. However, during the period of increases, low-wage female workers become on average 5 percentage points more likely to leave their firm, most of them exiting formal employment: 4 percentage point increase in the probability of no longer being formally employed two years later when the baseline average exit rate was 24% for women and 23% for men. This is true only for low-wage female workers, the effect being small and insignificant for men. Using labor force surveys, I compare more vs. less exposed local labor markets and show that female workers pushed out of formal employment mostly transition to informal work arrangements. Taking into account the exit of female workers from formal employment reduces the positive impact of minimum wage increases on narrowing the gender pay gap. However, the positive effects on wage growth for middle-wage bin workers remain significant for female workers, even under the most conservative assumptions on earnings after exiting the formal sector.

To make sense of these differential gender impacts on wage growth and exit, I introduce a framework

of oligopsonistic labor markets with firms that differ in productivity and workers who are heterogeneous in their elasticity of substitution between firms (Felix, 2021; Berger, Herkenhoff and Mongey, 2022*a*; Sharma, 2023; Berger, Herkenhoff and Mongey, 2022*b*). Incorporating these two dimensions of heterogeneity into the textbook monopsony model helps explain how female and male workers are initially sorted into firms and the resulting gender differences in monopsony power. It also allows me to characterize how the differential exposure of firms to the national minimum wage increases, as well as how firms' strategic interactions within local labor markets may lead to differential impacts on female and male workers. The first implication of this model is that small and less productive firms are more likely to be exposed to minimum wage increases and, as a result, exit the market. If women are more likely to work in these firms, they will be disproportionately displaced. Therefore, the initial sorting of female and male workers across firms plays a key role.

The strategic interactions of firms within local labor markets also imply that unconstrained firms might increase both employment and wages in response to minimum wage increases. The combination of minimum wage increases reducing employment at smaller firms and expanding employment at bigger firms may then lead to efficiency gains, with a fraction of workers reallocating from less to more productive firms. This also implies that whether the reduction or the expansion of employment dominates depends on firms' initial characteristics within local labor markets. As a result, we expect displaced workers to have different abilities to cope with having to leave their firm based on the set of outside options they face.

To test these predictions, I rely on the individual exposure approach previously introduced and additionally exploit variation in firms' exposure to minimum wage increases. I consider a continuous measure of firms' initial exposure that reflects, during the pre-increase period (2006 to 2008), the average wage growth that would be necessary to bring all workers in the firm up to the post-increase period minimum wage (set in 2015). Then, I compare the evolution of outcomes for workers and firms more versus less exposed to increases in the national minimum wage (similar to Harasztosi and Lindner (2019)).

I show that firms with greater initial exposure to the minimum wage increases are indeed more likely to exit the labor market. As these firms tend to employ a higher proportion of female workers, firm exit explains a significant share (40%) of the excess exit from formal employment that is only observed for female workers.

Consistent with more productive firms absorbing some of the displaced workers, I show that after increases in the minimum wage, low-wage workers who remain employed are more likely to transition to a firm with a higher median wage. The effect is more pronounced for women: the two-year transition rate increases by 4.5 percentage points for female low-wage workers and by 2.7 percentage points for their male counterparts.

To assess potential heterogeneity in the ability to reallocate within the formal sector, I introduce an outside option index (similar to Caldwell and Danieli (2022); Schubert, Stansbury and Taska (2022)). I document that female formal manufacturing workers initially have lower mobility across sectors and provinces. As a result, their outside options are more limited, although there is significant variation between

local labor markets. Using this index, I show that the exit from formal employment is higher when female workers have a reduced set of outside options.

Finally, I examine the implications for the dynamics of local labor markets. Conditional on staying formally employed, I show that women are significantly more likely to transition to the largest employers *within* their local labor market. Within a local labor market, the combination of less productive firms closing and the reallocation of workers to larger employers can result in higher employment concentration. To test this prediction, I use a difference-in-differences design to compare the evolution of the Herfindahl-Hirschman index in more vs. less exposed local labor markets (similar to Card (1992)). The documented effect supports this hypothesis: by the end of the minimum wage increases, female workers in more exposed local labor markets face significantly higher employment concentration, while there are no detectable changes for men.

The contribution of this paper is threefold. First, I provide novel evidence using comprehensive administrative data on the impact of minimum wage policies on gender gaps in a lower middle-income country. Previous evidence from high-income countries suggests that minimum wage policies can help reduce gender wage disparities for low-wage workers and have spillover effects in higher parts of the wage distribution (Autor, Manning and Smith, 2016; Caliendo and Wittbrodt, 2022; Blau et al., 2023).[5] However, little is known in contexts where informality is high, the gender wage gap is wide, and female labor force participation is low.

The approach developed in this paper advances this literature by combining rich data on formal sector employees and representative labor force surveys[6] to present rigorous empirical evidence on this question (Lemos, Rigobon and Lang, 2004; Bosch and Manacorda, 2010; Magruder, 2013; Jales, 2018). It complements insights from Brazil (Engbom and Moser, 2022; Derenoncourt et al., 2021) by focusing on a country with a significantly lower GDP per capita, weaker other wage-setting institutions, and a larger informal sector.[7] In the Brazilian context, the minimum wage does not have any detectable effect on pushing workers to the informal sector. In the Moroccan context, I document a significantly higher transition rate from the formal to the informal sector for directly impacted female workers. This is also due to the greater constraints women face in the labor market. Despite this negative impact on employment,

[5] In the US, Autor, Manning and Smith (2016) find that the erosion of the minimum wage affected lower-tail inequality up to the twenty-fifth percentile for women, while it does so only up to the tenth percentile for men. Blau et al. (2023) bring additional event study estimates that corroborate the role of minimum wage policies in reducing the inequality of pay between groups. In Germany, Caliendo and Wittbrodt (2022) study the introduction of a minimum wage in 2015 and show it reduces gender wage disparities for low-wage workers and has spillover effects in higher parts of the wage distribution.

[6] This type of data is rarely available in low and middle-income countries. As discussed in the meta-analysis of Neumark and Corella (2021), the evidence on the impact of minimum wage policies on employment in developing countries is mixed and often limited by the availability of data. In their review of evidence in developing countries, Broecke, Forti and Vandeweyer (2017) also underlined that some papers may not document an overall effect on employment because they cannot distinguish between the formal and informal sectors. In these cases, no disemployment effects can still be consistent with a fall in formal sector employment that is compensated by a rise in informal sector employment.

[7] In 2008, the GDP per capita in Brazil was $8,801 when it was only $ 3,180 in Morocco (World Bank national accounts data). In 2008, the share of informal workers was estimated at 50% while it was closer to 65% in Morocco when excluding agricultural workers (ILOSTAT).

my detailed investigation provides supporting evidence that minimum wage policies may be an effective lever to reduce gender pay gaps, due in part to the significant spillover effects on wage growth that benefit workers higher up in the wage distribution.

Second, this paper provides new empirical evidence on the efficiency and redistributive channels of minimum wage policies by examining the impact on workers' reallocation and local labor market dynamics (Berger, Herkenhoff and Mongey, 2022*a*,*b*). In Germany, Dustmann et al. (2022) provide recent evidence of positive reallocation effects of minimum wage policies, with low-wage workers becoming more likely to transition to "better" [8] firms after the introduction of the German national minimum wage. In the Moroccan context, I show that this positive reallocation pattern also exists for men and women who remain employed. The effect is more pronounced for women, suggesting that the initial allocation of workers to firms was likely more inefficient for female workers.

Third, this paper contributes to the growing literature documenting how *de-jure* gender-neutral policies or labor market shocks can have different welfare implications for female and male workers when gender differences in labor market opportunities are stark (Antecol, Bedard and Stearns, 2018; Biasi and Sarsons, 2021; Carry, 2022).[9] The paper also relates to the recent literature that focuses on the implications of women having more limited outside options than men in the labor market (Caldwell and Danieli, 2022; Sharma, 2023; Coviello, Deserranno and Persico, 2023). Coviello, Deserranno and Persico (2023) is especially relevant, as they examine gender differences in minimum wage impacts focusing on a multinational US company and workers' effort.[10] I aim to take a more holistic approach, measuring impacts across firms and local labor markets, in a context with more conservative gender norms and higher barriers to female work.

The remainder of this paper is organized as follows. Section 2 presents the Moroccan labor market context, minimum wage legislation, and other wage-setting institutions. Section 3 presents the data and the empirical strategies. Section 4 discusses the results associated with the impact of minimum wage increases on wages and gender pay gaps. Section 5 examines whether the minimum wage causes displacement from the formal sector and documents the effects on entry and reallocation. Section 6 documents the underlying features of the local labor markets that help explain the differential gender impacts. Section 7 concludes.

[8] In their context, "better" corresponds to different metrics including firms paying a higher average daily wage, larger and more stable firms, and more productive firms.

[9] Antecol (2000) finds that gender-neutral tenure policies in high-skilled professions widen gender gaps in tenure. Biasi and Sarsons (2021) show that increased wage flexibility disproportionately favors men due to their better negotiation skills. Focusing on the French context, Carry (2022) shows that the enforcement of a legal minimum on working hours benefits men more than women, mainly due to the change from part-time to full-time workers.

[10] Coviello, Deserranno and Persico (2023) show that women working in this multinational company respond to an increase in the minimum wage by working harder compared to men if and only if their outside option is worse.

2 Labor market context and minimum wage laws

2.1 The Moroccan labor market

Morocco is a lower middle-income country with a GDP per capita of $3,493 in 2018. [11] Over the past two decades, Morocco's relatively stable growth has been accompanied by low job creation. The Moroccan labor market conditions remain characterized by high informality, low job quality, and higher barriers for certain groups such as youth and women (Lopez-Acevedo et al., 2021). In this section, I briefly present recent trends in educational attainment, labor force participation, and formal and informal labor market dynamics. I discuss gender gaps along each of these dimensions.

Education attainment. Educational attainment has improved rapidly in Morocco, but most of the current workforce is still poorly educated. In 2021, the average length of schooling was 5.7 years; 6.6 years for men and 5.0 years for women. If prevailing patterns of age-specific enrollment rates persist, the current number of years of schooling that a child of school entrance age can expect to receive is 13.9 years for female children and 14.4 for male children (UNDP, 2022).

The gap in educational attainment between genders has also been narrowing in recent decades, as shown in Table B.1. According to the Ministry of Education, in both 2007 and 2017, there was an almost equal share of women and men among higher education graduates: 50.6% of the graduates were women (see Table B.2). There also does not seem to be a strong field-of-study segregation by gender. For example, women are well represented in engineering and scientific fields.

Labor force participation. Despite these advances in the educational attainment of women, female labor force participation (FLFP) remains low in Morocco. The Moroccan FLFP rate, measured as the percentage of women in the working-age population who are employed or actively seeking employment in the labor force, was only 22% in 2019. Compared to other regions of the world, the Middle East and North Africa (MENA) region generally has lower female labor force participation rates (see Figure A.1), and the FLFP of Morocco is close to the regional average (Figure A.3).

However, Morocco is one of the few MENA countries where FLFP has been declining since 2005. In contrast, despite some slight decline, the male labor force participation rate remains above 70% in both urban and rural areas. Figure A.2 also shows that the gender gap in labor force participation remains significant for all age groups.

Even when part of the labor force, women tend to face a higher unemployment rate. In 2019, the unemployment rate for women in urban areas reached 21.8% while it was only 10.3% for men (HCP, 2019).

[11] The GDP per capita was $3,180 in 2008, with a yearly growth ranging from 2.5% to 6% over this decade.

Legal restrictions to female work. Various factors may contribute to these gender disparities in labor force participation, including cultural and gender norm barriers (Antecol, 2000, 2001; Field, Jayachandran and Pande, 2010; Jayachandran, 2021) or more structural challenges, such as lack of childcare support or inadequacy of transport means (Martínez and Perticará, 2017; Martinez et al., 2020; Field and Vyborny, 2022). To give a sense of how these two types of factors may play in the Moroccan context, I look at two types of indicators.

Figure A.3 plots how the gender gap in labor market participation correlates with the Women, Business, and the Law (WBL) index. The WBL index evaluates 190 economies by looking at how laws impact women's work. It relies on 35 questions across eight categories and calculates an overall score out of 100. For Morocco, the score is significantly higher than the average of the MENA region, suggesting that the *de-jure* barriers to female work tend to be weaker than in other MENA countries. Figure A.4 reports the national average of perceived issues of women entering the workforce. When given the options between cultural and structural barriers, Moroccan respondents are significantly more likely to report structural challenges (lack of childcare or lack of transportation) than social norms as the greatest barrier to participation in the female labor force.

Formal and informal labor markets. As most low- and middle-income countries, Morocco is characterized by a large informal sector. Under Moroccan law, employers must register with the national social security system, the *Caisse Nationale de Securité Sociale* (CNSS), within 30 days following the hiring of their first employee. Subsequent to this registration, employers must consistently report to the CNSS on a monthly basis, documenting the days worked and wages earned for each employee.

Founded in 1959, the *Caisse Nationale de Securité Sociale* operates as the public agency charged with administering the compulsory social security scheme for Morocco's private sector workforce. It has two main missions: (i) collecting contributions from all private-sector employers based on their monthly declarations; (ii) managing the disbursement of benefits to employees who are officially registered.

From the perspective of a formal worker, being formally declared to the CNSS gives access to four types of benefit:

1. *Short-term benefits.* maternity leaves (fully covered by social security and not by employers); sick leave; unemployment benefits; death benefits.
2. *Pensions*: old age pensions; survivors pensions; disability benefits.
3. *Family benefits*: flat amounts based on the number of children and paid to one of the two parents.
4. *Health Insurance (AMO):* Basic health insurance for the affiliate worker and her dependents.

I define workers as *formal* when their employer declares them to the CNSS. By contrast, I define *informal* workers as unregistered employees, i.e., those not covered by the CNSS pooled together with the self-employed and entrepreneurs who did not register their businesses.

Based on these definitions, a high share of non-agricultural private sector jobs are informal (62% in 2019). Table A.1 shows that the prevalence of informality varies by sector and gender. On average, 72%

of women in the private sector and 74% of men are informal. However, these aggregate rates hide quite substantial heterogeneity. For example, women are less likely than men to be informal workers in market services (66% vs. 77%) while the reverse is true for non-market services (21% vs. 9%).

In Morocco, as in other developing settings, two margins of informality coexist (Ulyssea (2018)). First, the classical *extensive margin* captures whether firms register and pay entry fees to achieve formal status. This includes informal self-employed workers or businesses operating on a low scale. By contrast, the *intensive margin* of informality includes workers in "extensively formal" firms who are hired "off the books", that is, their employers do not pay social contributions on their wages, which implies that these workers do not have access to any social security coverage.

Table A.2 shows that female workers are more likely to work in smaller firms (Columns (3) and (5)) and that workers are more likely to be informal in smaller firms. However, 10% of the workforce still has an informal work arrangement in firms with more than 50 employees. As it is unlikely that firms of this size can operate informally, this suggests that the intensive margin of informality is non-negligible in the Moroccan context.

In terms of work conditions, beyond not giving access to social security benefits, informal jobs also tend to be of lower quality. There are no significant differences in the number of hours worked in the formal vs. informal sectors for women (40h/week on average in 2019), while informal male workers tend to work a bit more than formal workers (51h/week vs. 45h/week). However, Table A.3 and Figure A.5 show that there is a wage penalty associated with working in the informal sector. On average, informal workers earn 36% less than formal workers, even when controlling for sector-fixed effects and demographics.

2.2 Minimum wage legislation and increases

Legislation. The Moroccan minimum wage – *Salaire Minimum Interprofessionnel Garanti* (SMIG) – is set nationally. It has been in effect since June 1936. [12] Since its inception, its scope and rates have evolved. The last differentiation by region was abolished in 1971, by gender in 1975, and by age in 2004. Since 2005, it has covered all formal private sector employees of all regions, age, industries, and occupations.[13] Based on the hourly minimum wage, the monthly minimum wage is set at 191 times the hourly rate and the daily minimum wage at 7.33 times the hourly rate.

The minimum wage rate is set by government decrees after tripartite negotiations between representatives of the government, the trade unions, and the employers.[14] These negotiations usually happen in April or May for an increase in minimum wages that will come into effect on July, 1st of the same year. As a result, there is little room for anticipation.

[12] *Dahir du 18 juin 1936*, under the supervision of the French Protectorate of Morocco.

[13] Workers in the agricultural sector are subject to a specific regime, the SMAG (minimum agricultural wage). Another (higher) minimum wage is in place in the public sector.

[14] The composition and attributions of this commission were set in the *Dahir of October 31, 1959*.

Minimum wage increases between 2009 and 2015. Figure 1 shows the evolution of the nominal and real minimum wage between 2005 and 2019. This evolution can be characterized by three distinct periods. First, between 2005 to 2008, there is a *pre-period* with no real change in the minimum wage. The gray area in Figure 1 corresponds to a *period of rapid increases* in the minimum wage with a total increase of 24% (+39%) in real (nominal) terms between 2009 and 2015. Finally, between 2016 and 2018, there is a*post-period* with no change in the nominal minimum wage.

Enforcement. In the law, it is stipulated that *"failure to pay wages above the legal minimum wage [..] results in a fine of 300 to 500 MAD per non-compliant employee and per period of non-compliance"*. This represents a significant amount, 3 to 5 times the daily minimum wage in 2016.

Three different control and inspection services are in charge of ensuring that the tax and labor code are enforced. There is little coordination between them and no systematic use of administrative data for targeting controls. The Ministry of Labor's inspection services and Social Security's audit unit enforce the labor code via random firms' audits. Appendix C.2 provides more details and describes the functioning and capacity of these audit services.

Binding changes in the minimum wage. Figure 2 shows, in Moroccan Dirhams (MAD) of 2016, the distribution of the real daily wage in 2008 and 2016; the year before the first increase in the national minimum wage and the year following the last increase, in July 2015. Horizontal bars correspond to the prevailing minimum wage in 2008 (yellow bar) and in 2016 (dark green bar). It shows that, although enforcement is not perfect, in 2016, less than 6% of workers have a daily wage below the minimum wage and there is significant bunching just above the minimum wage introduced in 2015. Figure 3 provides additional insights on the bite and enforcement of the five changes in the national minimum wage. It plots the share of workers that are below the new minimum wage level by gender. We see that the changes affect a large share of the formal private sector employees. For example, in 2011, 25% of women are below the 2012 minimum wage (closer to 20% for men).

2.3 Other Moroccan wage-setting institutions

Labor Code of 2004. In 2003, both houses of the Moroccan Parliament approved a new Labor Code that went into effect in June 2004. The Labor Code was designed to align with ratified international labor conventions and guarantee fundamental workers' rights. In particular, it included:

- the effective enforcement of the right to unionize and participate in collective bargaining;
- the prohibition of discrimination with respect to race, color, sex, disability, marital status, religion, political opinion, union membership, national or social origin;
- the prohibition of all forms of forced labor and the elimination of child labor;

- the guarantee of decent terms of work and wages, including minimum wage; minimum age for employment; maternity protection; hours of work and overtime; paid annual and holiday leave; policies for special categories of workers; and occupational safety and health protection;
- the institution of labor inspection services as well as conciliation and arbitration services to settle collective labor disputes.

Low union affiliation. Despite unionization rights being guaranteed by the 2004 Labor Code, the vast majority of employed workers (95.3%) are not affiliated with any trade union or professional organization: 92.5% in urban areas and 99% in rural areas.[15] There are no significant gender differences: the affiliation rate is 4.7% for male workers and 4.9% for female workers.

Collective agreements. The 2004 Labor Code provides a legal and institutional framework for collective bargaining. However, as shown in Table C.3, the number of agreements signed within this framework remains low. Moreover, none of these agreements stipulates a floor wage above the national minimum wage. Some of them do mention pay scales based on the minimum wage, which would then be adjusted following an increase in the minimum wage.

3 Empirical strategy

3.1 Data

Exhaustive employer-employee panel dataset. My primary data source is a matched employer-employee panel dataset that covers all private-sector formal workers from 2005 to 2018. Each month, formal employers are required to declare their workers to the Moroccan Social Security Institution (CNSS). The information is then used to determine the amount of social security contributions payable by the employer. These monthly declarations include, for each worker, the number of days she worked in the firm and her associated monthly wage. They contain identifiers for workers and firms, which allows for the tracking of these two entities over the observation period.

Before anonymization, the data was aggregated at the annual level. For a formal worker employed in a given firm and in a given year, the data indicates the number of days she has been working in this firm and the total associated gross wage. Thus, my main wage indicator is the average daily wage of worker i when employed in firm j in year t, w_{ijt}. This yearly dataset also includes basic information on firms (location, sector of activity, legal status, date of creation, and date of registration as a formal firm) and on workers (gender, nationality, and age).

Figure D.1 plots the evolution of the number of workers across years and sectors of activity. More details on the data collection process can be found in the Appendix D.1.

[15] See *Note d'information du Haut-commissariat au Plan sur les principales caractéristiques de la population active occupée en 2019.*

National labor force surveys. To capture labor market dynamics beyond the formal labor market, the analysis also relies on a nationally representative household survey: the National Labor Force Surveys (*Enquête nationale sur l'emploi*, ENE) administered by the Moroccan Higher Planning Commission (*Haut-Comissariat au Plan*, HCP). It is a nationally representative survey of 60,000 households per year and covers all individuals, regardless of labor market status, in these households. It is a repeated cross-section between 2006 and 2016. Each year, half of the sample is resurveyed the following year. This longitudinal dimension is key to analyzing labor market transitions. Appendix D.2 discusses in more detail the sampling methodology and the exact wording of the questions used to build informality proxies. For the purposes of this analysis, I have access to the years 2007, 2008, and 2010 to 2016.

Additional household surveys. For additional descriptive statistics, I also exploit a panel of household surveys collected by another Moroccan institution, the *Observatoire National du Développement Humain* (ONDH), in 2017, 2019, and 2022. For the 2022 wave, I collaborated with the ONDH to develop the survey questionnaire. This collaboration was instrumental since the prior datasets lacked information on informal wages. Hence, a key focus of the 2022 survey was to gather comprehensive data on both formal and informal wages, alongside insights into the nature of employment arrangements.

I also use the Moroccan Census of 2014 collected by the *Haut Commissariat au Plan* (HCP). The publicly available version of this individual-level census only includes a 10% random sample of individuals.

Minimum wage database. I compile the changes in the national minimum wage from 2005 to 2022 using information published by the General Secretary of the Moroccan Kingdom (*Secrétariat Général du Gouvernement du Royaume du Maroc*).[16] The database contains, for each increase in minimum wage, its publication date, its application date, and references to the associated legislative texts.

3.2 Individual exposure approach

The first empirical specification focuses on incumbent workers and builds on Dustmann et al. (2022). The goal is to consider low-wage incumbent workers during years of minimum wage increases and to propose a counterfactual of what would have happened to them in the absence of an increase in the minimum wage. The proposed approach consists of comparing wage and employment changes for workers grouped by their initial wage levels. By workers' initial wage bins, I then analyze wage and employment changes in periods of increases in the minimum wage, always taking as reference changes in the period before any increase in the minimum wage (in this case, changes between 2006 and 2008).

Initial wage bins. For any given year between 2005 to 2016, I assign workers to one of the 44 wage bins that correspond to their real daily wage thin year. I consider all wages in real terms (taking 2016 as the

[16] See http://www.sgg.gov.ma/BulletinOfficiel.aspx.

base year) in steps of 5 MAD ($0.49). The first wage bin I consider, $k = 1$, corresponds to having a real daily wage between $b_0 = 80$ and $b_1 = 85$ MAD; the second wage bin, $k = 2$, is then $[b_1 = 85; b_2 = 90[$... until the last wage bin, $k = B$, defined as $[b_{B-1} = 295; b_B = 300[$. For the sake of clarity, when plotting results, I show workers with initial earnings between 80 and 220 MAD.

Outcomes as two-year changes. After assigning wage bins in years $t-2$, I examine the changes over a two-year window, i.e., between years $t-2$ and t. Indeed, all changes in the minimum wage occurred in July, and the data I have access to only measures a yearly average of daily wages.[17] It seems natural to consider the year before the increase in the minimum wage to assign the initial wage bin and to examine the changes between this initial year and the year after the increase. In what follows, I will denote the change between two years $\Delta y_{i,t}$. For all continuous outcomes, the outcome of interest corresponds to the two-year growth:

$$\Delta y_{i,t} = \frac{y_{i,t} - y_{i,t-2}}{y_{i,t-2}}$$

When examining labor market transition from state A (e.g. from formal employment) to state B (e.g. to out of formal employment), I consider the following dummy:

$$\Delta y_{i,t} = \mathbb{1}\{\text{worker } i \text{ is in state B in year } t | \text{worker } i \text{ is in state A in year } t-2\}$$

Conditional average by wage bins and gender. For transparency, I start by plotting the conditional yearly averages by wage bins:

$$\Delta y_{i,t} = \sum_{k=1}^{B} \sum_{\delta=2007}^{2018} 1\left[b_{k-1} < w_{i,t-2} \leq b_k\right] \times 1\left[t = \delta\right] \times \gamma_{k\delta} + \alpha X_{i,t-2} + \varepsilon_{it} \tag{1}$$

where $\forall k,\ 1\left[b_{k-1} < w_{it-2} \leq b_k\right]$ are the dummy variables corresponding to each 5-MAD width wage bin k, ranging from 80 to 300 MAD. In this specification, $X_{i,t-2}$ is a set of individual controls in year $t-2$ that include age, sex, tenure in the formal sector, a dummy for full-time status, and local labor market (LLM) fixed effects (where LLMs are defined as the province X sector cells).

This specification simply computes the average change in outcome for each worker's initial wage bin and for each year, conditional on individual baseline characteristics. I run this specification for all workers and by gender.

First difference comparing changes in outcome in the period of minimum wage increases (2009-15) to changes in outcome in the pre-policy period (2006-08). This specification aims to take into account that low-wage workers tend to have higher wage growth and separation rates than workers higher up in the wage distribution. To this end, I consider, by wage bin, the excess change compared to the pre-increase two-year change (between 2006 and 2008):

[17] Specifically, it doesn't contain an exact date for the end or beginning of an employment spell.

$$\Delta y_{i,t} = \sum_{k=1}^{B} \sum_{\delta=2007\neq 2008}^{2018} 1\left[b_{k-1} < w_{i,t-2} \leq b_k\right] \times 1\left[t=\delta\right] \times \beta_{k\delta} + \sum_{k=1}^{B} 1\left[b_{k-1} < w_{i,t-2} \leq b_k\right] \times b_k + \alpha X_{i,t-2} + \varepsilon_{it} \quad (2)$$

This specification captures the causal effect of the minimum wage increases on the change in outcome under the assumption that mean reversion and macroeconomic time effects are stable over time. The coefficient of interest, $\beta_{k\delta}$, can be interpreted as the excess change in outcome between year $\delta - 2$ and δ for the wage bin k relative to the change in outcome in the pre-policy period (2006 to 2008), controlling for individual workers' characteristics in year $t-2$.

Relying on this specification provides a transparent way to detect changes in wage growth and employment transitions across the wage distribution. However, to discuss coefficients across years and different outcomes, I also report estimates based on more aggregated wage bins, distinguishing between: (i) workers affected by the minimum wage increases (workers with an initial wage between 80 and 100 MAD); (ii) workers just above the last enforced minimum wage so that might benefit from spillover effects (workers with an initial wage between 100 and 160 MAD); and (iii) workers significantly higher up in the wage distribution and thus likely to be unaffected by the minimum wage increases (workers with an initial wage between 160 and 300 MAD):

$$\Delta y_{i,t} = \sum_{\gamma\in\{\text{bot, mid, upper}\}} \sum_{\delta=2007\neq 2008}^{2018} 1\left[w_{i,t-2} \in \gamma\right] \times 1\left[t=\delta\right] \times \beta_{\gamma\delta} + \sum_{\gamma\in\{\text{bot, mid, upper}\}} 1\left[w_{i,t-2} \in \gamma\right] \times b_\gamma + \alpha X_{i,t-2} + \varepsilon_{it} \quad (3)$$

Second difference comparing "high-wage" workers to "low-wage" workers. The last and main specification controls for potential changes in the macroeconomic environment between the periods with and without increases in the minimum wage:

$$\Delta y_{i,t} = \sum_{\gamma\in\{\text{bot, mid}\}} \sum_{\delta=2007\neq 2008}^{2018} 1\left[w_{i,t-2} \in g\right] \times 1\left[t=\delta\right] \times \beta_{\gamma\delta|\text{upper}} + \sum_{\gamma\in\{\text{bot, mid, upper}\}} 1\left[w_{i,t-2} \in \gamma\right] \times b_\gamma + \psi_t + \alpha X_{i,t-2} + \varepsilon_{it} \quad (4)$$

This specification captures the causal effect of the minimum wage on the excess change in outcome under the assumption that mean reversion is stable over time and macroeconomic effects are stable over the wage distribution. The coefficient of interest, $\beta_{\gamma\delta|\text{upper}}$, can thus be interpreted as the difference in wage growth (or exit from firms) in the periods corresponding to increases in the minimum wage relative to the reference period before any increase (2006 to 2008) between high-wage and low-wage workers.

In summary, the main specification focuses on incumbent workers. It compares excess changes (i) for workers affected by the change (workers with an initial wage between 80 and 100 MAD) and workers not affected (workers with an initial wage between 160 and 300 MAD) and (ii) in years with vs. without a minimum wage increase (with changes between 2006 and 2008 considered the reference period).

3.3 Firm exposure approach

To document the effects of minimum wage increases on firms and identify the role that manufacturing firms play in shaping the impacts on employment and wages, I exploit variation in firms' exposure to the increases in the national minimum wage. I then examine the evolution of key outcome variables for firms that need to make sizeable adjustments to their workers' wages compared to firms with fewer affected workers.

Firms' exposure to the minimum wage increases. To define firms' exposure, I consider the following continuous measure:

$$\text{Exp}_j = \sum_{t=2006}^{2008} \text{Exp}_{jt} \quad \text{with} \quad \text{Exp}_{jt} = \frac{\sum_{i \in j} d_{it} \max\{0, MW - w_{it}\}}{\sum_{i \in j} d_{it} w_{it}} \tag{5}$$

where d_{it} is the number of days worker i worked in firm j in year t; w_{it} is her associated daily wage; and MW is the highest minimum wage level that I am considering (2015). This measure can be interpreted as the percent wage increase necessary to bring all workers in the firm up to the post-increase period minimum wage.

As a robustness check, I also consider an alternative measure for each firm j:

$$\text{Exp}_j = \sum_{t=2006}^{2008} Exp_{jt} \quad \text{with} \quad \text{Exp}_{jt} = \frac{\sum_{i \in j} 1\{MW > w_{it}\}}{N_{jt}} \tag{6}$$

where N_{jt} is the number of workers i that worked in firm j in year t. This continuous measure corresponds to the share of workers initially below the minimum wage.

Main specification. I then closely follow Harasztosi and Lindner (2019) and estimate the following difference-in-differences specification at the firm level:

$$\mathbb{Y}_{jt} = \frac{y_{jt} - y_{j2008}}{y_{j2008}} = \gamma_j + \lambda_t + \sum_{\tau \neq y_{pre}} \beta_\tau \text{Exp}_j + \varepsilon_{jpt} \tag{7}$$

where the left-hand side is the percentage change in outcome y of firm j between 2008 (i.e., the year before minimum wage increases) and year t; γ_j are firm fixed effects; and λ_t are year fixed effects. The regressions are weighted by firms' initial employment, averaged over 2006 to 2008, the pre-increase period. Standard errors are clustered at the local labor market level.

The key identifying assumption underpinning this difference-in-differences regression posits that changes in firms with fewer minimum wage workers offer a reliable counterfactual of what would have happened, in the absence of increases, in firms with a significant share of their workforce affected by the minimum wage increases. While it is not possible to directly verify this assumption, I provide supportive

evidence for the validity of the parallel trends assumption before the minimum wage raises. Encouragingly, for most outcomes, I cannot reject the presence of differential trends.

3.4 Local labor market approach

A limitation of the previous approach is that it restricts the analysis to incumbent workers or firms. To provide complementary evidence of the impacts on entry and exit in the labor force, I also exploit heterogeneity in local labor markets' exposure to minimum wage increases. This approach allows me, for instance, to assess whether the minimum wage increases reduced the hiring of unemployed workers or, instead, resulted in more workers joining the labor market because of improved formal labor market opportunities. With this approach, I can also assess impacts on outcomes that are defined beyond the firm or individual levels, such as the evolution of quantiles, gender gaps, or local labor concentration.

Local labor markets. I define *local labor markets* (LLMs) as province X manufacturing sector cells. I consider the 2018 province definition and, for sectors, I rely on the ISIC Rev. 4 classification at the two-digit level. [18]

Tables A.5 and A.6 provide descriptive statistics on these 269 LLMs in 2008. On average, a local labor market has 1,700 workers. In this pre-policy period, conditional on switching jobs, Moroccan manufacturing workers, particularly women, tended to stay within their province and manufacturing subsector. As a result, the share of workers who left their local labor markets between 2007 and 2008 remains low: 3.2% for female workers and 6% for male workers.

Depending on the type of analysis and information available, I also define LLMs using only geography. For example, for the analysis that relies on data from labor force surveys, I define LLMs at the regional level ($N = 21$ regions) since the province identifier was not included in the data. [19]

LLM exposure. To characterize local labor markets' exposure to the increases in the national minimum wage, I consider the following continuous measure for each LLM l:

$$\text{Exp}_l = \frac{1}{3}\sum_{t=2006}^{2008} \text{Exp}_{lt} \quad \text{with} \quad \text{Exp}_{lt} = \frac{\sum_{i \in l} 1\{MW > w_{it}\}}{\sum_{i \in l} 1} \tag{8}$$

where MW is the minimum wage in 2015; w_{it} is worker i's daily wage in year t; and $1\{MW > w_{it}\}$ is an indicator for whether worker i's wage in year t was less than the 2015 minimum wage.

[18] ISIC is a standard classification of economic activities as defined by the International Labour Organization. For more details, see: https://ilostat.ilo.org/resources/concepts-and-definitions/classification-economic-activities/?.

[19] Between 1997 and 2015, Morocco was officially divided into 16 regions, and, since 2015, into only 12. The 21 regions I consider are the intersections of these two administrative divisions. They are the only geographical identifiers that exist in both the labor force survey and the employer-employee dataset covering formal workers.

This continuous exposure measure corresponds to the average share of workers within an LLM that is initially below the 2015 minimum wage. To facilitate the interpretation of the results, I also report estimates when using as the exposure variable a dummy dividing LLMs into "more" vs. "less" exposed (corresponding to a median split of the continuous measure).

Main specification. I then use this exposure measure in a difference-in-differences specification. In particular, at the local labor market level, I run:

$$\mathbb{Y}_{lt} = \gamma_l + \lambda_t + \sum_{\tau \neq 2008} \beta_\tau \text{Exp}_l \times \delta_\tau + \varepsilon_{lt} \tag{9}$$

where γ_l are LLM fixed effects; λ_t are year fixed effects. All regressions are weighted by the average number of workers in each LLM in the pre-increase period (2006 to 2008). Standard errors are clustered at the LLM level.

In this regression, the coefficient of interest is β_τ, which corresponds to the average difference in outcome $\mathbb{Y}_{lt}$ between more and less exposed LLMs. Under the classical parallel trends assumption, namely, that absent changes in the minimum wage the outcomes of these two groups of LLMs would have evolved in parallel, β_τ has a causal interpretation. For all the reported outcomes, I provide supportive graphical evidence that this parallel trends assumption is likely to hold. In fact, before the increases in the national minimum wage, more and less exposed local labor markets exhibited similar trends. Note that another important assumption for this empirical design to be valid is that there are no geographic spillovers. As mentioned above, the transition rate from one local labor market to another is quite low for workers at different levels of the wage distribution and both genders, providing some reassurance that spillover effects are limited.

3.5 Sample of interest

Sample restrictions. The main sample of analysis is restricted to male and female workers between the ages of 20 and 59. The yearly datasets allow me to reconstruct each worker X firm employment spell in a given year. I drop spells less than a month long. When spells are overlapping (e.g. a worker worked for multiple firms at once), I keep the highest paid among all longest employment spells.

Figure B.2 presents the number of formal workers by firm sector of activity and workers' gender. It shows that, in Morocco, manufacturing is the main formal sector all the subsequent analysis is restricted to this sector. Women account for more than 45% of the formal manufacturing workers but are also represented in non-market services (education, healthcare workers, and social services). Figure B.3 plots the median wages of formal workers in 2008 and 2016 by sector. It shows that there is a significant gender wage gap, in particular, in the manufacturing sector where it was 28% in 2008.

Summary statistics of workers. The sample of analysis is described in Table 1 and contains wage observations from 2005 to 2018. It contains more than 6 million worker-year observations for the manufacturing sector, corresponding to over 1 million unique workers and 16k unique firms. Around 45% of these observations relate to female workers.

Table A.7 provides additional descriptive evidence on the minimum wage workers. Compared to workers who earn more than 160 MAD, workers who earned below the 2015 minimum wage in 2008 are more likely to be women, are younger, and have less stable jobs. Indeed, they are more likely to not be working full-time and to switch firms between years. While most manufacturing employment is concentrated in firms with more than 50 employees, minimum wage workers tend to be over-represented in small firms.

Labor market mobility and frictions. Table A.6 shows that, within the formal sector, transition patterns across firms differ by gender: conditional on switching firms, women are 15 percentage points more likely than men to stay in the same province, and 25 percentage points more likely to transition to a firm within the same manufacturing sector.

Figure A.6 shows, for the years 2009 to 2010, the transition matrix between different labor market statuses. Each row corresponds to an initial status in year $t-1$ (here, 2010). The columns correspond to the employment status in year t. In each cell, the reported figure corresponds to the percentage of individuals transitioning to the status indicated in the column conditional on their row status. It indicates that, when exiting the formal labor market, women are more likely to fully exit the labor market (62%) while male workers tend to transition to informal work arrangements (77%). On average, 18.5% of women and 3.3% of men who were initially formally employed transition out of the labor force the following year.

4 Impact on wages and gender pay gap

Impact on wage growth. Figure 4 plots the two-year real daily wage growth by wage bins, separately when considering excess wage growth between 2013 and 2015 and between 2014 and 2016 relative to baseline wage growth between 2006 and 2008. This corresponds to plotting, for each worker's initial wage bin, the coefficient $\beta_{\delta t}$ of Equation (2). This figure highlights that the minimum wage policy raises daily wages for both female and male low-wage workers: the wage growth in lower-wage bins is significantly larger than in the pre-increase period. This positive effect on wage growth is still significant for workers not directly targeted by the policy, although it fades away for higher-wage bins. These spillover effects are also stronger for female workers. This is also due to female workers initially experiencing significantly lower wage growth than their male counterparts: panel (b) of Figure A.7 shows that the gender gap in wage growth is the largest in the middle-wage bins and, during the years of increases in the minimum wage, this gap almost disappears.

As expected, higher up in the wage distribution, changes in wage growth are insignificant: for each

wage bin, workers who initially (in year $t-2$) earned more than 160 MAD are not significantly different from the baseline wage growth, between 2006 and 2008. This is also consistent with macroeconomic time effects not playing a key role, at least during these years. Panel (a) of Figure 4 considers estimates in a placebo period, between 2005 and 2007, i.e., when there was no change in the minimum wage. Reassuringly, these estimates are mostly insignificant and considerably smaller in magnitude, supporting the view that these changes in wage growth are indeed prompted by the increases in the national minimum wage.

Figure 5 reports one coefficient per year, where the wage bins are now grouped into three groups: (i) bottom-wage workers, who have an initial wage between 80 and 100 MAD, (ii) middle-wage workers who have an initial wage between 100 and 160 MAD, and (iii) higher-wage workers, who have an initial wage between 160 and 300 MAD. The figure then plots, by gender and comparing bottom-wage and high-wage workers, the excess two-year real daily wage growth taking as a reference the two-year real wage growth between 2006 and 2008 (each coefficient corresponds to $\beta_{\gamma\delta|\text{upper}}$ in equation 4). The gray vertical bars correspond to increases in the minimum wage (indicated in real terms and with darker bars corresponding to larger increases in the minimum wage). It shows a clear pattern of higher wage growth in years with a greater increase in the minimum wage, with women benefiting significantly more than men, particularly in the later years of increases in the national minimum wage.

Looking at the first two coefficients, we can see that the real wage growth between 2005 and 2007, the period before increases in the national minimum wage, is very similar to the real wage growth between 2006 and 2008 (the reference period that corresponds to the last one before increases in the minimum wage).

Table 2 summarizes the key findings considering aggregated wage bins and grouping the years of changes when running the regression (Equations (3) and (4) with a post dummy that corresponds to the years 2010 to 2016). As in the previous specifications, the change between 2006 and 2008 is considered the baseline reference change. Panel A confirms that female workers directly exposed to the minimum wage experience a 9.8% higher daily wage growth over the period of minimum wage increases than over the 2006 to 2008 pre-change period. In contrast, for female workers in the upper wage bins, the wage growth in years of minimum wage increases is very close to and not significantly different from the wage growth in the pre-changes period. To exclude possible macroeconomic time effects, columns (10) to (12) of Table 2 report difference-in-differences estimates that compare the excess wage growth for the bottom wage bins with the excess wage growth for the upper wage bin (workers earning between 160 and 300 MAD). This corresponds to the differences in the estimates reported in columns (1) and (7), columns (2) and (8), and columns (3) and (9) respectively. As the daily wage growth in the upper wage bins is very similar to the daily wage growth in the pre-changes period, the difference-in-differences estimates are close to the estimates reported in the first three columns.

Columns (4) to (6) of Table 2 also show that there are significant spillover effects for the middle-wage bins, i.e. for workers just above 1.6 times the 2015 minimum wage. Gender gaps in impacts are also larger,

with female workers in the middle distributions benefiting significantly more than their male counterparts (2.2 pp greater increase for female workers in the bottom wage bin while 4.4 pp greater increase for female workers in the middle wage bins).

Panel B restricts the analysis to workers who remain employed in the same firm and shows that this wage boost and spillover effects also occur within the firm. This suggests that there are spillovers within firms for workers initially paid significantly more than the minimum wage.

In the Appendix Table A.8, I provide additional robustness checks of the individual exposure approach. In particular, in line with the pre-change trends presented in Figure 5, estimates are considerably smaller in magnitude and mostly not significant when reproducing the Table 2 but this time comparing wage growths between 2005-2007 and 2006-2008. These additional checks support the causal interpretation of the estimates reported in Table 2.

Impact on gender pay gaps. Figure 6 plots the evolution of the raw gender pay gap in the manufacturing sector, over the period of increases in the minimum wage (the gray-shaded area in the figure). Following the literature, I denote the raw gender pay gap as the coefficient β in the following equation:

$$log(w_{it}) = \alpha + \beta \text{Female}_i + \varepsilon_{it}$$

Figure 6 shows a clear reduction in the gender pay gap over the period of increases in the minimum wage: from 28% in 2008 to 22% in 2016. To test whether increases in minimum wage drive this reduction, I compare the evolution of the gender pay gap in local labor markets that are more vs. less exposed to the minimum wage increases (Equation (9)). Table 3 shows that the narrowing of the gender pay gap is greater in more exposed local labor markets.

5 Formal employment and reallocation to the informal sector

The previous section showed that minimum wage increases boost wage growth for low-wage workers and help narrow the gender pay gap. However, it focused on incumbent workers who remain formally employed over a two-year period. Employers may also offset the costs associated with a higher minimum wage by reducing work hours or the number of work days of their employees. Beyond reducing work time, employers may also lay off workers.

Impact on worktime and separation rate. Panel C of Table 2 shows the impact of minimum wage increases on the two-year transition rate from full-time to half-time work. This information is not directly reported by employers and I use a proxy for full-time employment that is equal to 1 if the average number of work days per month is greater than 20 and 0 otherwise. Using this proxy, we see that female low-wage workers are initially more likely to transition from full-time to half-time work than their male counterparts

(19% vs. 13%) but the increases in the national minimum wage do not seem to have any impact on this margin.

On the other adjustment margin, exiting employment, Panel D reveals that there are no initial gender gaps in the two-year probability of exiting the firm; it is quite high and on average 40% for both genders. However, during the years of increases in the minimum wage, we see that female low-wage workers, after two years, are 6.4 percentage points more likely to exit the firm they were working at. We don't see any significant effects for men.

Impact on exiting the formal sector. Minimum wage increases induce a higher separation rate from employers among low-wage female workers. I am now interested in understanding where the displaced workers transition to: are they pushed out of formal employment or are they transitioning to other formal firms? Following the same individual exposure strategy, I first examine transitions out of the formal labor market.

Figure 9 is similar to Figure 5 but now reports coefficients of $\beta_{\gamma\delta|\text{top}}$ in equation (3) when considering as the outcome of interest a dummy equals to 1 when an initially formally employed worker remains in the formal sector after two years and 0 otherwise. It shows that female low-wage manufacturing workers are more likely to exit formal employment during the year of increases in the minimum wage.

Panel D of Table 2 confirms this result: on average over the years of minimum wage increases, women become 5.1 percentage points more likely to exit formal employment (3.1 percentage point if we additionally control for the exit rate observed in the upper wage bins).

Transition to the informal sector. Table 4 reports difference-in-differences estimates associated with the local labor market exposure design, where the exposure is measured, for each of the 21 regions, as the average share of workers below the minimum wage in the years before the increases (2006 to 2008). It reports the coefficients associated with the specification at the individual level from Equation (3). The outcome of interest for all regressions is, starting with the sample of formal workers, a dummy equal to 1 if the individual remains formally employed in the following year and 0 otherwise Columns (1) to (3) are based on the exhaustive matched formal employer-employee dataset. Columns (4) to (6) replicate the same specification using the labor force survey data. Note that, because of the restrictions in access to the labor force surveys, the "post" period corresponds to the years of transitions between 2012 and 2013 to 2015 and 2016 while the "pre" period corresponds to the baseline transition rate between 2007 and 2008. We also consider here the one-year changes. Table 4 confirms the negative impact on formal employment using both sources of data.

Table 5 also reports difference-in-differences estimates from equation (6) but now examines where the workers transition to when they exit formal employment. For Columns (1) to (3), the dependent variable is a dummy that equals 1 if the worker is informally employed the following year and 0 otherwise. For Columns (4) to (6), the dependent variable is a dummy that equals 1 if the individual becomes unemployed

in the following year. For Columns (7) to (9), the dependent variable is a dummy that equals 1 if the individual transitions out of the labor force in the following year and 0 otherwise. Column (2) shows that, when pushed out of formal employment, female low-wage workers tend to transition to informal job arrangements.

Overall impact on gender pay gaps. The previous section documents that women at the bottom of the wage distribution are more likely to leave the formal sector after an increase in the minimum wage. To understand whether, even when accounting for this disemployment effect, minimum wage policies can help narrow overall gender pay gaps, I reproduce the individual results but consider as an outcome the two-year wage growth with different assumptions about wages when the worker exits the formal sector:

$$\text{Hyp 1:} \quad \tilde{w}_{it} = w_{it-2} \times (1 + g_{t-2 \to t}) \times \kappa_{informal} \implies \Delta y_{it} = (1 + g_{t-2 \to t}) \times \kappa_{informal} - 1$$
$$\text{Hyp 2:} \quad \tilde{w}_{it} = w_{it-2} \implies \Delta y_{it} = 0$$
$$\text{Hyp 3:} \quad \tilde{w}_{it} = 0 \implies \Delta y_{it} = -1$$

where $g_{t-2 \to t}$ is the average growth rate in the formal sector of daily real wages between t-2 and t and $\kappa_{informal} = (1 - 0.34)$ is the informal wage penalty.

Figure 10 shows the resulting impact on wage growth under these different assumptions. The positive effects on wage growth for middle-wage bin workers remain significant for female workers, even under the most conservative assumptions on earnings after exiting the formal sector (Hypothesis 3).

I also calculate the overall unadjusted wage gaps under these different assumptions, when for each year t, imputing wages for workers no longer formally employed at year t but that were formally employed at year $t-2$ (Figure A.8).

Taken together, these bounding exercises suggest that the overall net impact of the minimum wage on gender pay gaps is much lower due to the gender differential exit but still narrowing over the period of increases in the national minimum wage.

6 Interpreting the differential gender impacts

To interpret these differential gender impacts on wage growth and exit, I first introduce a framework of oligopsonistic labor markets with heterogeneous workers and firms (in the spirit of Felix, 2021; Berger, Herkenhoff and Mongey, 2022*a*; Sharma, 2023; Berger, Herkenhoff and Mongey, 2022*b*). Then, I provide empirical support to the channels highlighted by this theoretical framework.

6.1 Theoretical framework

Agents. The economy consists of a large but discrete number of labor markets $l \in [1, L]$ that will be the 269 group cells defined by province x sector in this context. In each labor market l, there are $M_l \sim G(M)$ firms that differ by their total factor productivity z_{jl} (drawn from a location invariant distribution). Workers can be of two types $g \in \{f, m\}$ and are heterogeneous along the following two key dimensions: their elasticities of substitution across firms within a labor market $\eta_{(g)}$ and their elasticities of substitution across labor market $\theta_{(g)}$

Worker problem. Workers (discretely) choose the firm they want to work for based on a nested logit model. I assume that workers have reservation wages $b_{ig} \sim F_g(.)$ and that worker i chooses the firm j located in the local labor market l taking the wages $\{w_{gjl}\}$ and the share of formal workers $\{p_{gjl}\}$ as given and picking j, l such as the associated utility u_{ijl} is higher than the utility associated with any of the alternatives. Dropping the gender subscript, I consider:

$$u_{ijl} = \ln(w_{jl}) + \ln(p_{jl}) + \ln(\lambda_l) - \ln(b_i) + \nu_{ijl}$$

where ν_{ijl} is an idiosyncratic taste for working in a firm j operating in a local labor market l, λ_l is a nesting parameter specific to the local labor market or a taste shifter for working in LLM l that is common to all workers. We thus have, the probability that worker i chooses j, l that is given by:

$$p_{jl} = \Pr\left(U_{ijl} > U_{ij'l'} \text{ for all } j', l' \neq j, l\right)$$

I further assume that the idiosyncratic taste term follows a Gumbel distribution:

$$F\left(\{\nu_{ijl}\}\right) = \exp\left[-\sum_{l=1}^{L}\left(\sum_{j=1}^{M_l} e^{-\left(1+\eta_{(g)}\right)\nu_{igjl}}\right)^{\frac{1+\theta_{(g)}}{1+\eta_{(g)}}}\right]$$

$\eta_{(g)} > 0$ and $\theta_{(g)} > 0$ are the two key dispersion parameters. They correspond to the cross-LLM and within-LLM cross-firm substitution elasticities of workers and differ by gender. Within a local labor market, $\eta_{(g)}$ captures the costs associated with transitioning to another employer in the same local labor market (for example due to search friction). A lower $\eta_{(g)}$ implies a higher variance of idiosyncratic draws between employers within a local labor market (LLM), and we can then expect a lower rate of transition between firms. The cross-LLM elasticity $\theta_{(g)}$ captures the costs associated with switching sectors or moving to another province. As workers more easily substitute between employers within a local labor market, than across local labor markets, I assume $\forall g,\ \eta_{(g)} > \theta_{(g)} > 0$.

Firm problem. Given the finite number of firms in each local labor market, I assume that firms behave strategically and compete *à la Cournot*: firms take as given the quantities of labor chosen by local competitors when taking their actions and internalize that their labor demand affects the total within labor market demand and wages. However, I assume that firms take quantities and wages outside of their local labor market as given. To abstract away from profits, I also assume that they are equally rebated.

Equilibrium. The equilibrium will depend on how much the minimum wage increases constraint firms and the mix of firms within a local labor market. At the firm level, we can start by distinguishing three cases:

(a) firms that are constrained by the minimum wage but such that the minimum wage remains below the marginal revenue of labor product (MRLP). In this "ideal" scenario, we expect both wages and employment to expand after an increase in the minimum wage.

(b) firms that are constrained by the minimum wage and by the fact that they cannot pay wages that exceed the marginal revenue of labor product (MRLP). In these firms, employment will shrink and may lead to firm closure.

(c) firms that are unconstrained by the minimum wage but that may still be impacted by the increases in the minimum wage through strategic interactions with other firms in their local labor market.

In this framework, the gender differences in impact are then driven by different factors. First, the within- and across-LLM elasticities of substitution – $\eta_{(g)}, \theta_{(g)}$ – shape the type of firms female and male workers are employed at and the initial wage-setting power of employers over female and male workers. Then, the number and characteristics of firms within a local labor market will determine the overall wage and employment effects.

Channels. As discussed in Berger, Herkenhoff and Mongey (2022*b*), this model highlights different channels through which increases in the minimum wage affect employment and wages.

Exit of less efficient firms: The first implication of this model is that small and less efficient firms are more likely to be exposed to minimum wage increases. As a result, these firms reduce employment or are pushed out of the market. If women are more likely to work in these firms, they will be disproportionately displaced. Therefore, the initial sorting of female and male workers across firms plays a key role.

Reallocation of workers across firms: The strategic interactions of firms within local labor markets also imply that unconstrained firms could increase both employment and wages in response to increases in minimum wages. As a result, minimum wage increases may both destroy jobs at unproductive firms and expand employment at more productive ones. Displaced workers may then be able to reallocate to more productive firms.

Different ability to transition to another formal firm: This also implies that whether the destruction of jobs or the expansion of employment dominates depends on firms' initial characteristics within local labor markets. As a result, we can expect that displaced workers have different abilities to cope with leaving their firm based on the set of outside options they face.

6.2 Firm exit and reallocation

Firm exit and differential employment impacts on female workers. I first want to assess whether more exposed firms are more likely to exit or to reduce their workforce. To do so, I rely on the firm level of exposure defined in Equation (6). Figure 11 reports the coefficients of Equation (7). It shows that more exposed to the minimum wage increases are indeed more likely to exit the formal labor market. Panel D of Table 6 shows that firm exit explains 40% of the formal disemployment effect for female low-wage workers. Panel (c) of Figure 11 also shows that more exposed firms tend to reduce their share of female workers.

Impact on reallocation from lower to higher-paying firms. Table 7 examines whether the minimum wage induces upward mobility for workers who remain formally employed. To measure the change in the quality of the employer over a two-year period I consider the following measure:

$$\Delta y_{i,t} = q^{t-2}_{j(i,t)} - q^{t-2}_{j(i,t-2)}$$

where $q^{\delta}_{j(i,t)}$ corresponds to the quality at time δ of the firm j where worker i is employed at time t. That way, I always consider the baseline characteristics of both firms. For the lower to higher-paying firms, I rank firms in a given year based on their median wage (for both genders) and consider that it is a transition from a lower-paying to a higher-paying firm when there is a rank increase greater than 15%.

Panel B of Table 7 shows that, in years of increases in the minimum wage, both female and male workers are more likely to transition to a higher-paying employer. This upward reallocation effect is stronger for women. Panels C and D also show that female low-wage workers are more likely to transition to large establishments and/or the two main employers within their local labor markets.

6.3 Heterogeneity based on outside options

Outside option index. Worker's option set is typically not observable. A simple approach is to consider that an individual's labor market consists of all jobs within the same commuting zone and industry or occupation. However, we saw with Table A.6, that there is mobility across local labor markets, in particular across different manufacturing sectors. Within a local labor market, even when workers are identical in their observable characteristics – for instance in the same firm, occupation, and wage bracket – they may face different option sets due to their specific skills, preferences, the employers' screening process, or

their mobility constraints. Table A.6 shows that there is significant heterogeneity across female and male workers, including in their ability to transition to another province or to a formal job outside manufacturing (the construction sector being an "outside" sector available to men but not so much to women). This may play a role in workers' ability to cope with displacement effects induced by minimum wage increases.

To capture the type of outside options available to workers, I consider an outside option index that closely follows Schubert, Stansbury and Taska (2022). It takes into consideration three key parameters: (i) the ability for a worker in sector s to transition to sector s' (captured by the initial empirical transition rate $\pi_{s\to s'}$); (ii) whether the sector s' represents a large share of employment within province p at time t ($\frac{s_{s,p,t}}{s_{s,t}}$ captures the relative employment share in province p of sector s at time t); (iii) the average wage in sector s', province p and at time t ($\bar{w}_{s',p,t}$). In this definition of the outside option index, we may also want to consider the different ability of workers to transition out of their province. [20] For workers of gender g initially working in sector s and in the province p, I then consider:

$$oo_{s,p,t} = \pi_{p\to p}\left[\underbrace{\pi_{s\to s}\cdot\frac{s_{s,p,t}}{s_{s,t}}\cdot\bar{w}_{s,p,t}}_{\text{within LLM (=sector x province) oo}} + \underbrace{\sum_{s'\neq s}^{S}\pi_{s\to s'}\cdot\frac{s_{s',p,t}}{s_{s',t}}\cdot\bar{w}_{s',p,t}}_{\text{within province outside sector oo}}\right] + \underbrace{\sum_{p'\neq p}^{P}\pi_{p\to p'}\sum_{s'}^{S}\pi_{s\to s'}\cdot\frac{s_{s',p',t}}{s_{s',t}}\cdot\bar{w}_{s',p',t}}_{\text{outside province oo}}$$

where the transition rate from s to s' is calculated using the pre-years (2007 to 2008) and by gender with $\pi_{s\to s'} = (1-\text{leave share}_s)\cdot\text{transition share}_{s\to s'}$'; $s_{s',p,t}$ is the share of sector s' in province p. I compute it for each gender separately.

When plotting the distribution of the outside option index for each gender separately, we observe significant variation for both genders. However, female manufacturing workers tend to have a lower $oo_{s,p,t}$, indicated a more restricted set of formal job opportunities. In my heterogeneity analysis, I consider the 2008 value of this index.

More severe formal disemployment effect in local labor markets with more restricted outside options. Table 8 reports, for female workers only, the average excess two-year exit rate from formal employment in the years of minimum wage increases relative to the two-year change in the reference period, between 2006 and 2007. Column (2) restricts the regressions to workers in the bottom tercile of the outside option index, column (3) the middle tercile, and column (4) the top tercile. Column (1) shows that on average female low-wage workers are 2.3 percentage points more likely to exit formal employment. In the bottom

[20] As shown in Table A.6, conditional on switching jobs, 30% of male workers transition to another province while only 15% of female workers do so.

tercile, they are 4.5 percentage points more likely to exit and the impact is marginally significant for the middle tercile while it is insignificant for the top tercile.

6.4 Concentration of employers in more exposed local labor markets

LLM concentration: To assess the overall impact on local labor market concentration, I consider the Herfindahl-Hirschman Index (HHI) defined as:

$$HHI_l = \sum_{j \in l} s_{jl}^2$$

where s_{jl} corresponds to the share of employment for firm j in local labor market l.

Figure A.11 plots the distribution of HHI by gender in 2008, before the minimum wage increases. It shows that local labor markets tend to be concentrated for manufacturing workers and even more so for female workers: in the median LLM, the HHI is 0.272 for female workers while it is 0.202 for male workers.

Impact of minimum wage increases on local labor market concentration. Figure 12 presents the coefficients of the difference-in-differences specified in Equation 9 where the outcome variable of interest is the Herfindahl–Hirschman index (HHI), calculated at the LLM level and disaggregated by gender. It shows that, for female workers, the HHI increases by 0.04 points in the local labor markets more exposed to the increases in the minimum wage compared to the less exposed local labor markets. The effects are only significant for women.

Consistent with this finding, Figure A.14 shows that the share of employment at the largest employers within a local labor market increased over the period of increases in the minimum wage. Although power might be an issue, this does not seem to be associated with any overall employment effect (see Figure A.15).

7 Conclusion

This paper examines how increases in the Moroccan national minimum wage affect gender gaps in employment and wages within the manufacturing sector, highlighting both positive and unintended negative impacts. A higher minimum wage boosts the wages of low-wage incumbent workers who remain formally employed, including those initially earning above the newly enforced minimum wage. These direct and spillover effects are more pronounced for women. Additionally, women who remain in formal employment are more likely to transition to larger, higher-paying employers, suggesting potential efficiency gains. These combined effects contribute to narrowing the gender pay gap in the formal manufacturing sector.

However, the minimum wage increases also negatively impact female formal employment, particularly for women at the bottom of the wage distribution, who become more likely to leave the formal sector. This adverse effect on female formal employment is primarily observed in smaller, less productive firms that struggle to raise wages to the minimum level. These firms often reduce their workforce or shut down completely. Since women tend to be overrepresented in firms more affected by the minimum wage increases, they are disproportionately likely to be displaced. Due to their more limited job opportunities, they also face greater challenges than men in finding new formal employment opportunities. Consequently, they are more likely to transition to less secure and lower-wage informal work arrangements.

Taking into account the exit of female workers from formal employment reduces the positive impact on narrowing the gender pay gap. However, the positive impact on wage growth for middle-wage workers remains significant for female workers, even under conservative assumptions about their earnings after exiting the formal sector. Thus, even when accounting for the displacement effect, the minimum wage remains an effective tool for reducing gender pay inequality.

Given the significant role of the informal sector, designing and implementing minimum wage policies in such contexts necessitates a comprehensive approach. Future policies should include measures to support workers adversely affected, ensuring that the benefits of wage increases are not offset by declines in job security and employment quality, particularly among already vulnerable female workers. To mitigate negative impacts, policymakers may also want to design interventions targeting smaller or less productive firms, which remain a key source of female employment, and assist these firms in upgrading their operations. Furthermore, as the minimum wage increases lead smaller businesses to exit the market, they result in higher employer concentration for female workers. This could have important longer-term implications for wage-setting dynamics.

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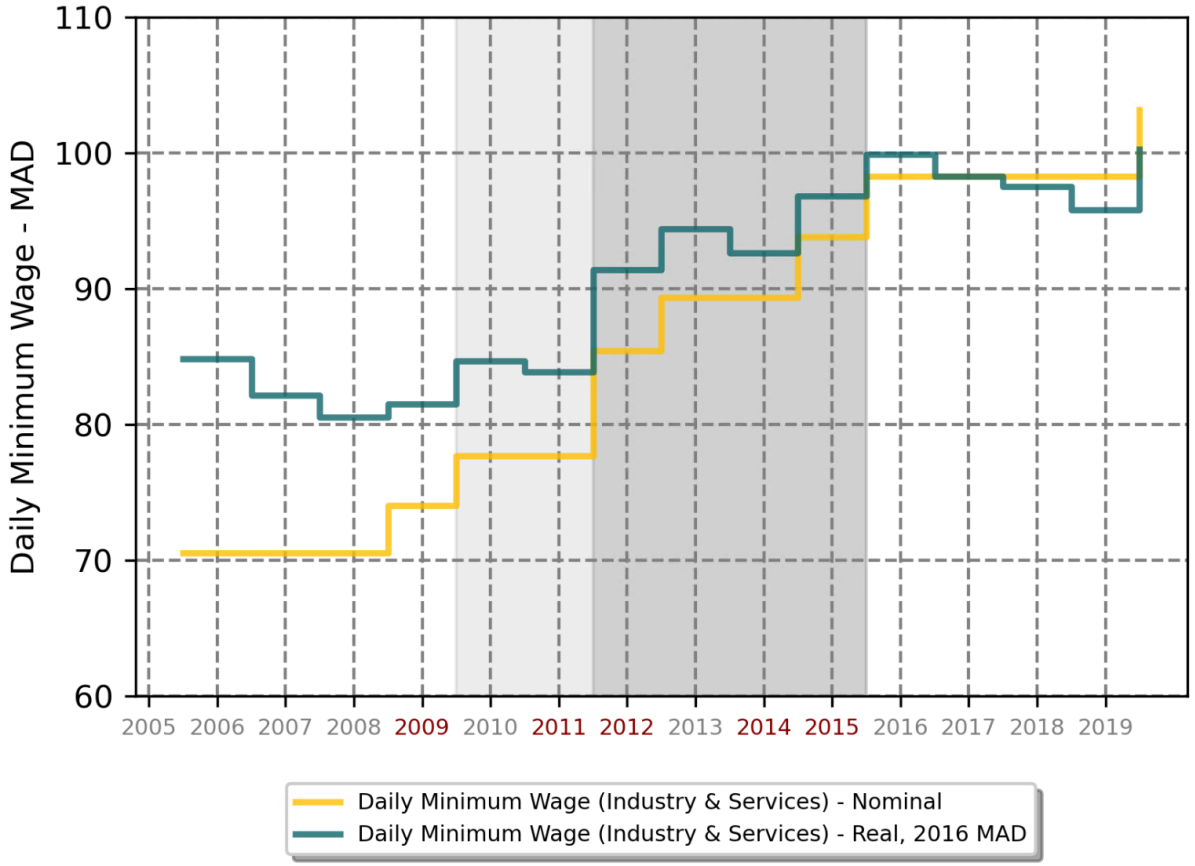
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8 Figures

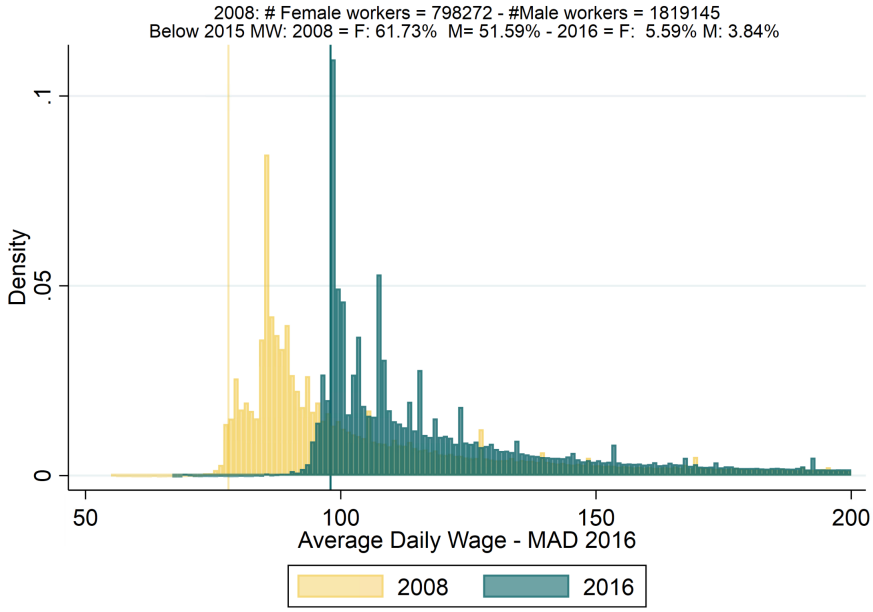
FIGURE 1: EVOLUTION OF THE MOROCCAN DAILY MINIMUM WAGE



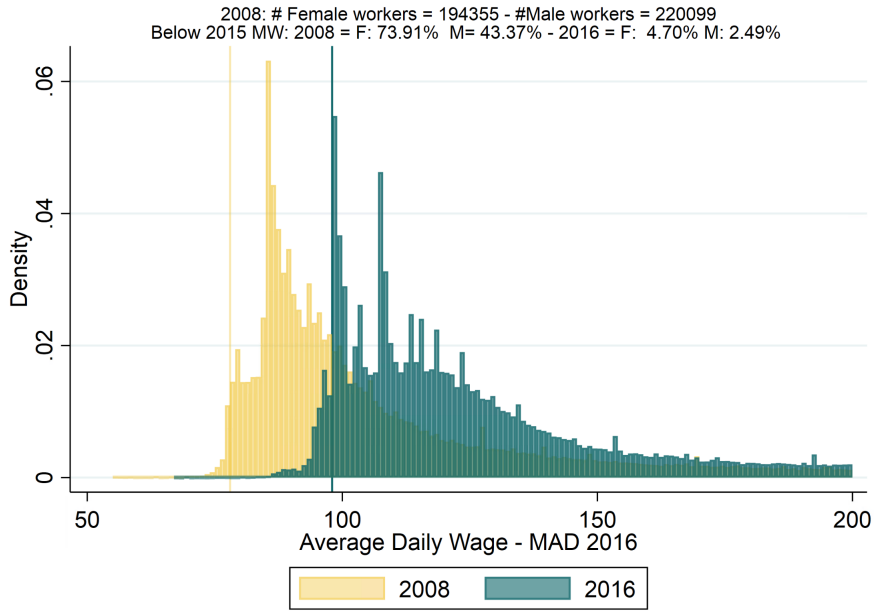
Note: This figure shows the evolution of the daily minimum wage for the private non-agricultural formal sector (SMIG) in nominal (yellow) and real (green) terms. The real daily minimum wage is in MAD of 2016.
Source: Author's computations based on official regulations.

FIGURE 2: DISTRIBUTION OF REAL DAILY WAGES – 2008 & 2016

A – *All non-agricultural formal workers*



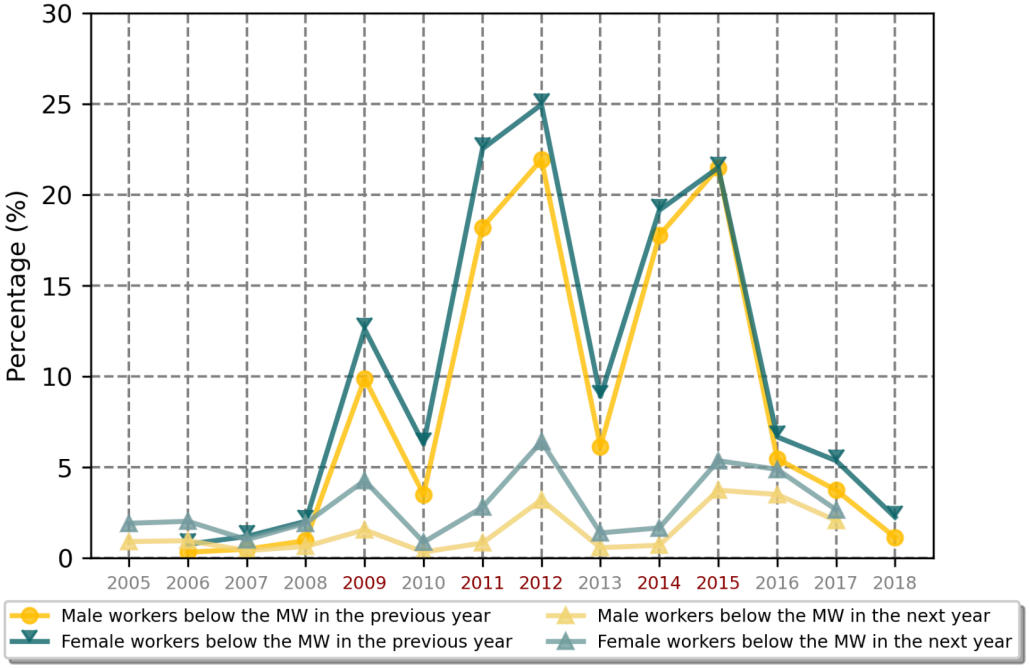
B – *All manufacturing formal workers*



Note: Figure 2 plots the distribution of the real daily wage (MAD 2016) in 2008 and 2016 for all formal non-agricultural workers (panel A) and for formal manufacturing workers (panel B). Horizontal bars correspond to the prevailing minimum wage in 2008 (yellow bar) and in 2016 (dark green bar).

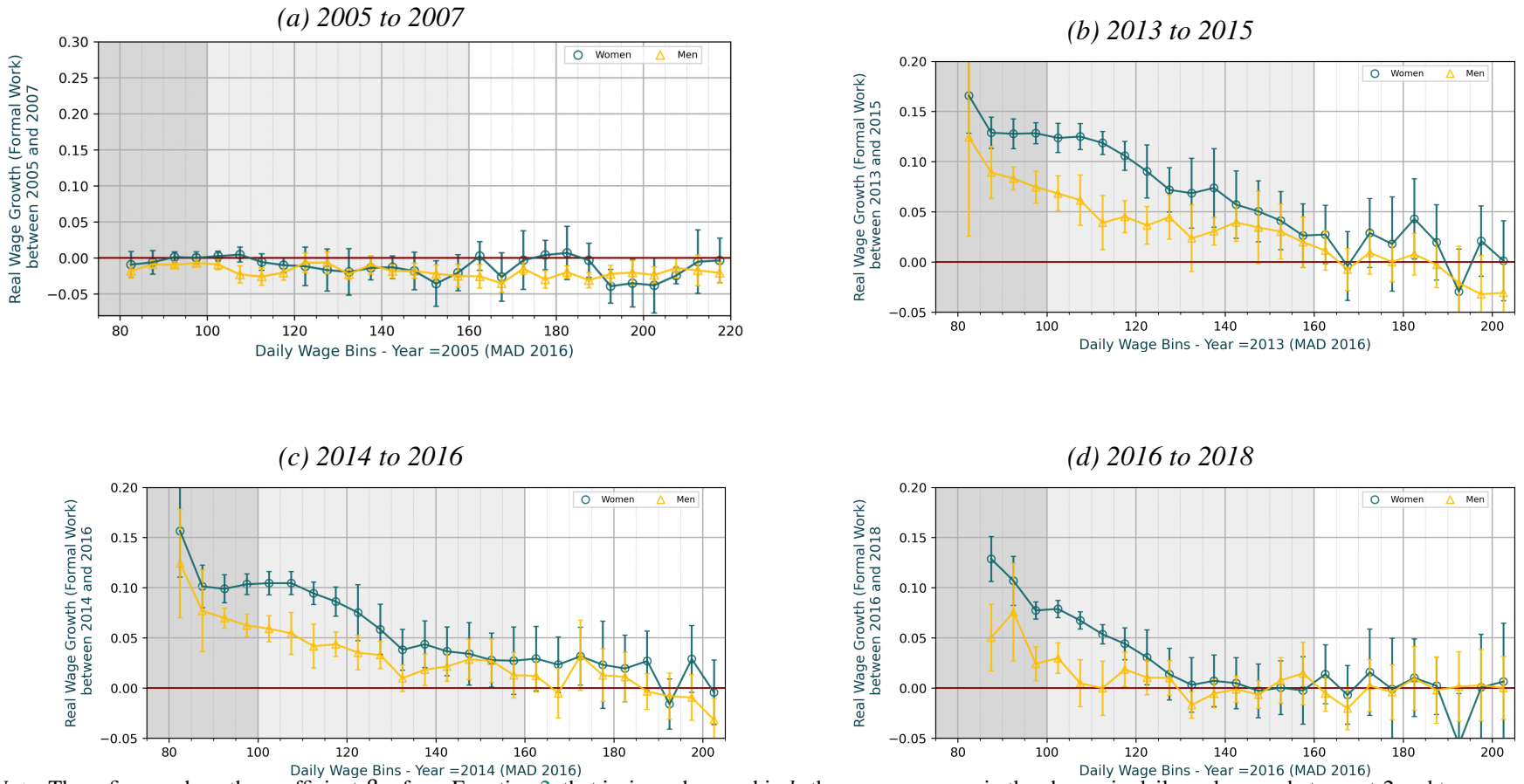
Source: CNSS.

FIGURE 3: BITE AND ENFORCEMENT OF THE CHANGES IN THE NATIONAL MINIMUM WAGE



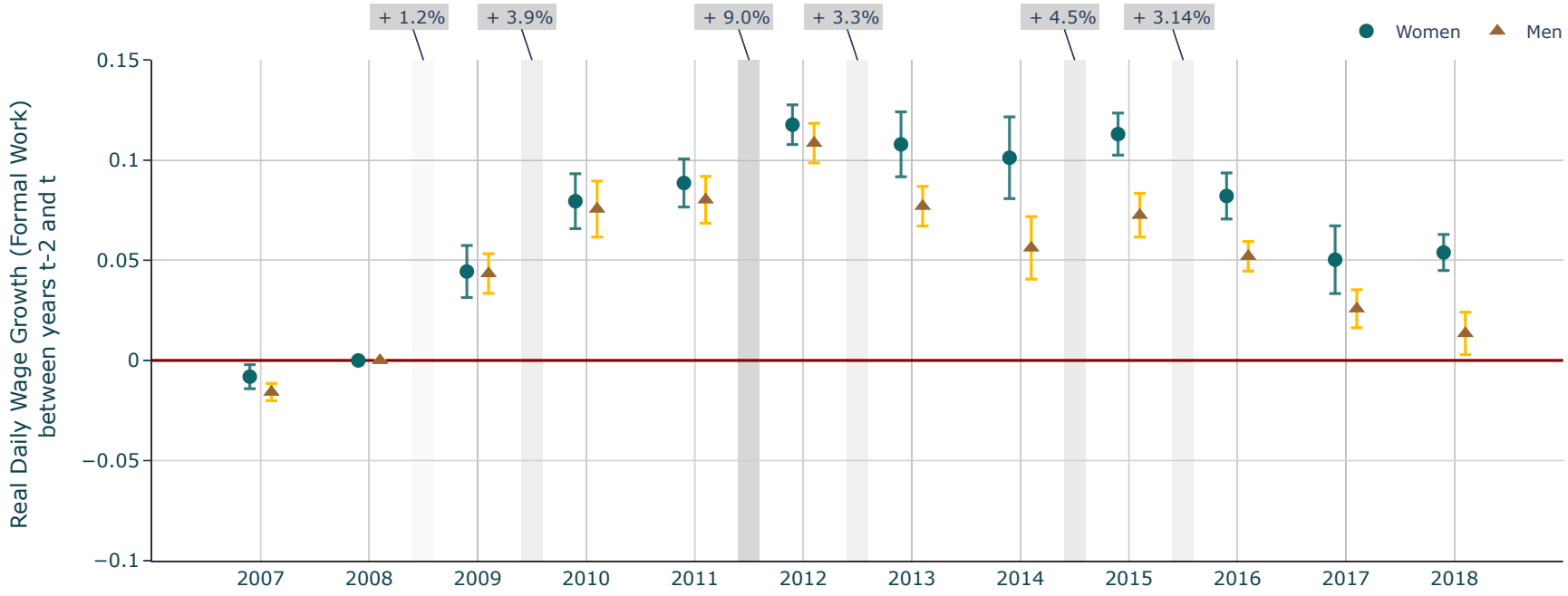
Note: This figure shows the share of workers who are below the newly introduced minimum wage level by gender. We see that, in 2011, 25% of women were below the 2012 minimum wage, while it is closer to 20% for men. The lighter lines also show a proxy for enforcement: It corresponds to the share of workers still below the new minimum wage in the following year.
Source: CNSS.

FIGURE 4: INDIVIDUAL APPROACH – IMPACT ON TWO-YEAR REAL WAGE GROWTH BY INITIAL WAGE BINS, RELATIVE TO 2006 TO 2008



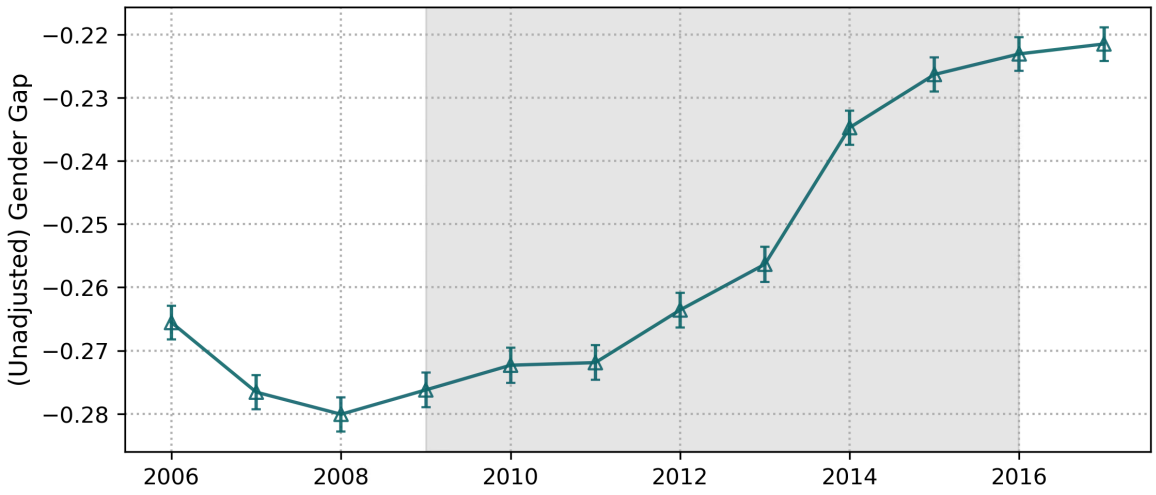
Note: These figures show the coefficient $\beta_{k\delta}$ from Equation 2, that is, in each wage bin k, the average excess in the change in daily real wages between t-2 and t compared to the reference period between 2006 and 2008 and conditional on a vector of individual baseline characteristics measured at $t-2$. The coefficients for female workers are reported in green, and those for male workers are reported in yellow.

FIGURE 5: INDIVIDUAL APPROACH – IMPACT ON REAL WAGE GROWTH BETWEEN YEARS $t-2$ AND t, RELATIVE TO 2006 TO 2008 FOR BOTTOM VS. TOP WAGE WORKERS



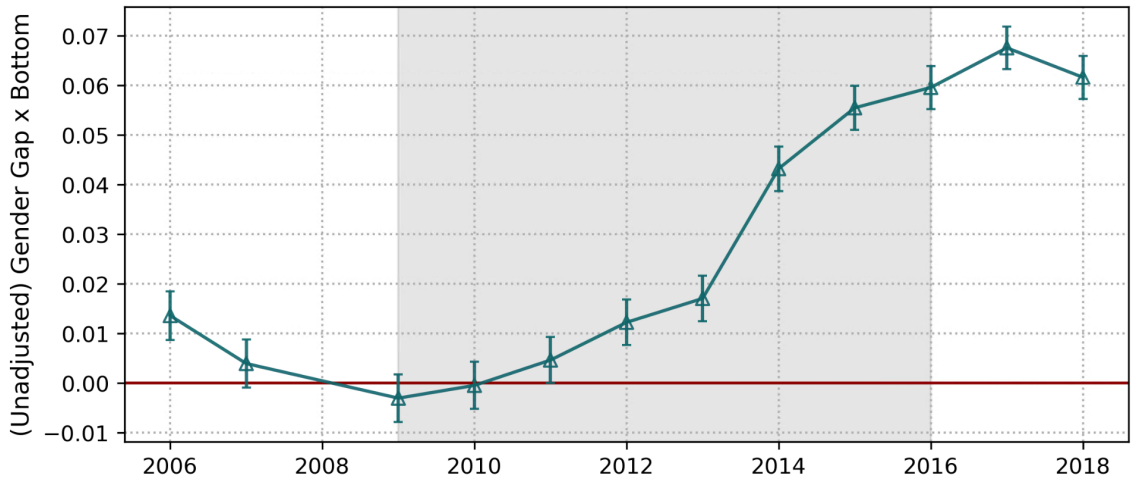
Note: Figure 5 plots, by gender and comparing two groups of workers, the excess two-year real daily wage growth taking as a reference the two-year real wage growth between 2006 and 2008. It reports the coefficients of $\beta_{\gamma\delta|\text{upper}}$ in Equation 4. The gray vertical bandwidth corresponds to increases in the minimum wage (indicated in real terms). The graph also reports, for each year, the estimated coefficient and the associated p-value.

FIGURE 6: REDUCTION IN THE GENDER WAGE GAP AS MINIMUM WAGE INCREASES



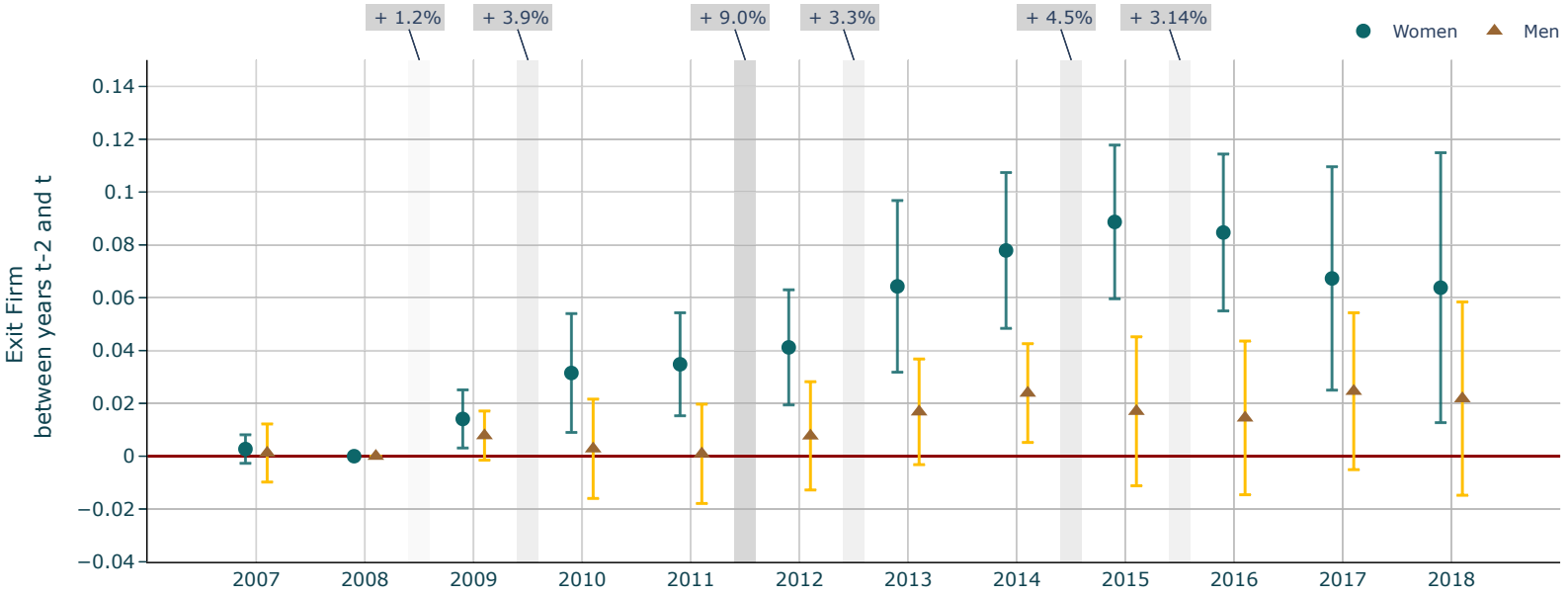
Note: This figure shows the evolution of the (raw) gender pay gap in the manufacturing sector. Following the literature, it is defined as the coefficient β when running the following equation, for each year: $log(w_{it}) = \alpha + \beta \text{Female}_i + \varepsilon_i$.

FIGURE 7: REDUCTION IN THE GENDER WAGE GAP DRIVEN BY THE BOTTOM AND MIDDLE OF THE WAGE DISTRIBUTION



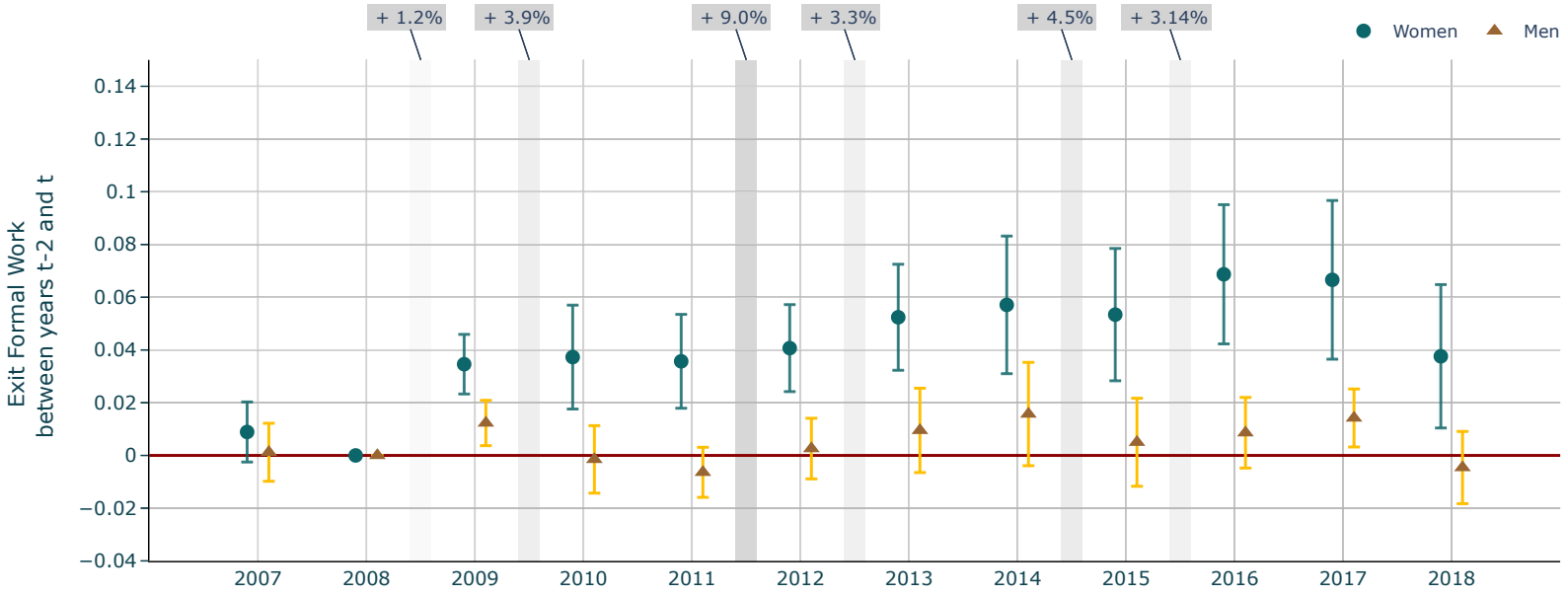
Note: This figure shows the coefficients associated with the following regressions: $\log(w_{it}) = \alpha_t + \sum_{\tau \neq 2008} \beta_\tau \times 1\left[\text{gender}_i = F\right] \times 1\left[w_{it} < 150\right] + \sum_\tau 1\left[\text{gender}_i = F\right] \times \gamma_\tau + \sum_\tau \eta_\tau \times 1\left[w_{it} < 150\right] + \varepsilon_{it}$.

FIGURE 8: INDIVIDUAL APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON THE PROBABILITY OF EXITING EMPLOYER BETWEEN YEARS $t-2$ AND t, RELATIVE TO 2006 TO 2008 FOR BOTTOM VS. TOP WAGE WORKERS



Note: Figure 9 graphs, by gender and comparing two groups of workers, the excess two-year change in the probability of exiting formal employment taking as a reference the two-year real wage growth between 2006 and 2008. It reports the coefficients of $\beta_{\gamma\delta|\text{upper}}$ in Equation 4. The gray vertical bandwidth corresponds to increases in the minimum wage (indicated in real terms). The graph also reports, for each year, the estimated coefficient and the associated p-value.

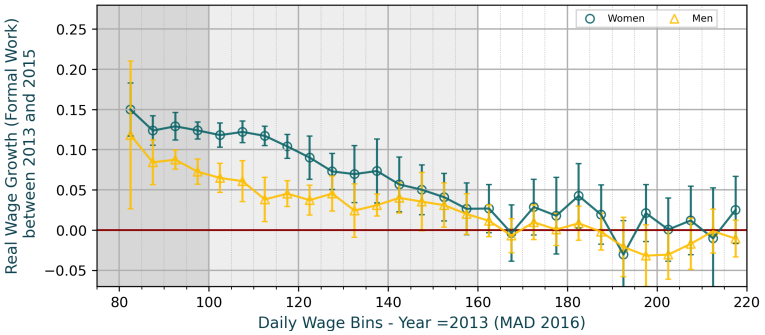
FIGURE 9: INDIVIDUAL APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON THE PROBABILITY OF EXITING FORMAL EMPLOYMENT BETWEEN YEARS $t-2$ AND t, RELATIVE TO 2006 TO 2008 FOR BOTTOM VS. TOP WAGE WORKERS



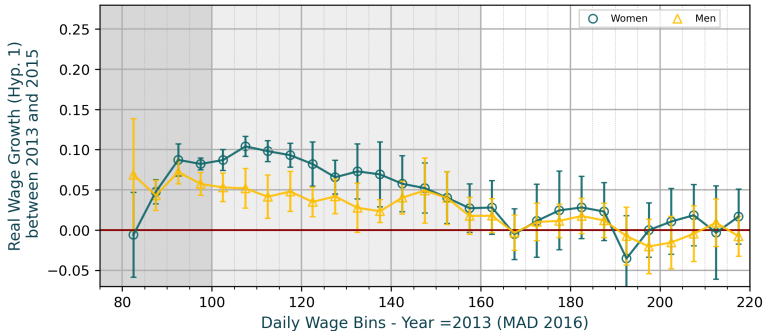
Note: Figure 9 graphs, by gender and comparing two groups of workers, the excess two-year change in the probability of leaving formal employment taking as a reference the two-year real wage growth between 2006 and 2008. It reports the coefficients of $\beta_{\gamma\delta|\text{upper}}$ in Equation 4. The gray vertical bandwidth corresponds to increases in the minimum wage (indicated in real terms). The graph also reports, for each year, the estimated coefficient and the associated p-value.

FIGURE 10: INDIVIDUAL APPROACH: IMPACT ON TWO-YEAR REAL WAGE GROWTH TAKING INTO ACCOUNT EXIT FROM FORMAL EMPLOYMENT BY INITIAL WAGE BINS, 2013 TO 2015 RELATIVE TO 2006 TO 2008

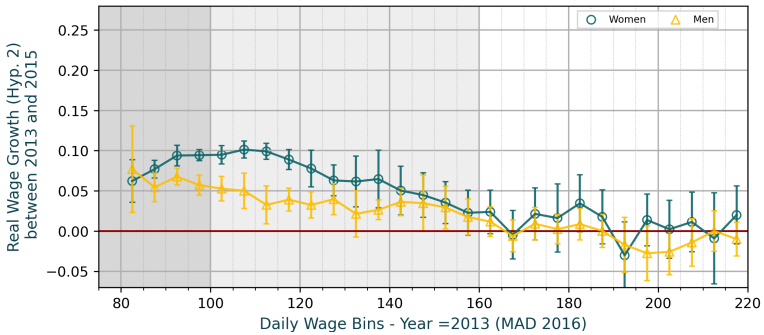
(a) Only formal incumbent workers



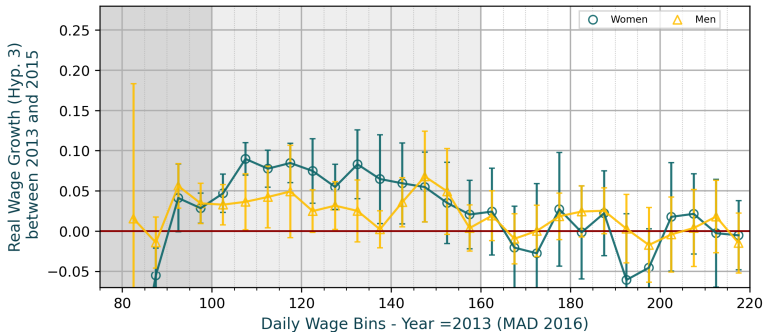
(b) Hypothesis 1



(c) Hypothesis 2

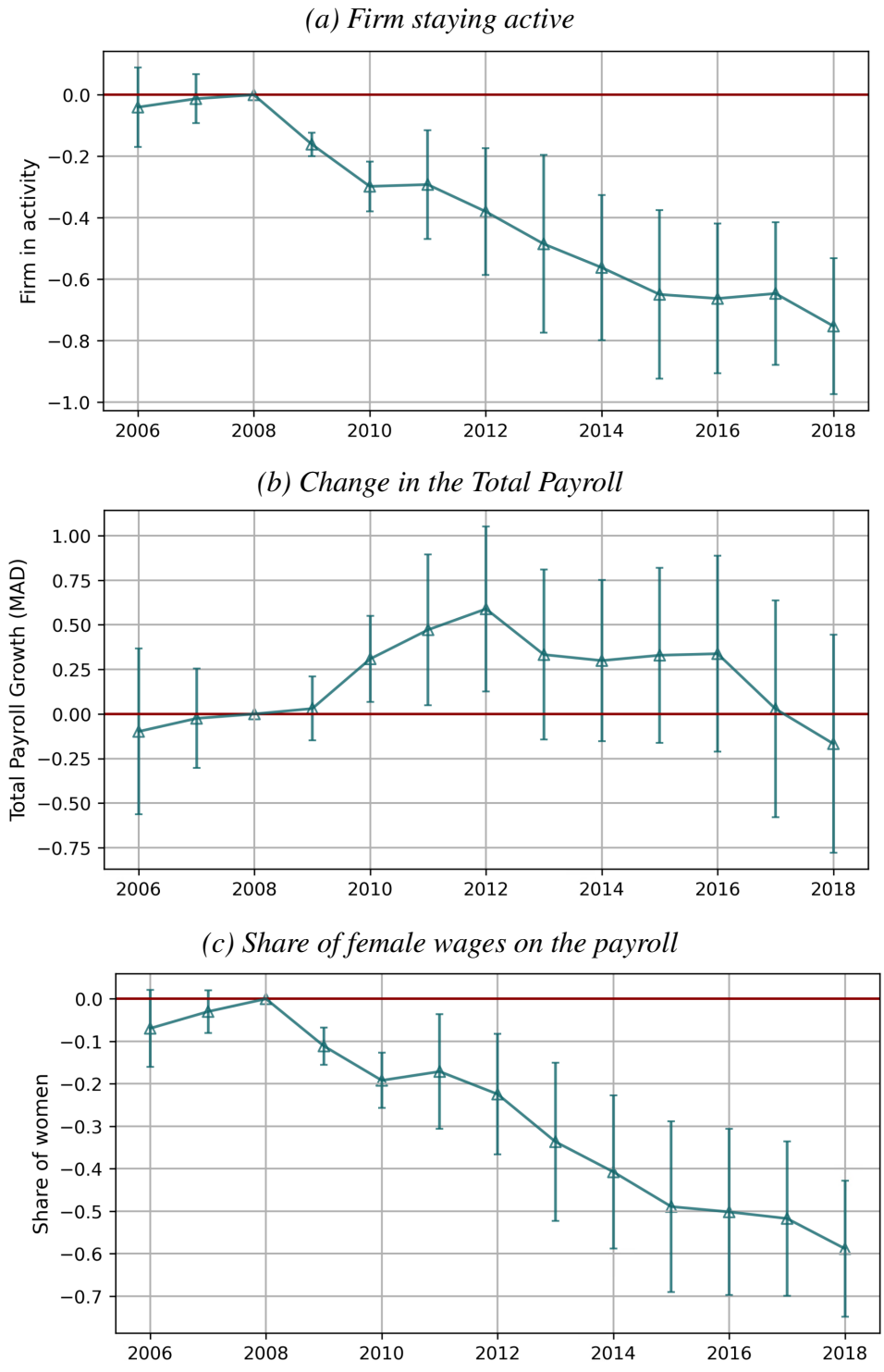


(d) Hypothesis 3



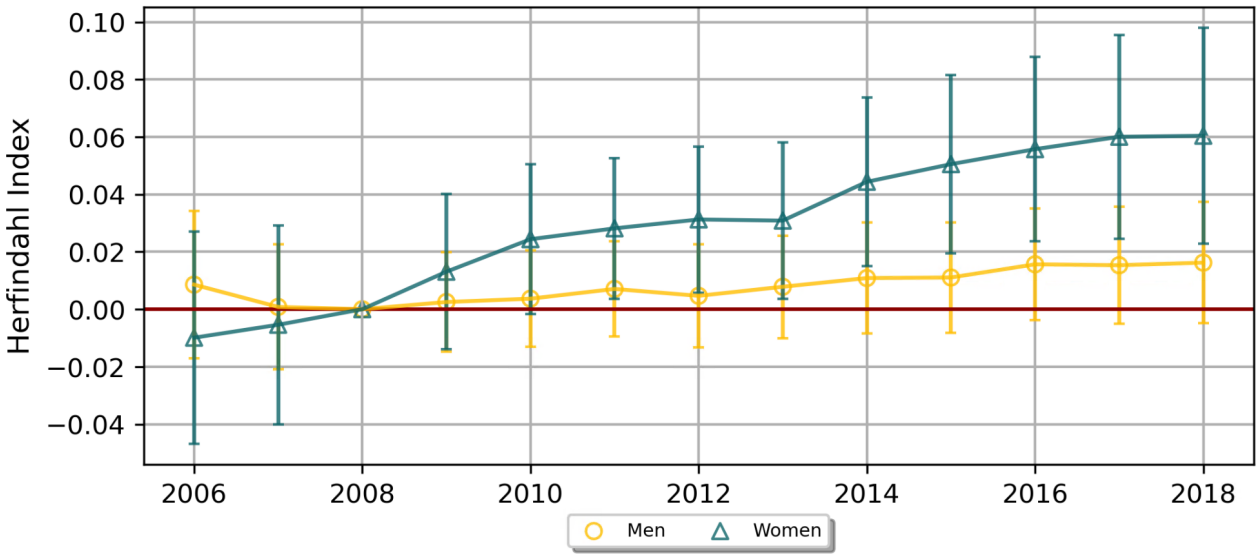
Note: These figures show the coefficient $\beta_{k\delta}$ from Equation 2, that is, in each wage bin k, the average daily real wage change between t-2 and t compared to the reference period between 2006 and 2008 and conditional on a vector of individual baseline characteristics measured at $t-2$.

FIGURE 11: FIRM APPROACH – FIRM ACTIVITY, TOTAL PAYROLL AND SHARE OF FEMALE WORKERS, CHANGE SINCE 2008



Note: Figure 11 shows the change in firm outcomes taking as a reference period 2008 as described when introducing Equation (7).

FIGURE 12: STRONGLY TREATED VS. WEAKLY TREATED LLM: HHI



Note: Figure 12 presents the coefficients of the difference-in-differences specified in Equation 9. In this analysis, the strongly treated local labor markets (LLMs) are defined as those where the proportion of workers earning below the 2015 minimum wage exceeds the median across regions during the pre-policy years. The outcome variable of interest is the Herfindahl–Hirschman index (HHI), calculated at the LLM level and disaggregated by gender.

9 Tables

TABLE 1: SUMMARY STATISTICS, 2008 AND 2016

	2008		2016	
	Female	Male	Female	Male
	(1)	(2)	(3)	(4)
Age	33.24	37.13	35.81	37.62
	(8.75)	(10.23)	(9.44)	(10.07)
Years since first entry in the formal sector	9.24	11.91	11.11	12.32
	(7.22)	(9.86)	(8.46)	(9.30)
Full-time workers	0.643	0.818	0.678	0.854
Industries, *share of workers:*				
Clothing industry	57.69	23.46	40.72	15.99
Textile manufacturing	8.31	8.31	13.31	9.11
Food industry	15.99	20.12	22.32	21.09
Other	18.01	48.11	23.65	53.82
Establishment size, *share of workers:*				
1 to 9	2.38	8.61	3.32	9.54
10 to 49	7.08	18.49	7.86	17.54
50 to 199	19.82	27.57	17.52	23.89
200 to 499	28.31	19.35	23.84	18.10
500+	42.41	25.98	47.45	30.94
Real daily wage	113.36	180.61	141.81	203.108
	(85.51)	(190.84)	(113.24)	(210.23)
Share of workers by daily real wage bins:				
Bottom wage bins: [80;100] MAD	69.29	40.76	17.91	12.89
Middle wage bins:]100;160] MAD	22.29	28.52	67.43	48.03
Upper wage bins:]150;300] MAD	5.75	19.22	10.47	25.88
Above: [300; - [MAD	2.69	11.50	4.20	13.19
2-year wage growth by wage bins:				
Bottom wage bins: [80;100] MAD	0.00	0.04	0.08	0.08
	(0.12)	(0.21)	(0.11)	(0.15)
Middle wage bins:]100;150] MAD	-0.02	0.04	0.05	0.07
	(0.14)	(0.22)	(0.11)	(0.16)
Upper wage bins:]150;300] MAD	0.06	0.07	0.06	0.07
	(0.25)	(0.25)	(0.17)	(0.21)
Total number of worker-years observations:	2,794,913	3,308,765		
Total number of unique workers	478,502	553,866		
Total number of unique establishments	16,546			

Note: Table 1 reports key summary statistics for the years 2008 and 2016, separately for male and female workers. For continuous variables, the average and standard deviations are indicated in parentheses.

TABLE 2: INDIVIDUAL APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON WAGE GROWTH AND EMPLOYMENT

	Bottom Wage Bins]80; 100]			**Middle Wage Bins**]100; 160]			**Upper Wage Bins**]160; 300]			**Bottom vs. Top**			**Mid vs. Top**
	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	F - M
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A: Real Daily Wage Growth (workers staying formally employed)													
Years 2010-2016	0.0977	0.0763	0.0214	0.0857	0.0411	0.044	0.0053	0.0049	0.0013	0.0925	0.0714	0.0201	0.0427
	(0.004)***	(0.004)***	(0.004)***	(0.006)***	(0.005)***	(0.006)***	(0.008)	(0.006)	(0.007)	(0.008)***	(0.005)***	(0.008)**	(0.009)***
Average change 2006-2008	-0.0008	0.0526		-0.0277	0.0393		0.0774	0.0759					
N	631677	445026	1076705	568257	664159	1232416	88262	336902	425164	1288196	1446087	2734285	2734285
Panel B: Real Daily Wage Growth (workers staying in the same firm)													
Years 2010-2016	0.1002	0.0786	0.0214	0.0883	0.0448	0.0432	0.0116	0.015	-0.0024	0.0886	0.0636	0.0238	0.0456
	(0.005)***	(0.004)***	(0.005)***	(0.006)***	(0.005)***	(0.007)***	(0.008)	(0.006)***	(0.007)	(0.008)***	(0.006)***	(0.008)***	(0.008)***
Average change 2006-2008	-0.0037	0.0284		-0.0183	0.0397		0.075	0.0691					
N	476926	340319	817247	484306	555047	1039354	78316	300037	378353	1039548	1195403	2234954	2234954
Panel C: Transition from full-time to half-time work (workers staying in the same firm)													
Years 2010-2016	0.0082	-0.0039	0.0104	0.0026	0.0058	-0.0033	0.0008	0.0021	-0.0031	0.0074	-0.0061	0.0134	-0.0003
	(0.024)	(0.010)	(0.017)	(0.009)	(0.003)*	(0.007)	(0.005)	(0.003)	(0.004)	(0.025)	(0.010)	(0.016)	(0.008)
Average change 2006-2008	0.1911	0.1233		0.1158	0.0593		0.0378	0.0244					
N	346790	307538	654330	455499	605401	1060900	84779	328283	413062	887068	1241222	2128292	2128292
Panel D: Exit Firm (workers initially formally employed)													
Years 2010-2016	0.0592	0.0138	0.0454	0.0399	0.0118	0.0288	0.0311	-0.0075	0.0353	0.0281	0.0213	0.0101	-0.0065
	(0.011)***	(0.009)	(0.013)***	(0.019)**	(0.009)	(0.016)*	(0.011)***	(0.009)	(0.012)***	(0.015)*	(0.013)	(0.016)	(0.018)
Average change 2006-2008	0.3998	0.3918		0.267	0.2703		0.2082	0.2063					
N	847587	568570	1416160	681900	776362	1458264	101681	376194	477875	1631168	1721126	3352299	3352299
Panel E: Exit Formal Work (workers initially formally employed)													
Years 2010-2016	0.0494	0.0062	0.0429	0.0328	0.0053	0.0264	0.0272	-0.0069	0.0326	0.0222	0.0131	0.0103	-0.0062
	(0.009)***	(0.007)	(0.006)***	(0.006)***	(0.006)	(0.006)***	(0.009)***	(0.006)	(0.009)***	(0.010)**	(0.009)	(0.010)	(0.009)
Average change 2006-2008	0.2205	0.2121		0.1447	0.1362		0.1092	0.1098					
N	847587	568570	1416160	681900	776362	1458264	101681	376194	477875	1631168	1721126	3352299	3352299

Note: Table 2 reports, by gender and comparing two groups of workers, the excess two-year change in outcomes in the years of minimum wage increases relative to the two-year change in the reference period, between 2005 and 2007. Columns (1) and (2) indicate the coefficient $\beta_{\text{bot, post}}$ of Equation 2 for workers who earned less than 100 MAD at the beginning of the two-year period. Column (3) indicates, for the same group of low-wage workers, the gender differences in impact. Columns (4) to (6) report the same for middle-wage bin workers: $\beta_{\text{middle, post}}$. Columns (7) and (9) indicate the coefficient $\beta_{\text{top, post}}$ for higher-wage workers who initially earn more than 160 MAD and that we do not expect to be affected by minimum wage increases. Columns (10) to (12) report difference-in-differences estimates that compare the excess 2-year changes for workers directly affected by the minimum wage changes with the excess two-year changes for workers higher up in the distribution (coefficient $\beta_{\gamma\delta|\text{top}}$ in equation 4). In Panel A, for workers staying formally employed within the two-year window, I compute the daily wage growth as defined above. Panel B examines the same outcomes, but restricts the sample to workers who stay employed in the same formal firm. Panel C looks at, for workers staying employed in the same firm in the two-year interval and who were initially full-time workers, the probability that they transition from full-time to half-time work arrangements. I define the full-time dummy proxy as equal to 1 if working on average more than 20 full days per month within that year and 0 otherwise. Panel D considers the set of workers initially formally employed, and the dummy equals 1 if they have exited the firm after two years and 0 otherwise. Panel E considers the set of workers initially formally employed, and the dummy equals 1 if they exited the formal sector after two years and 0 otherwise.

TABLE 3: LABOR MARKET APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON THE AVERAGE AND STANDARD DEVIATION OF DAILY WAGES

	Avg. Daily Wage: $w_{it} \in [80;160]$		Avg. Daily Wage: $w_{it} > 160$		Sd of Daily Wage: w_{it}	
	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
Strong Exp. x 2010-2016	0.10 **	0.07 *	-0.64	0.02	-0.86 ***	-0.14
	(0.048)	(0.043)	(0.38)	(0.28)	(0.27)	(0.29)
N	390	390	390	390	390	390

Note: Table 3 reports difference-in-differences estimates to increases in the minimum wage when using the local labor market exposure approach, where exposure is defined as the average share of workers below the minimum wage in the years before increases (2006 to 2008; see Equation 6). It reports the coefficients associated with the specification at the labor market level of Equation 7.

TABLE 4: LABOR MARKET APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON THE PROBABILITY OF STAYING FORMALLY EMPLOYED

	CNSS: Stay Formal			LFS: Stay Formal		
	All	Female	Male	All	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)
Strong Exp. x 2013-2015	-0.0052***	-0.0180***	-0.0002	-0.0404***	-0.0575***	-0.0357
	(0.0023)	(0.0020)	(0.0022)	(0.0196)	(0.0216)	(0.0479)
	0.021	0.000	0.897	0.0091	0.0077	0.3397
N	1,246,506	607,594	638,912	35,771	11,051	24,720

Note: Table 4 reports the difference-in-difference estimates for the impact of the region exposure to the minimum wage increases, where the exposure is measured as the average share of workers below the minimum wage in the years before the increases (2006 to 2008; see Equation (5)). It reports the coefficients associated with the specification at the individual level (Equation (6)). The outcome of interest for all regressions is, starting with the sample of formal workers, the dummy equals 1 if the individual remains formally employed in the following year and 0 otherwise. Columns (1) to (3) are based on the exhaustive, matched, formal employer-employee data set. Columns (4) to (6) replicate the same specification using labor force survey data. Note that due to restrictions in access to labor force surveys, the "post" period corresponds to the transition years between 2012 and 2013 and 2015 and 2016, while the "pre" period corresponds to the baseline transition rate between 2007 and 2008.

TABLE 5: LABOR MARKET APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON THE TRANSITIONS TO INFORMAL EMPLOYMENT, UNEMPLOYMENT AND OUT OF FORMALITY

	LFS: Formal to Informal			LFS: Formal to Unemployment			LFS: Formal to Out of LF		
	All	Female	Male	All	Female	Male	All	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)	(9)	
Strong Exp. x 2013-2015	0.0418***	0.0507**	0.0345	0.0015	0.0020	0.0015	0.0121	0.0059	0.0246
	(0.0170)	(0.0199)	(0.0318)	(0.0062)	(0.0069)	(0.0146)	(0.0110)	(0.0089)	(0.0422)
N	35,771	11,051	24,720	35,771	11,051	24,720	35,771	11,051	24,720

Note: Table 5 reports difference-in-differences estimates for the impact of the region's exposure to the minimum wage increases, where the exposure is measured as the average share of workers below the minimum wage in the years before the increases (2006 to 2008; see Equation (5)). It reports the coefficients associated with the specification at the individual level (equation (6)). The outcomes are defined for all workers initially formally employed. For columns (1) to (3), the dependent variable is a dummy that equals 1 if the worker is employed informally the following year and 0 otherwise. For columns (4) to (6), the dependent variable is a dummy equal to 1 if the individual becomes unemployed in the following year. For columns (7) to (9), the dependent variable is a dummy that equals 1 if the individual transitions out of the labor force in the following year and 0 otherwise. Note that, due to restrictions in access to labor force surveys, the "post" period corresponds to the years of transitions between 2012 and 2013 and 2015 and 2016, while the period "pre" period corresponds to the baseline transition rate between 2007 and 2008.

TABLE 6: INDIVIDUAL APPROACH – IMPACT ON OVERALL WAGE GROWTH AND ROLE OF FIRM EXIT

	Bottom Wage Bins]80; 100]			**Middle Wage Bins**]100; 160]			**Upper Wage Bins**]160; 300]			**Bottom vs. Top**			**Mid vs. Top**
	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	F - M
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A: Real Daily Wage Growth (workers initially formally employed, assuming = 0 for leavers)													
Years 2010-2016	0.0717	0.0592	0.0125	0.0716	0.0352	0.0359	0.0028	0.0053	-0.0019	0.0689	0.0538	0.0144	0.0378
	(0.003)***	(0.003)***	(0.003)***	(0.005)***	(0.004)***	(0.006)***	(0.007)	(0.005)	(0.006)	(0.007)***	(0.005)***	(0.007)**	(0.008)***
Average change 2006-2008	-0.0006	0.0414		-0.0237	0.034		0.0689	0.0675					
N	847400	568370	1415773	681779	776135	1457916	101668	376149	477817	1630847	1720654	3351506	3351506
Panel B: Real Daily Wage Growth (workers initially formally employed, assuming =-1 for leavers)													
Years 2010-2016	0.022	0.0529	-0.0306	0.0387	0.0298	0.0095	-0.0246	0.0123	-0.0348	0.0466	0.0406	0.0042	0.0443
	(0.009)**	(0.007)***	(0.007)***	(0.009)***	(0.008)***	(0.010)	(0.009)***	(0.008)	(0.009)***	(0.011)***	(0.011)***	(0.010)	(0.013)***
Average change 2006-2008	-0.2215	-0.1709		-0.1687	-0.1024		-0.0409	-0.0429					
N	847400	568370	1415773	681779	776135	1457916	101668	376149	477817	1630847	1720654	3351506	3351506
Panel C: Exit Firm Because of Firm Exit (workers initially formally employed)													
Years 2010-2016	0.0257	-0.002	0.027	0.0033	0.0057	-0.0038	0.0231	0.0023	0.0192	0.0026	-0.0043	0.0078	-0.0229
	(0.010)***	(0.008)	(0.009)***	(0.023)	(0.007)	(0.020)	(0.011)**	(0.005)	(0.009)**	(0.015)	(0.007)	(0.013)	(0.018)
Average change 2006-2008	0.054	0.0667		0.063	0.0426		0.034	0.0317					
N	847587	568570	1416160	681900	776362	1458264	101681	376194	477875	1631168	1721126	3352299	3352299
Panel D: Exit Formal Work Because of Firm Exit (workers initially formally employed)													
Years 2010-2016	0.0146	-0.0045	0.0183	0.0116	0.001	0.0089	0.0127	0.0007	0.0111	0.0019	-0.0051	0.0072	-0.0022
	(0.004)***	(0.003)	(0.004)***	(0.005)**	(0.004)	(0.004)**	(0.004)***	(0.002)	(0.004)***	(0.006)	(0.003)*	(0.006)	(0.005)
Average change 2006-2008	0.0274	0.0389		0.0215	0.0215		0.0158	0.014					
N	847587	568570	1416160	681900	776362	1458264	101681	376194	477875	1631168	1721126	3352299	3352299

Note: Table 6 reports, by gender and comparing two groups of workers, the excess two-year change in outcomes in the years of minimum wage increases relative to the two-year change in the reference period, between 2006 and 2007. Columns (1) and (2) indicate the coefficient $\beta_{\text{bot, post}}$ of Equation 2 for workers who earned less than 100 MAD at the beginning of the two-year period. Column (3) indicates, for the same group of low-wage workers, the gender differences in impact. Columns (4) to (6) report the same for middle-wage bin workers: $\beta_{\text{middle, post}}$. Columns (7) and (9) indicate the coefficient $\beta_{\text{top, post}}$ for higher-wage workers who initially earn more than 160 MAD and that we do not expect to be affected by increases in minimum wage. Columns (10) to (12) report difference-in-differences estimates that compare the excess 2-year changes for workers directly affected by the minimum wage changes with the excess two-year changes for workers higher up in the distribution (coefficient $\beta_{\gamma\delta|\text{top}}$ in equation 4). In Panel A, I consider the impact on wage growth when assigning a wage growth of 0 to workers who leave formal employment. In Panel A, the impact on wage growth is considered when assigning a wage growth of -1 to workers who leave formal employment. Panel C examines the probability that the worker leaves their employer in the two-year interval following the firm closing. Panel C examines the probability that the worker leaves formal employment in the two-year interval following the firm closing.

TABLE 7: INDIVIDUAL APPROACH – IMPACT OF MINIMUM WAGE INCREASES ON FORMAL LABOR MARKET REALLOCATION

	Bottom Wage Bins]80; 100]			**Middle Wage Bins**]100; 160]			**Upper Wage Bins**]160; 300]			**Bottom vs. Top**			**Mid vs. Top**
	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	Female	Male	F - M	F - M
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A: Transition to another firm (workers initially formally employed)													
Years 2010-2016	0.0294	0.0134	0.0165	0.0161	0.0097	0.0084	0.0083	-0.0018	0.0074	0.0211	0.0152	0.0091	0.001
	(0.016)*	(0.011)	(0.013)	(0.023)	(0.007)	(0.019)	(0.010)	(0.006)	(0.009)	(0.013)	(0.013)	(0.013)	(0.017)
Average change 2006-2008	0.23	0.2281		0.1429	0.1552		0.1112	0.1083					
N	632338	445374	1077714	568595	664580	1233175	88351	337150	425501	1289284	1447104	2736390	2736390
Panel B: Transition to a firm with higher median wage (workers staying formally employed)													
Years 2010-2016	0.0244	0.0148	0.0101	0.0152	0.0044	0.0116	0.0071	0.0015	0.0046	0.0173	0.0134	0.0055	0.007
	(0.007)***	(0.008)*	(0.006)	(0.004)***	(0.003)*	(0.003)***	(0.004)*	(0.002)	(0.004)	(0.007)**	(0.008)	(0.007)	(0.005)
Average change 2006-2008	0.0988	0.1089		0.0223	0.0398		0.0332	0.0281					
N	632338	445374	1077714	568595	664580	1233175	88351	337150	425501	1289284	1447104	2736390	2736390
Panel C: Transition to firm with more than 200 employees (workers staying formally employed)													
Years 2010-2016	0.028	0.0067	0.022	0.0143	0.0041	0.0117	0.0069	-0.0007	0.005	0.0211	0.0074	0.017	0.0067
	(0.012)**	(0.009)	(0.011)*	(0.023)	(0.006)	(0.019)	(0.009)	(0.005)	(0.008)	(0.011)**	(0.011)	(0.010)	(0.016)
Average change 2006-2008	0.1383	0.1071		0.0873	0.0783		0.0453	0.0464					
N	632338	445374	1077714	568595	664580	1233175	88351	337150	425501	1289284	1447104	2736390	2736390
Panel D: Transition to main employers within LLM (workers staying formally employed)													
Years 2010-2016	0.0067	0.0	0.0074	-0.0103	-0.0015	-0.0085	-0.0023	-0.0018	-0.0013	0.009	0.0018	0.0087	-0.0072
	(0.004)*	(0.002)	(0.003)**	(0.022)	(0.003)	(0.019)	(0.004)	(0.002)	(0.003)	(0.003)***	(0.002)	(0.004)**	(0.017)
Average change 2006-2008	0.0126	0.0117		0.0273	0.0121		0.008	0.0093					
N	632338	445374	1077714	568595	664580	1233175	88351	337150	425501	1289284	1447104	2736390	2736390
Panel E: Transition to one of the three main employers within LLM (workers staying formally employed)													
Years 2010-2016	0.0172	0.0004	0.0176	-0.0035	-0.0033	0.0012	-0.0012	-0.0032	0.001	0.0184	0.0036	0.0166	0.0002
	(0.006)***	(0.003)	(0.006)***	(0.021)	(0.004)	(0.018)	(0.005)	(0.003)	(0.004)	(0.005)***	(0.004)	(0.007)**	(0.016)
Average change 2006-2008	0.032	0.0235		0.0345	0.0232		0.0134	0.0175					
N	632338	445374	1077714	568595	664580	1233175	88351	337150	425501	1289284	1447104	2736390	2736390

Note: Table 7 reports, by gender and comparing two groups of workers, the excess two-year change in outcomes in the years of minimum wage increases relative to the two-year change in the reference period, between 2006 and 2007. Columns (1) and (2) indicate the coefficient $\beta_{\text{bot, post}}$ of Equation 2 for workers who earned less than 100 MAD at the beginning of the two-year period. Column (3) indicates, for the same group of low-wage workers, the gender differences in impact. Columns (4) to (6) report the same for middle-wage bin workers: $\beta_{\text{middle, post}}$. Columns (7) and (9) indicate the coefficient $\beta_{\text{top, post}}$ for higher-wage workers who initially earn more than 160 MAD and that we do not expect to be affected by increases in the minimum wage. Columns (10) to (12) report difference-in-differences estimates that compare the excess 2-year changes for workers directly affected by the minimum wage changes with the excess two-year changes for workers higher up in the distribution (coefficient $\beta_{\gamma\delta|\text{top}}$ in equation 4). All panels refer to workers who remained formally employed for the two-year period. Panel A examines the transition to another firm, Panel B to a firm with a higher median wage (where a higher median wage is defined as firms having a median wage ranking in that year 15% higher than the ranking of the initial firm in which the worker was employed), Panel C transitions to a firm with more than 200 employees and Panel D & E transitions to the main employer(s) within the local labor market.

TABLE 8: INDIVIDUAL APPROACH – HETEROGENEITY BY OUTSIDE OPTION INDEX, FEMALE WORKERS

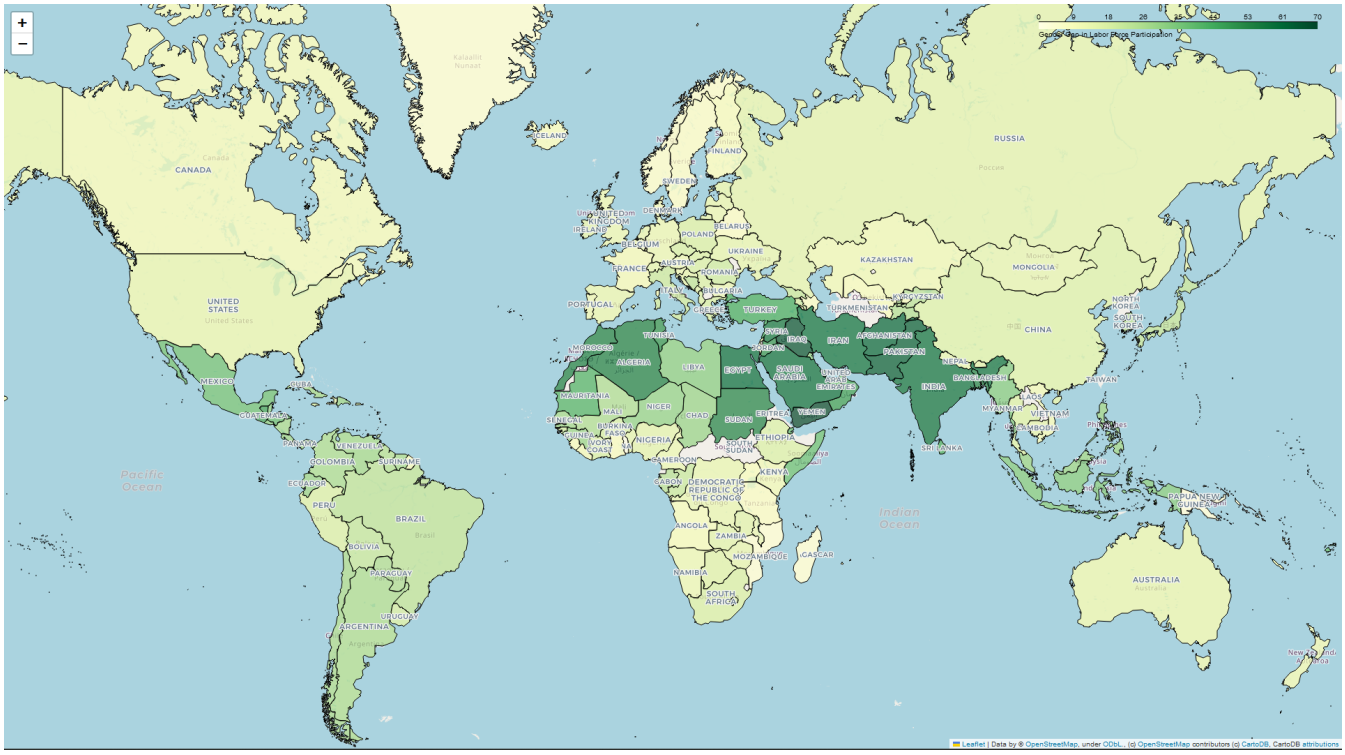
	Probability of Leaving Formal Employment After Two Years:			
	All	Bottom Tercile of OOI	Middle Tercile of OOI	Top Tercile of OOI
	(1)	(2)	(3)	(4)
Years 2009-2016	0.023	0.045	0.013	0.009
	(0.011)**	(0.006) ***	(0.007)*	(0.017)
N	1,649,695	570,130	567,769	519,782

Note: Table 8 reports, for female workers only, the excess two-year exit rate from formal employment in the years of minimum wage increases relative to the two-year change in the reference period, between 2006 and 2007. Column (2) restricts the regressions to workers in the bottom tercile of the outside option index, column (3) the middle tercile, and column (4) the top tercile.

Appendices

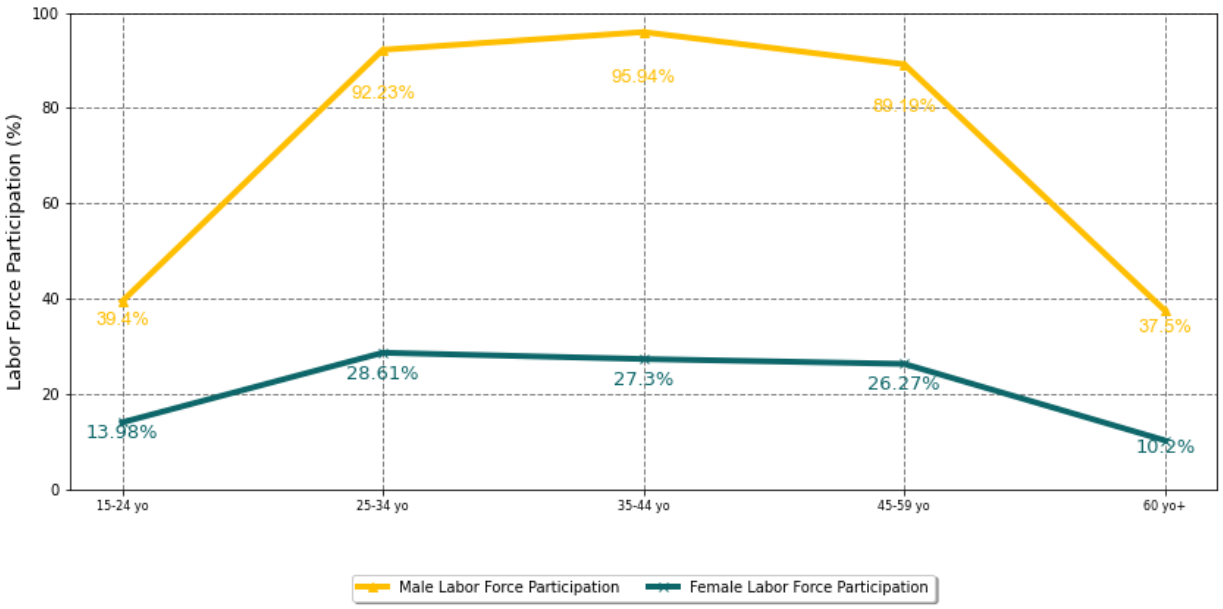
A Appendix Figures and Tables

FIGURE A.1: GENDER GAPS IN LABOR FORCE PARTICIPATION ACROSS THE WORLD



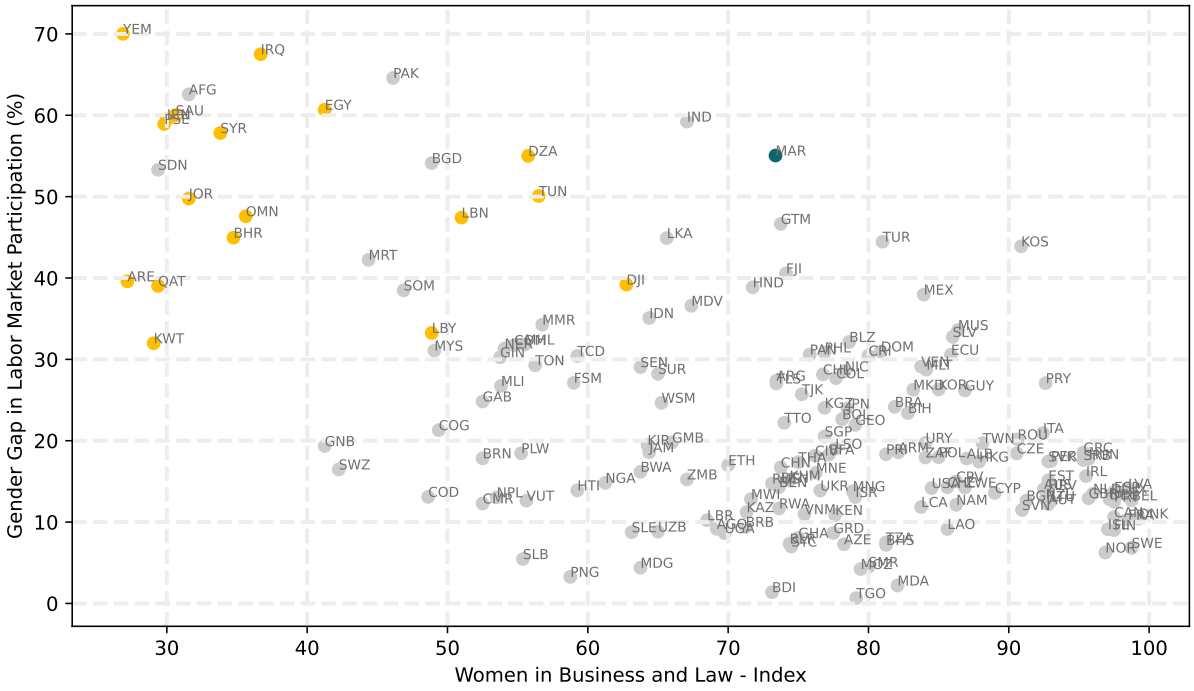
Note: This figure shows the gaps in labor force participation. It is calculated as the percentage of active men minus the percentage of active women among 15-60 yo individuals.
Source: ILO.

FIGURE A.2: LARGE GENDER GAP IN LABOR FORCE PARTICIPATION ALL ALONG THE AGE DISTRIBUTION



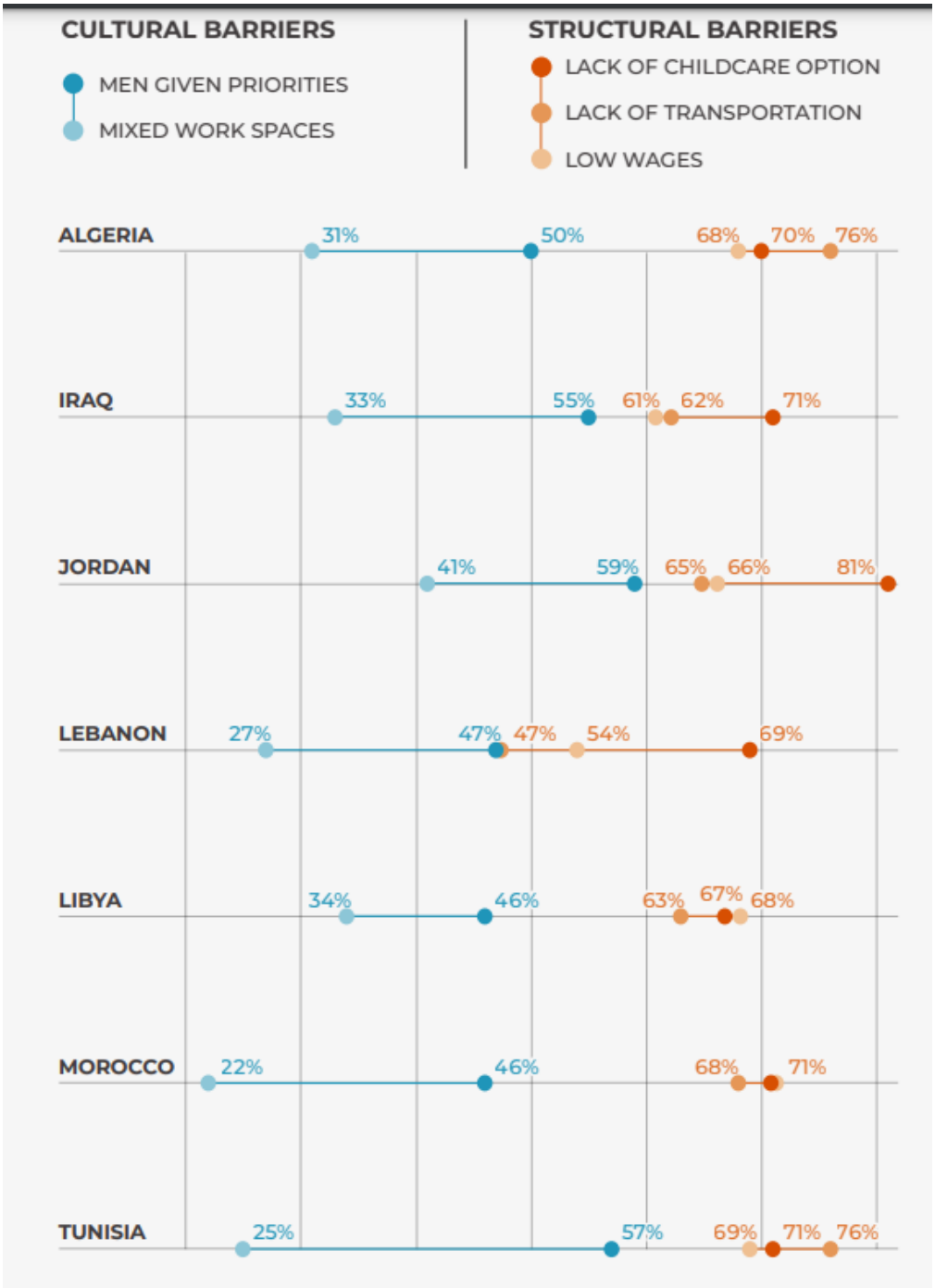
Note: Figure A.2 reports the share of the active population for 15-60 year old individuals.
Source: ENE, HCP.

FIGURE A.3: *Women, Business and the Law* INDICATOR & GENDER GAP IN LFP: 2008



Note: Figure A.3 plots how the gender gap in labor market participation correlates with the Women, Business and the Law (WBL) Index in 2008. Morocco in Green; other MENA countries in yellow.
Source: World Bank, ILO.

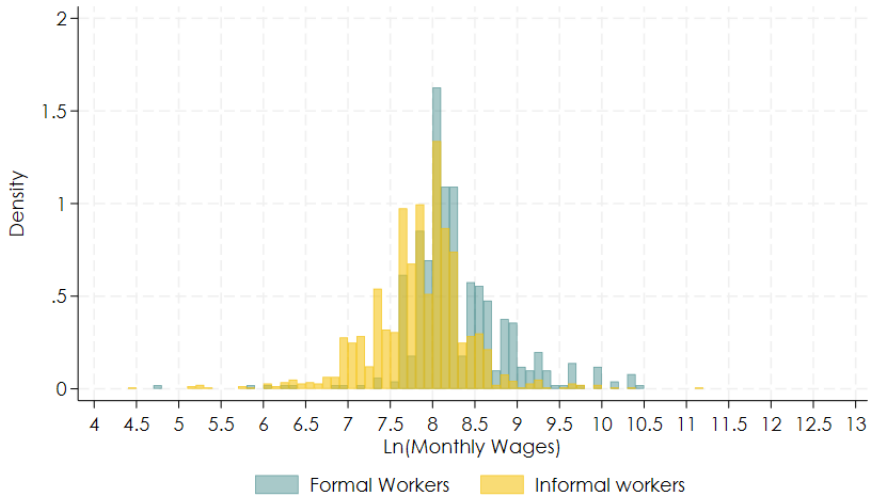
FIGURE A.4: *Arab Barometer* INDICATOR & GENDER GAP IN LFP: 2021



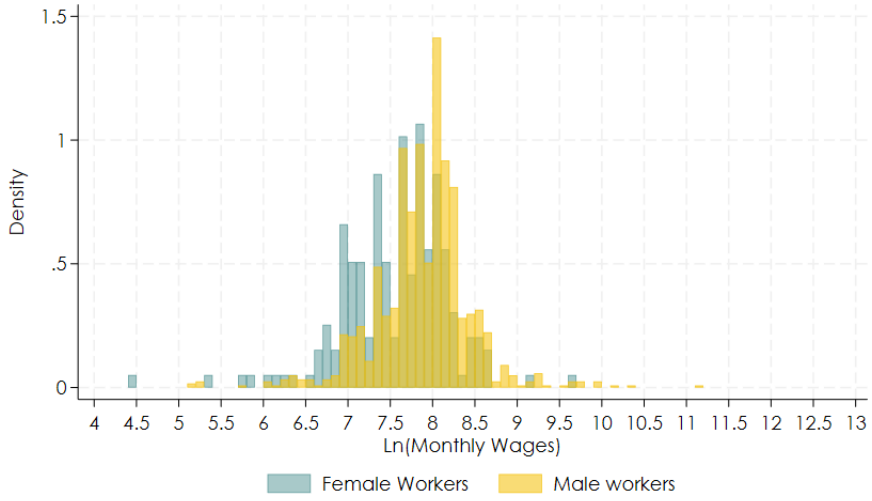
Note: Note: Figure A.4 reports the percentage of respondents who reported cultural or structural barriers as the main barrier to entry into the workforce for women.
Source: Arab Barometers, Wave 6, March-April 2021.

FIGURE A.5: DISTRIBUTION OF MONTHLY WAGES IN THE MOROCCAN NON-AGRICULTURAL PRIVATE FORMAL AND INFORMAL SECTORS

(a) Formal and informal log monthly wages

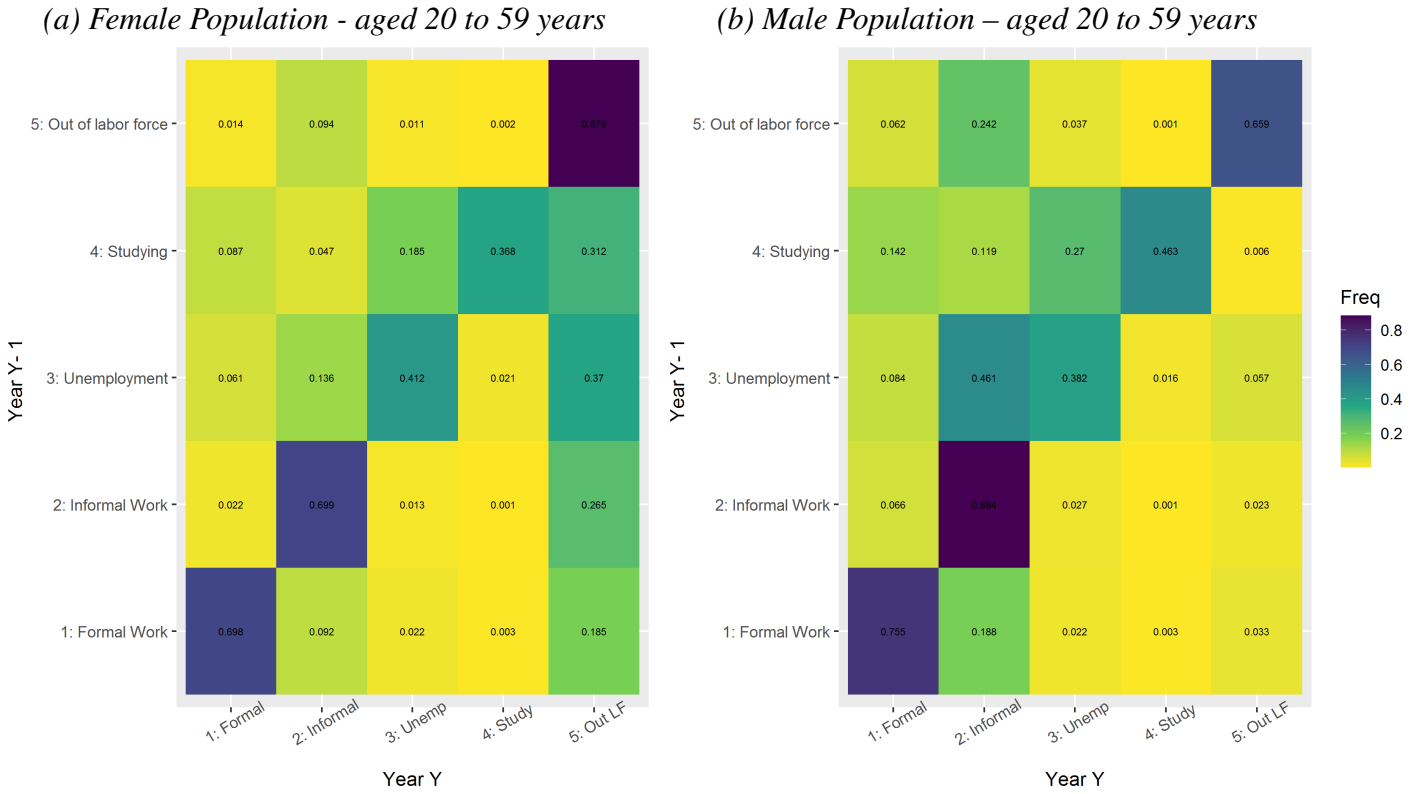


(b) Informal log monthly wages for male and female workers



Note: Figure A.5 shows the histograms of monthly wages for formal and informal workers, when restricting the sample to active non-agricultural private sector workers aged 15 to 60 years.
Source: ONDH-MEL data, 2021.

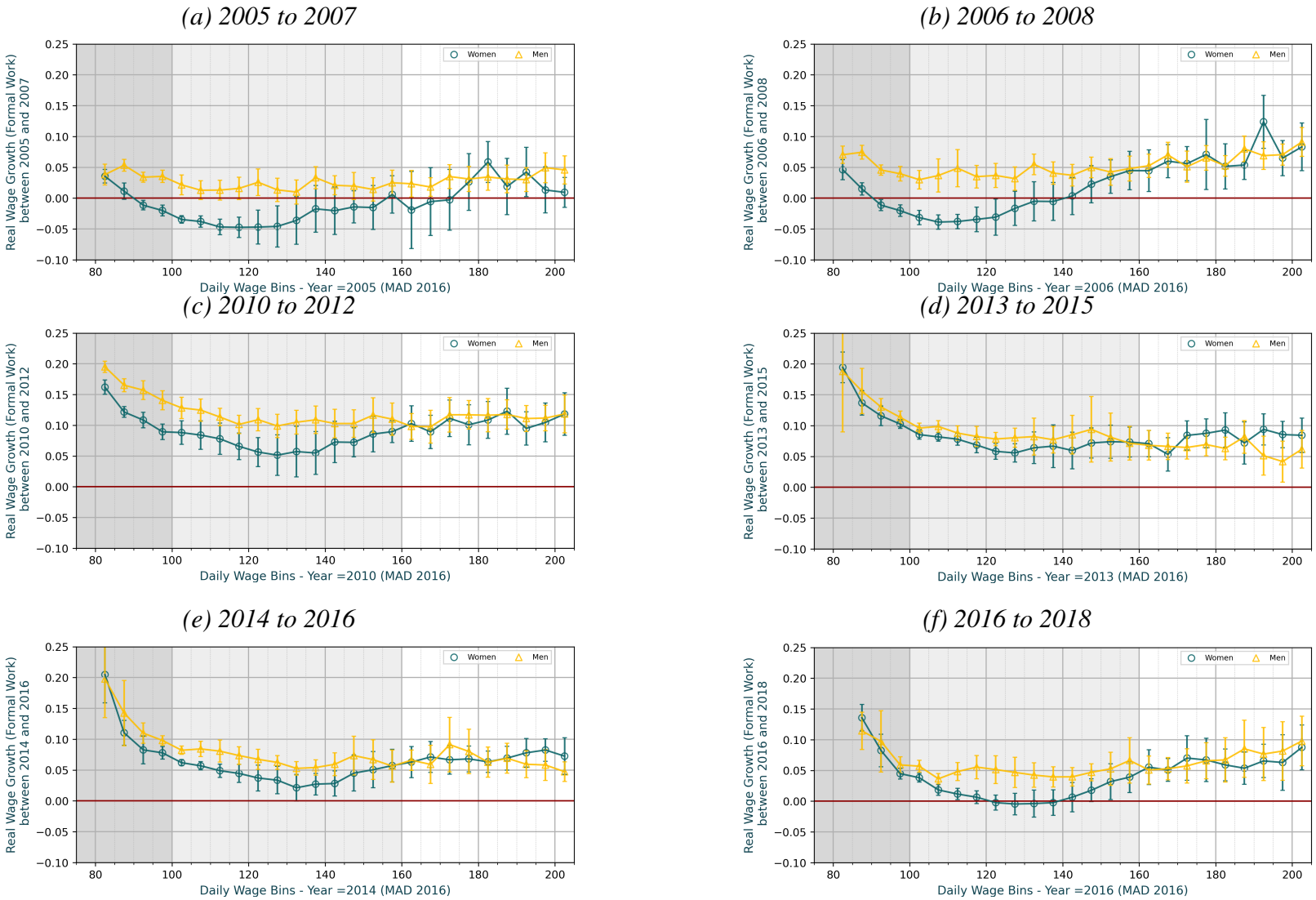
FIGURE A.6: WHEN EXITING FORMAL EMPLOYMENT, WOMEN TEND TO TRANSITION OUT OF THE LABOR FORCE



Note: Each row corresponds to an initial status in year $t-1$ (here 2010). The columns correspond to the employment status in year t. In each cell, the percentage of people who transition from the state indicated in the row to the state indicated in the column is reported. For example, 18.5% of the women initially employed formally leave the labor force.

Source: National Labor Force Surveys, HCP.

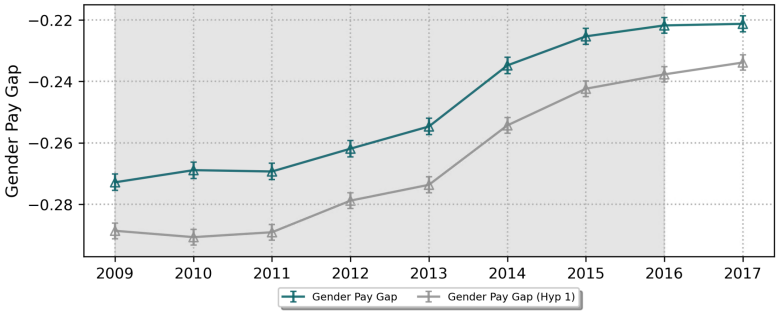
FIGURE A.7: INDIVIDUAL APPROACH: RAW TWO-YEAR REAL WAGE GROWTH BY INITIAL WAGE BINS



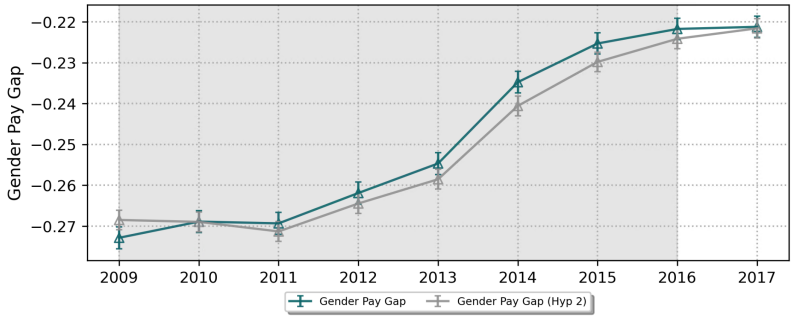
Note: These figures plot the coefficient $\beta_{k\delta}$ from Equation 1, that is, in each wage bin k, the unconditional change in the daily average real wage between t-2 and t, without including any controls. The sample includes all incumbent workers (i.e. present at both $t-2$ and t) and who are 20 to 59 year old. The coefficients for female workers are reported in green and those for male workers in yellow.

FIGURE A.8: INDIVIDUAL APPROACH: EVOLUTION OF THE GENDER PAY GAP TAKING INTO ACCOUNT EXIT FROM FORMAL EMPLOYMENT

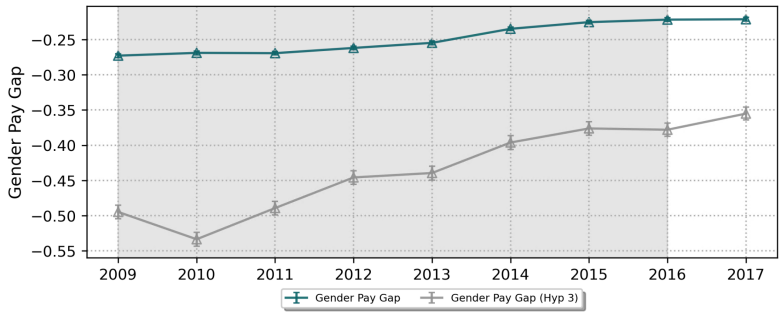
(a) Hypothesis 1



(b) Hypothesis 2



(c) Hypothesis 3

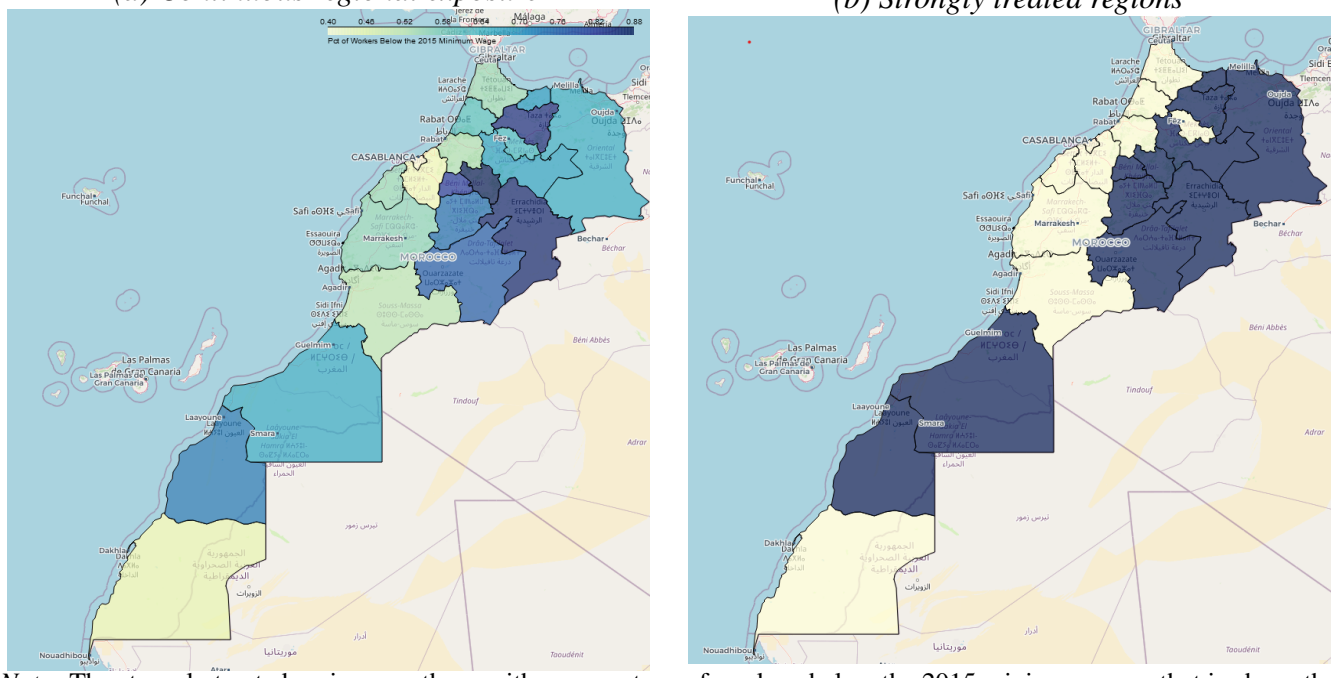


Note: These figures plot the gender pay gaps under different assumptions for imputing the wage of workers that exit formal employment.

FIGURE A.9: REGIONAL EXPOSURE TO THE MINIMUM WAGE INCREASES

(a) Continuous regional exposure

(b) Strongly treated regions



Note: The strongly treated regions are those with a percentage of workers below the 2015 minimum wage that is above the median across regions in the pre-changes years.
missing monthly earnings variable. There are 14 strongly treated states (and 13 weakly treated states).
Source: CNSS.

FIGURE A.10: DISTRIBUTION OF OUTSIDE OPTION INDEX

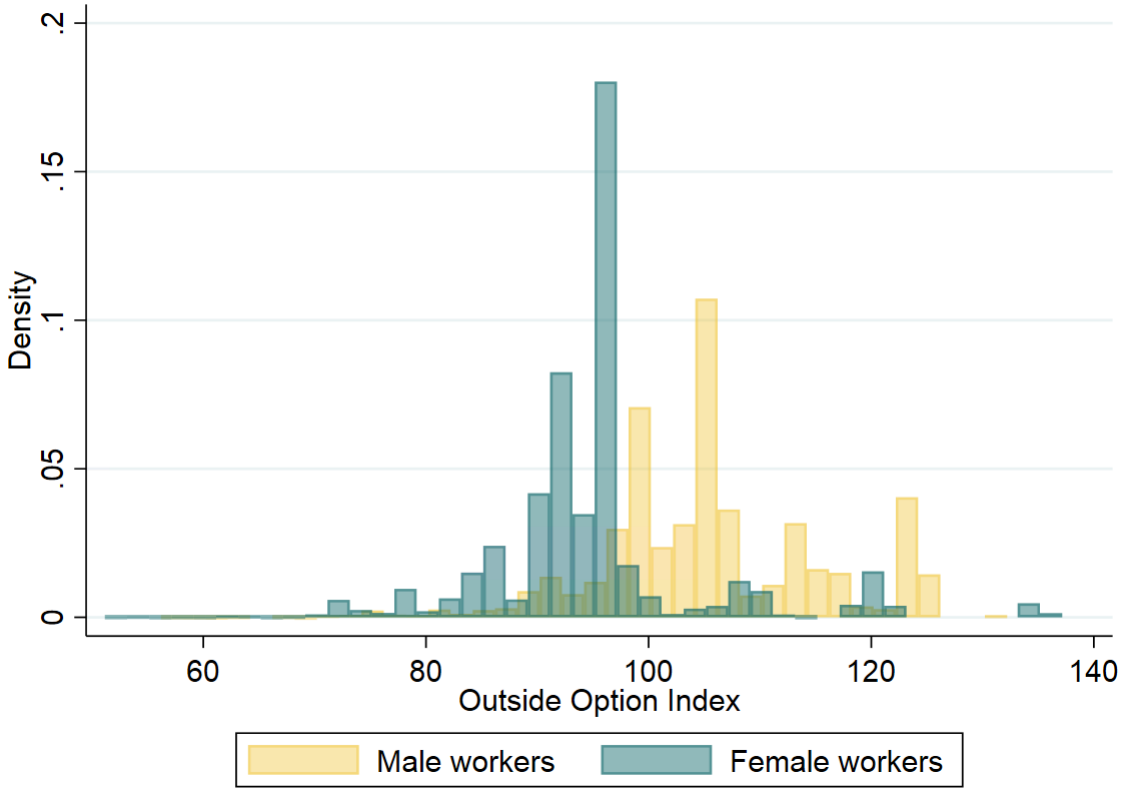
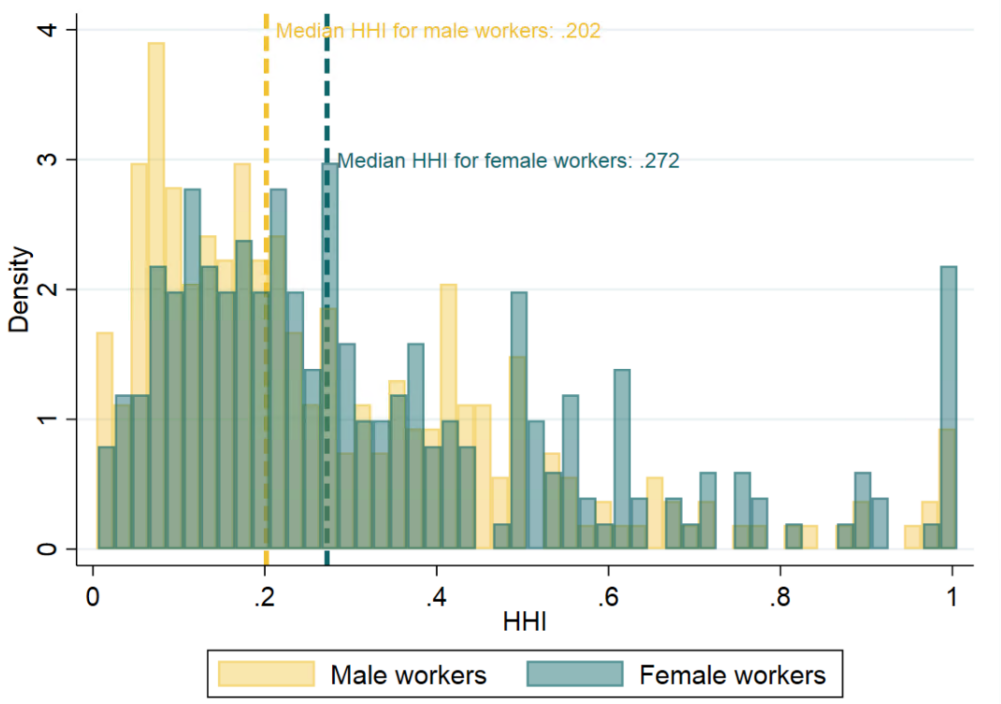


FIGURE A.11: LOCAL LABOR MARKET CONCENTRATION: HHI & EMPLOYMENT SHARE OF TWO AND THREE LARGEST EMPLOYERS WITHIN LOCAL LABOR MARKETS

(a) LLM Herfindahl–Hirschman Index

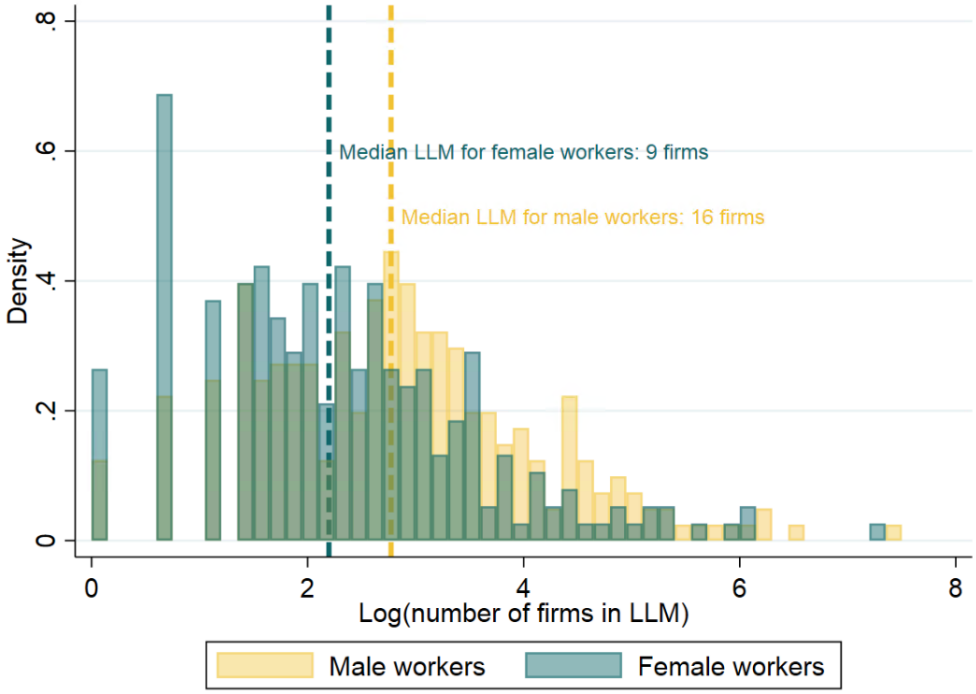


(b) Employment share of largest two employers



FIGURE A.12: NUMBER OF FIRMS AND WORKERS BY LLMS

(a) Distribution of the number of firms within a LLM



(b) Distribution of the number of workers within a LLM

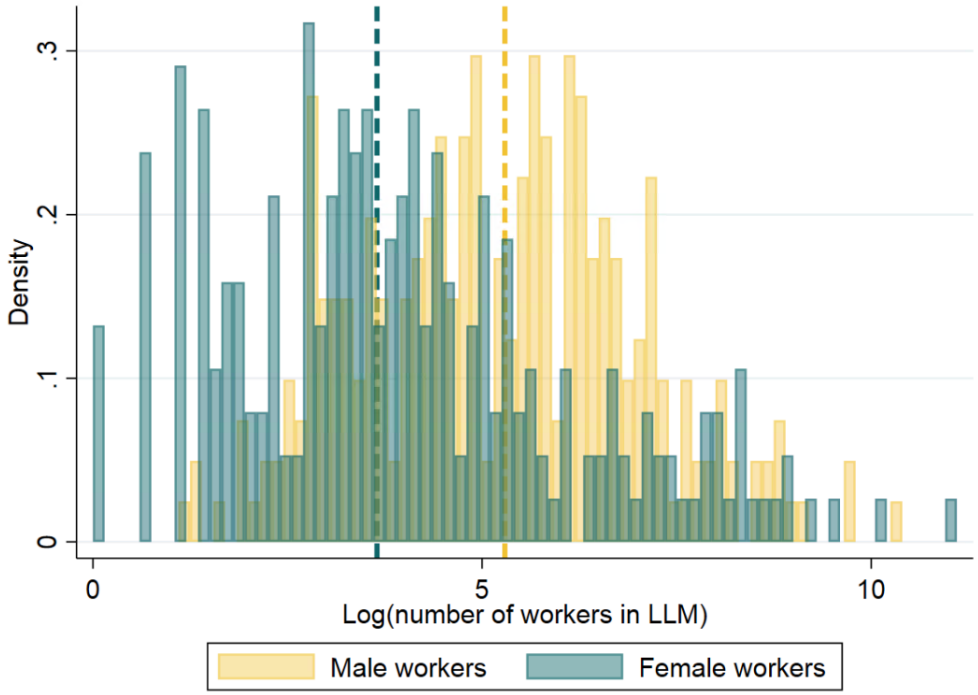
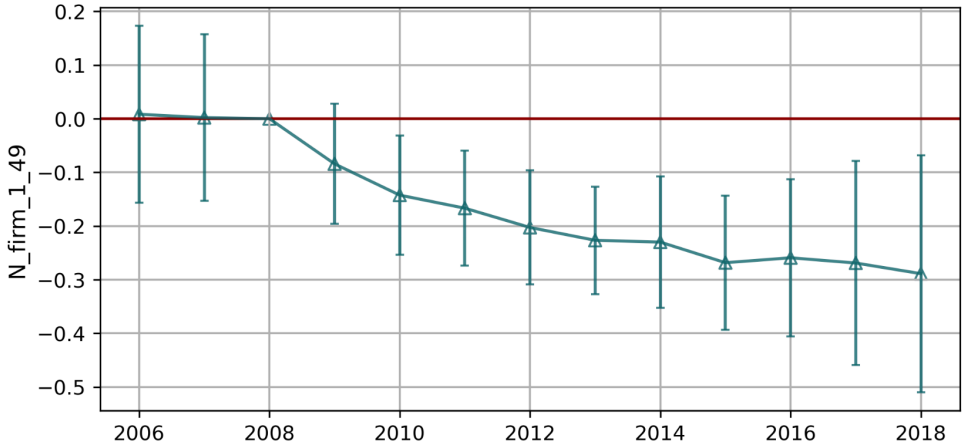
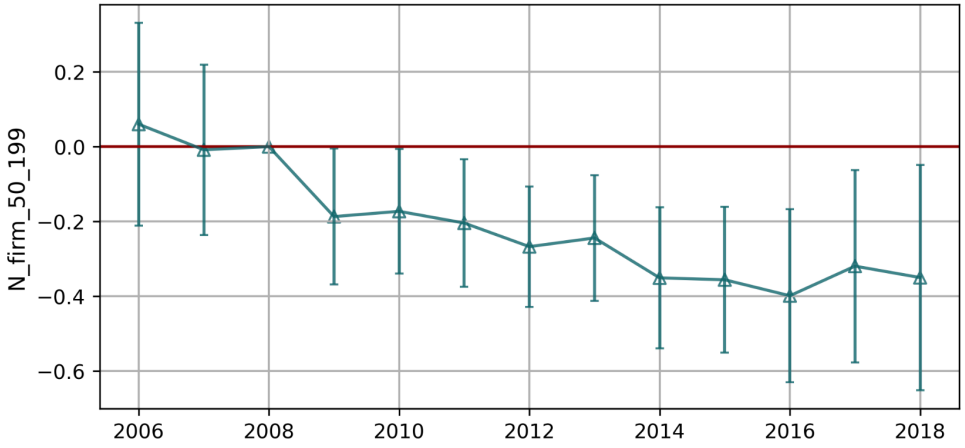


FIGURE A.13: EVOLUTION OF CUMULATIVE GROWTH RATE FOR THE NUMBER OF FIRMS OF 1-49, 50-199 AND MORE THAN 200 EMPLOYEES IN STRONGLY VS. WEAKLY TREATED LOCAL LABOR MARKETS

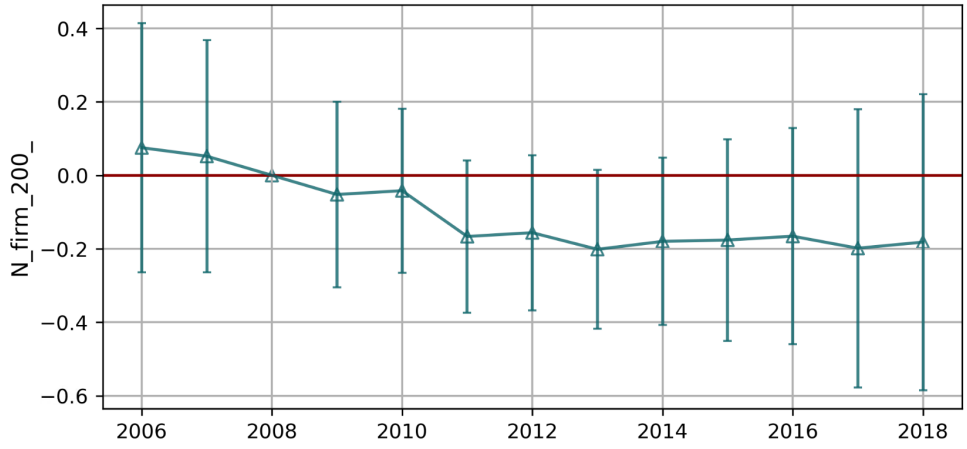
(a) Firms from 1 to 49 employees



(b) Firms from 50 to 199 employees



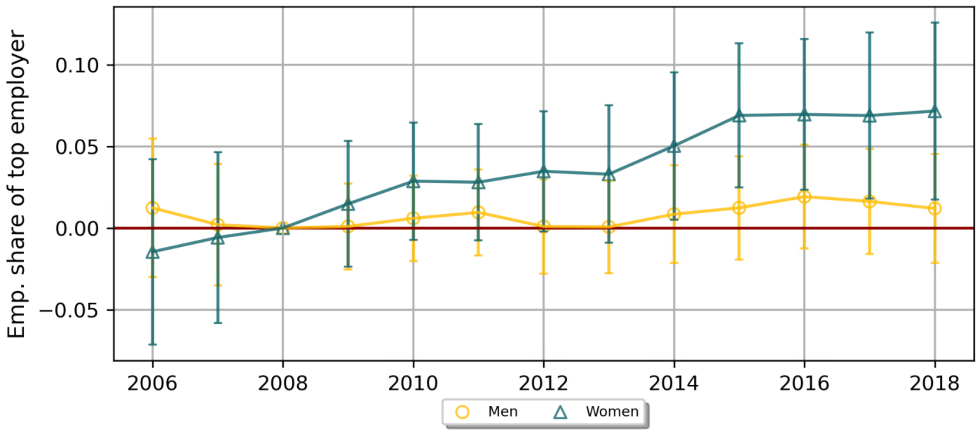
(c) Firms with more than 200 employees



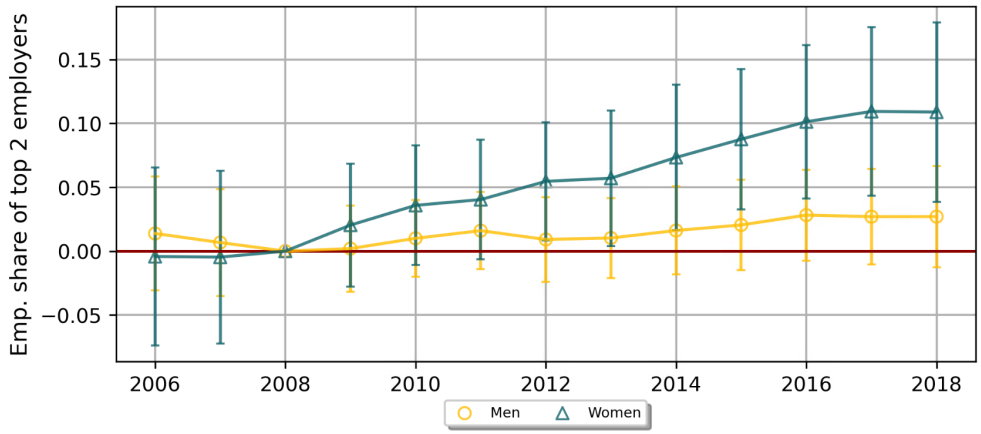
Note: These figures plot the coefficients of the difference-in-differences specified in Equation 9 where the strongly treated local labor markets (LLMs) are LLMs with a percentage of workers below the 2015 minimum wage that is above the median across regions in the pre-changes years. Panel (a) traces the impact on the cumulative growth rate of the number of firms that have between 1 and 49 employees taking 2008 as a reference year, i.e. for local labor market $l, \Delta y^{(l)}_{t,2008} = (N^{(l)}_t - N^{(l)}_{2008})/N^{(l)}_{2008}$. Panel (b) reports the same for firms from 50 to 199 employees, and Panel (c) for firms with more 200 employees.

FIGURE A.14: SHARE OF EMPLOYMENT IN TOP 1,2 OR 3 LARGEST FIRM(S) WITHIN THE LLM IN STRONGLY VS. WEAKLY TREATED LLM

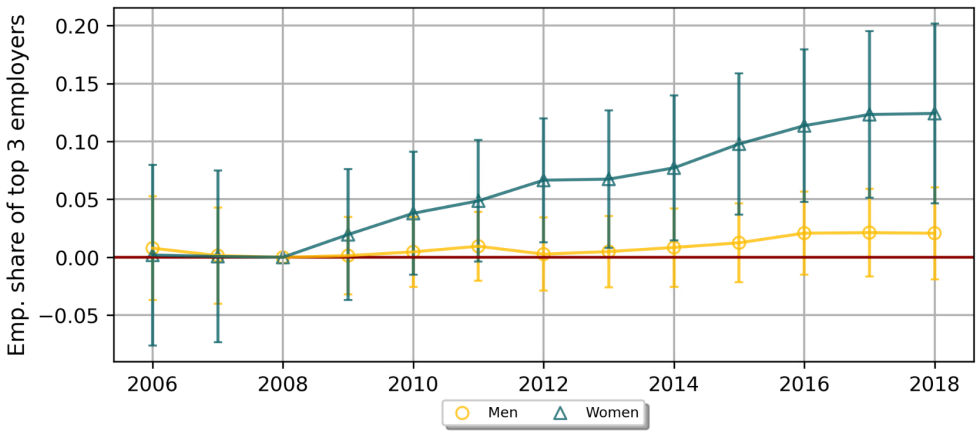
(a) Largest LLM employer



(b) Two largest LLM employers

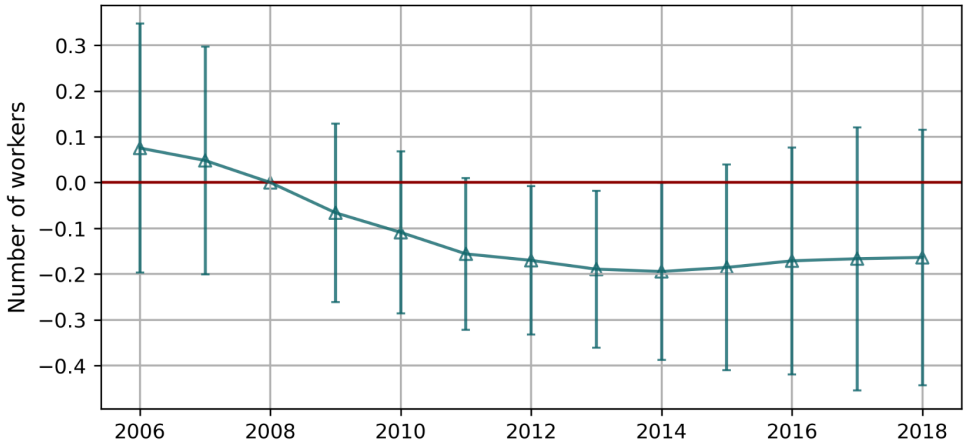


(c) Three largest LLM employers



Note: These figures plot the coefficients of the difference-in-differences specified in Equation 9 where the strongly treated local labor markets (LLMs) are LLMs with a percentage of workers below the 2015 minimum wage that is above the median across regions in the pre-changes years. Panel (a) traces out the share of employment at the largest employers, Panel (b) for the two largest employers and Panel (c) for the three largest employers.

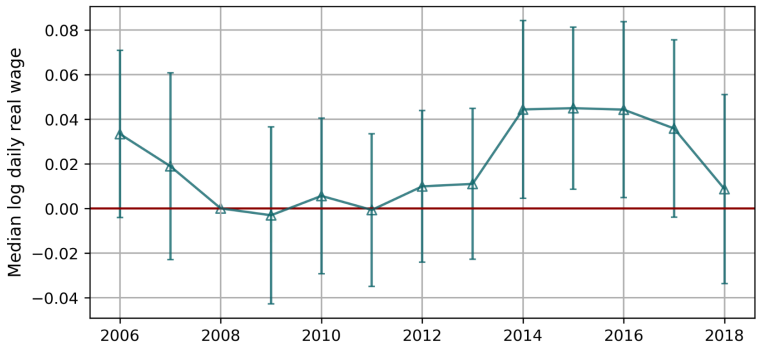
FIGURE A.15: GROWTH RATE OF THE TOTAL NUMBER OF WORKERS IN STRONGLY VS. WEAKLY TREATED LOCAL LABOR MARKETS



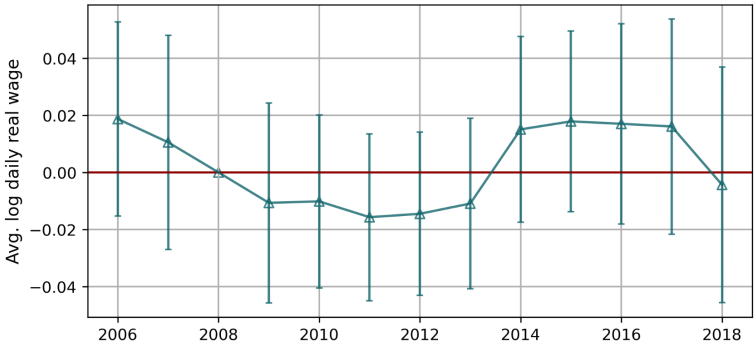
Note: This figure plots the coefficients of the difference-in-differences specified in Equation 9 where the strongly treated local labor markets (LLMs) are LLMs with a percentage of workers below the 2015 minimum wage that is above the median across regions in the pre-changes years. It traces out the change in the number of workers taking as reference 2008.

FIGURE A.16: IMPACT ON THE AVERAGE AND MEDIAN DAILY WAGES IN STRONGLY VS. WEAKLY TREATED LOCAL LABOR MARKETS

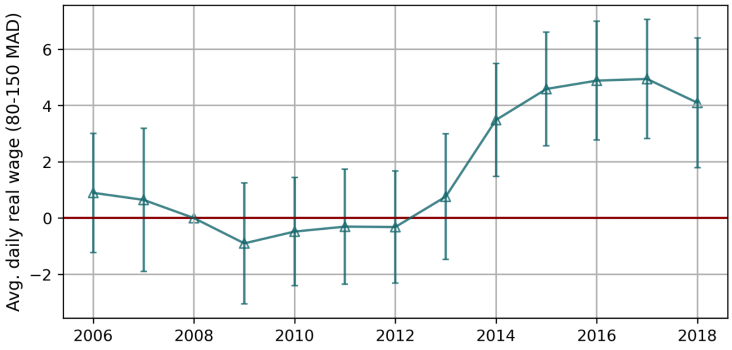
(a) Median log real daily wage



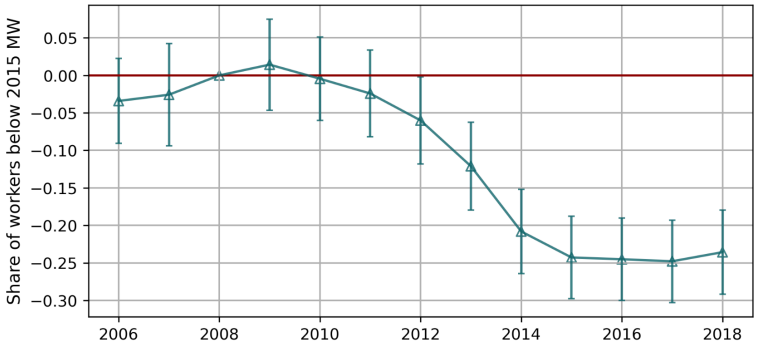
(b) Average log real daily wage



(c) Average real daily wage for workers between 80 and 150 MAD



(d) Share of workers below the 2015 minimum wage



Note: The figures plots the coefficients of the difference-in-differences specified in Equation 9 where the strongly treated local labor markets (LLMs) are LLMs with a percentage of workers below the 2015 minimum wage that is above the median across regions in the pre-changes years. Panel (a) traces the evolution of the within LLM median log real daily wage, Panel (b) the average of the log real daily wage, Panel (c) the log real daily wage for workers having a real daily wage above 80 MAD and below 150 MAD, Panel (d) tracks the share of workers below the 2015 minimum wage.

TABLE A.1: SHARE OF INFORMAL WORKERS BY SECTOR AND GENDER – 2019

	All Workers	Female Workers	Male Workers
1: Manufacturing	58.8%	56.1%	58.4%
2: Construction	85.3%	15.8%	85.9%
3: Market services	74.9%	65.9%	76.9%
4: Non-Market Services	13.5%	21.1%	9.35%
5: Agriculture	94.9 %	92.8%	98.3%
Private Sector Workers (all sectors)	73.2%	72.2%	73.6%
Private Sector Workers (excluding agriculture)	61.7%	49.0%	64.9%

Note: This table provides the share of informal workers by sector and gender in 2019.
Source: ENE, HCP.

TABLE A.2: SHARE OF WORKERS AND INFORMAL WORKERS BY FIRMS' SIZE – 2019

	Pct. Workers All	Pct. Informal All	Pct. Workers Male	Pct. Informal Male	Pct. Workers Female	Pct. Informal Female
	(1)	(2)	(3)	(4)	(5)	(6)
1-4 employees	56.93%	95.03%	53.71%	94.80%	72.99%	95.89%
5-9 employees	32.43%	94.41%	37.34%	95.27%	7.95%	74.29%
10-19 employees	2.78%	35.12%	2.44%	36.09%	4.44%	32.46%
20-49 employees	2.87%	14.82%	2.39%	14.42%	5.26%	15.73%
50-199 employees	2.89%	9.68%	2.37%	9.26%	5.48%	10.57%
200+ employees	2.10%	5.94%	1.75%	5.07%	3.88%	7.90%

Note: This table provides the share of informal workers by firm size and gender in 2019.
Source: ENE, HCP.

TABLE A.3: WAGE GAPS: INFORMALITY AND GENDER, ONDH DATA (2021)

	Log(Monthly Wage) (1)	Log(Monthly Wage) (2)	Log(Monthly Wage) (3)
Informal	-0.459	-0.347	-0.358
	(0.034)***	(0.034)***	(0.034)***
Female	-0.210	-0.176	-0.147
	(0.060)***	(0.057)***	(0.057)***
Female x Informal	-0.100	-0.041	-0.020
	(0.075)	(0.072)	(0.071)
Constant	8.338	7.506	7.711
	(0.030)***	(0.261)***	(0.304)***
N	1893	1521	1521
FE: Demographics	No	Yes	Yes
FE: Demographics + Occupation	No	No	Yes

Note: Gender and Informality Wage Gap using ONDH Data. OLS regression includes in column (2): age, region, education, and marital status; in column (3), it also controls for workers' occupations. *Source*: ONDH, 2022.

TABLE A.4: WAGE GAPS: INFORMALITY AND GENDER, MANUFACTURING SECTOR

	Log(Monthly Wage) (1)	Log(Monthly Wage) (2)	Log(Monthly Wage) (3)
Informal	-0.440	-0.374	-0.347
	(0.064)***	(0.064)***	(0.063)***
Female	-0.292	-0.182	-0.197
	(0.089)***	(0.086)**	(0.084)**
Informal x Female	-0.072	-0.008	0.029
	(0.117)	(0.113)	(0.111)
Constant	8.255	7.750	6.881
	(0.051)***	(0.106)***	(0.235)***
N	380.000	319.000	319.000
FE: Demographics	No	Yes	Yes
FE: Demographics + Sector	No	No	Yes

Note: Gender and Informality Wage Gap using ONDH Data. OLS regression includes in column (2): age, region, education, and marital status; in column (3), it also controls for workers' occupations. *Source*: ONDH, 2022.

TABLE A.5: LOCAL LABOR MARKETS: KEY DESCRIPTIVE STATISTICS IN 2008

	All	Women	Men
	(1)	(2)	(3)
Conditional on having at least one worker in the LLM:			
Number of LLM	269	252	269
Avg number of workers per LLM	1688	867	876
Median number of workers per LLM	243	39	199
Avg number of employers per LLM	49	31	46
Median number of employers per LLM	17	9	16
Median share of LLM employment for largest LLM employer	34.6%	39.5%	34.2%
Median share of LLM employment for 2 largest LLM employers	55.7%	62.8%	53.8%
Median share of LLM employment for 3 largest LLM employers	66.5%	74.2%	66.7%
Median Employment HHI	0.21	0.27	0.20

TABLE A.6: LOCAL LABOR MARKETS: WITHIN AND ACROSS TRANSITION PATTERNS BETWEEN 2007 AND 2008

	All	Women	Men
	(1)	(2)	(3)
Conditional on having at least one worker:			
Number of LLM (when $N^g_{worker} > 0$)	269	252	269
Number of firms (when $N^g_{worker} > 0$)	13,085	7,786	12,424
Share of workers who transitioned to another firm (from 2007 to 2008)	9.6%	9.8%	9.3%
Out of workers transitioning, percent staying in…			
Province	77%	85%	70%
Manufacturing	67%	80%	55%
Manufacturing Sub-sectors	57%	74%	41%
LLM: Province x Sub-sector cell	50%	67%	33%

TABLE A.7: WHO ARE THE MINIMUM WAGE MANUFACTURING WORKERS? DESCRIPTIVE STATISTICS IN 2008

	All workers			Male workers			Female workers			All	M	F
	[80; 100[	[100; 160[	]160; 300]	[80; 100[	[100; 160[	]160; 300]	[80; 100[	[100; 160[	]160; 300]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Share of workers	0.365	0.477	0.162	0.286	0.470	0.243	0.441	0.485	0.074	-	-	-
Average daily wage	88.820	120.437	226.265	88.777	123.292	226.838	88.846	116.427	224.191	139.782	166.117	112.465
	6.123	15.943	51.564	6.096	16.290	51.685	6.139	14.524	51.073	121.768	146.327	80.820
Women	0.618	0.416	0.217	-	-	-	-	-	-	0.490	-	-
Average age	32.716	36.587	40.540	33.904	37.417	41.058	31.982	35.420	38.666	35.276	37.187	33.286
	8.896	9.410	9.426	9.546	9.864	9.579	8.385	8.599	8.594	9.703	10.195	8.730
By age												
Share less than 24	0.196	0.085	0.031	0.178	0.084	0.030	0.208	0.087	0.035	0.136	0.106	0.167
Share 25-34	0.436	0.382	0.264	0.404	0.355	0.251	0.456	0.421	0.311	0.389	0.342	0.437
Share 35-44	0.247	0.314	0.352	0.256	0.304	0.342	0.241	0.328	0.390	0.281	0.291	0.271
Share 45-59	0.121	0.219	0.352	0.162	0.258	0.377	0.095	0.164	0.263	0.194	0.261	0.124
Employment Status												
Formally employed in previous year	0.812	0.888	0.927	0.770	0.860	0.927	0.838	0.926	0.927	0.851	0.839	0.864
Formally employed in previous year and switched firm	0.099	0.060	0.037	0.080	0.052	0.038	0.110	0.070	0.034	0.077	0.059	0.095
Share full-time	0.605	0.877	0.961	0.666	0.916	0.966	0.568	0.821	0.943	0.743	0.828	0.654
Share full-time to half-time	0.138	0.052	0.023	0.099	0.036	0.020	0.163	0.075	0.033	0.079	0.048	0.120
Share half-time to full-time	0.264	0.426	0.555	0.271	0.523	0.581	0.260	0.360	0.484	0.291	0.325	0.274
By regions												
Casablanca	0.425	0.541	0.663	0.439	0.549	0.658	0.417	0.531	0.684	0.504	0.542	0.465
Rabat	0.115	0.100	0.087	0.103	0.102	0.089	0.123	0.096	0.077	0.105	0.097	0.113
Tangier	0.217	0.171	0.115	0.215	0.159	0.109	0.217	0.188	0.136	0.184	0.165	0.203
Fes	0.108	0.066	0.041	0.092	0.057	0.039	0.117	0.079	0.048	0.084	0.066	0.103
Other regions	0.135	0.122	0.094	0.151	0.134	0.105	0.126	0.107	0.055	0.123	0.130	0.116
By sector												
Food	0.181	0.151	0.210	0.209	0.161	0.232	0.163	0.136	0.133	0.180	0.203	0.155
Textile & clothing	0.561	0.407	0.219	0.345	0.287	0.193	0.694	0.576	0.314	0.454	0.278	0.636
Metallurgy	0.045	0.083	0.107	0.082	0.112	0.123	0.022	0.041	0.051	0.065	0.100	0.029
Electrical cabling	0.054	0.081	0.115	0.065	0.060	0.092	0.048	0.110	0.197	0.073	0.073	0.072
Other	0.159	0.279	0.349	0.299	0.380	0.361	0.072	0.137	0.304	0.229	0.345	0.107
By firm size												
1-4 Employees	0.056	0.019	0.018	0.119	0.026	0.018	0.017	0.009	0.021	0.039	0.061	0.015
5-9 Employees	0.048	0.020	0.023	0.097	0.027	0.023	0.018	0.009	0.024	0.035	0.053	0.016
10-49 employees	0.155	0.131	0.142	0.258	0.182	0.143	0.091	0.060	0.139	0.144	0.198	0.087
50-199 employees	0.241	0.267	0.271	0.246	0.317	0.279	0.237	0.196	0.238	0.253	0.276	0.229
200-499 employees	0.233	0.223	0.225	0.141	0.211	0.234	0.290	0.240	0.193	0.231	0.191	0.273
500+ employees	0.278	0.344	0.325	0.160	0.242	0.308	0.351	0.487	0.390	0.305	0.231	0.382

Note: This table compares manufacturing workers in different parts of the daily wage distribution in terms of location, age, working time status, industry affiliation, and establishment size in 2008. For the two continuous variables, age and average daily wage, the second row reports the standard deviation.

TABLE A.8: INDIVIDUAL APPROACH – PLACEBO TEST FOR IMPACT OF MINIMUM WAGE INCREASES ON WAGE AND EMPLOYMENT

	Bottom Wage Bins]80; 100]		**Middle Wage Bins**]100; 160]		**Upper Wage Bins**]160; 300]		**Bottom vs. Top**		**Mid vs. Top**	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Real Daily Wage Growth (workers staying formally employed)										
2007	0.0003	0.0036	0.0049	-0.0038	0.0071	0.0031	-0.0069	0.0005	-0.0023	-0.0069
	(0.004)	(0.003)	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)	(0.004)	(0.008)	(0.004)*
Panel B: Real Daily Wage Growth (workers staying in the same firm)										
2007	0.0002	0.0045	0.0052	-0.0018	0.0091	0.0038	-0.0089	0.0006	-0.0039	-0.0056
	(0.004)	(0.003)	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)	(0.004)	(0.008)	(0.004)
Panel C: Exit Firm (workers initially formally employed)										
2007	0.0083	-0.0003	-0.0216	0.0049	-0.0072	0.0041	0.0155	-0.0044	-0.0144	0.0008
	(0.004)**	(0.006)	(0.021)	(0.009)	(0.007)	(0.006)	(0.008)*	(0.008)	(0.018)	(0.007)
Panel D: Exit Formal Work (workers initially formally employed)										
2007	-0.0017	0.0016	-0.0038	0.0065	0.0011	0.0056	-0.0028	-0.0039	-0.0049	0.0009
	(0.003)	(0.002)	(0.003)	(0.006)	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)
Panel E: Transition to firm with more than 200 employees (workers staying formally employed)										
2007	0.002	0.0012	-0.0146	0.0004	0.0031	0.0009	-0.0011	0.0003	-0.0177	-0.0005
	(0.002)	(0.003)	(0.022)	(0.005)	(0.007)	(0.003)	(0.005)	(0.001)	(0.017)	(0.003)
Panel F: Transition to one of the three main employers within LLM (workers staying formally employed)										
2007	0.0039	-0.0002	-0.0205	-0.0011	-0.0036	0.003	0.0076	-0.0032	-0.0169	-0.0041
	(0.003)	(0.001)	(0.022)	(0.003)	(0.006)	(0.003)	(0.008)	(0.003)	(0.016)	(0.004)

Note: Table A.8 reports, by gender and comparing two groups of workers, the excess two-year change in outcomes between 2005 and 2007 to the two-year change in the reference period, between 2006 and 2007. Columns (1) and (2) indicate the coefficient $\beta_{\text{bot, post}}$ of Equation 2 for workers who earned less than 100 MAD at the beginning of the two-year period. Columns (3) and (4) report the same for middle-wage bin workers: $\beta_{\text{middle, post}}$. Columns (5) and (6) indicate the coefficient $\beta_{\text{top, post}}$ for higher-wage workers who initially earn more than 160 MAD and that we do not expect to be affected by minimum wage increases. Columns (7) and (8) report difference-in-differences estimates that compare the excess 2-year changes for workers directly affected by the minimum wage changes with the excess two-year changes for workers higher up in the distribution (coefficient $\beta_{\gamma\delta|\text{top}}$ in equation 4). In Panel A, for workers staying formally employed within the two-year window, I compute the daily wage growth as defined above. Panel B examines the same outcomes, but restricts the sample to workers who stay employed in the same formal firm. Panel C considers the set of workers initially formally employed, and the dummy equals 1 if they have exited the firm after two years and 0 otherwise. Panel D considers the set of workers initially formally employed, and the dummy equals 1 if they exited the formal sector after two years and 0 otherwise.

B Moroccan context

B.1 Education

TABLE B.1: SHARE OF WOMEN AMONG ENROLLED STUDENTS AT DIFFERENT EDUCATION LEVELS

	2007/2008	2017/2018
Preschool	41.6%	44.8%
Primary school	46.7%	47.6%
Secondary school	44.8%	46.3%
Vocational Secondary Level	48.6%	50.3%
Higher Education		
Private	41.4%	45.9%
Public Schools	49.8%	60.0%
Public Universities	46.7%	48.8%

Note: This table reports the share of women among enrolled students at the different education levels for the years 2007/2008 and 2017/2018.
Source: Ministère de l'Education Nationale, de la Formation Professionnelle, de l'enseignement supérieure et de la recherche scientifique.

TABLE B.2: SHARE OF WOMEN AMONG HIGHER EDUCATION GRADUATES BY FIELD OF STUDY – 2019

	2006/2007	2016/2017
Law & Economics	49.98	50.52
Humanities and Social Sciences	54.39	51.63
Literature and Translation	45.61	-
Science and Technology	46.33	54.75
Business and Management	55.73	64.11
Medicine and dentistry	71.34	76.60
Medicine and Pharmacy	62.95	63.50
Technology	43.21	51.08
Sciences	46.23	45.86
Engineering Sciences	27.43	45.78
Education (ENS&ENSET)	81.25	43.03
Paramedical	-	66.67
All graduates	**50.65**	**50.60**

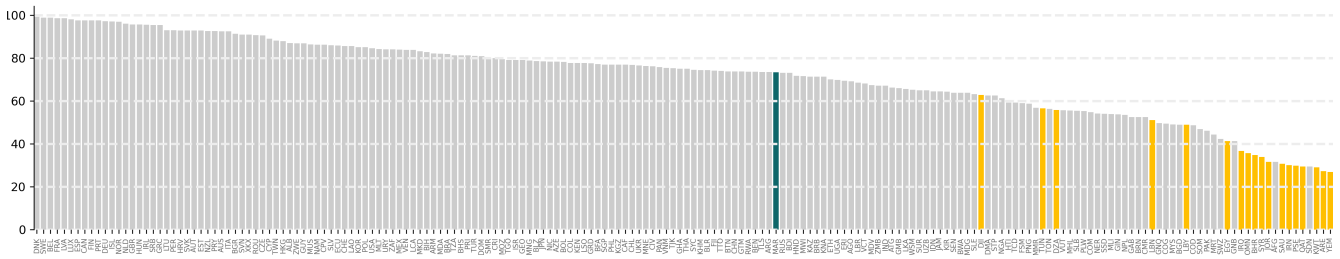
Note: This table reports the higher education graduates by field of study in 2019.
Source: Ministère de l'Education Nationale, de la Formation Professionnelle, de l'enseignement supérieure et de la recherche scientifique.

B.2 Gender, Laws and Social Norms

Women, Business and Law (WBL). The Women, Business and the Law (WBL) is an indicator developed by the World Bank Group that collects data on laws and regulations that affect women's economic opportunities. This indicator includes whether the country has laws that prohibit discrimination in employment based on gender, mandates equal remuneration for work of equal value, or has legislation on sexual harassment in employment.

As shown in Figure B.1, Morocco scores quite high compared to other MENA countries on the *Women, Business and the Law* (WBL) indicator.

FIGURE B.1: WBL INDEX – 2008

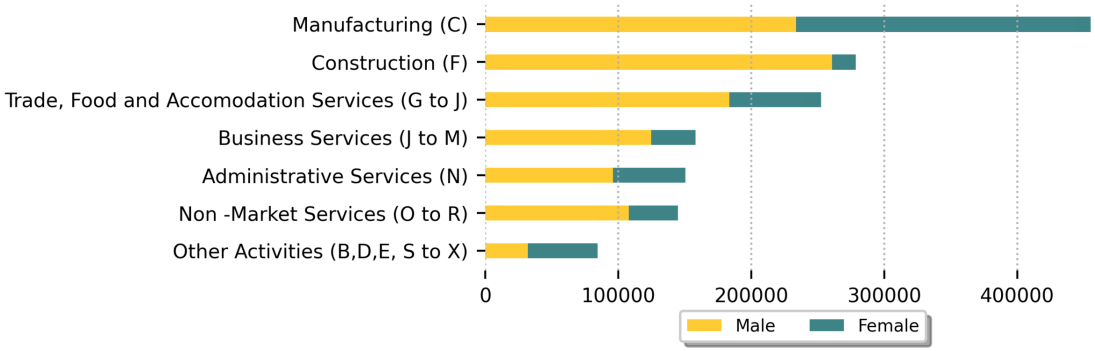


Note: Countries are sorted based on how they score on the *Women in Business and Law* index. A higher index indicates that the country has a legal framework that is more conducive to gender equality at work. Morocco appears in green; other MENA countries are in yellow.
Source: WBL, World Bank.

However, despite this rather high index, Figure A.3 indicates that it does not translate into a reduced gender gap in labor market participation.

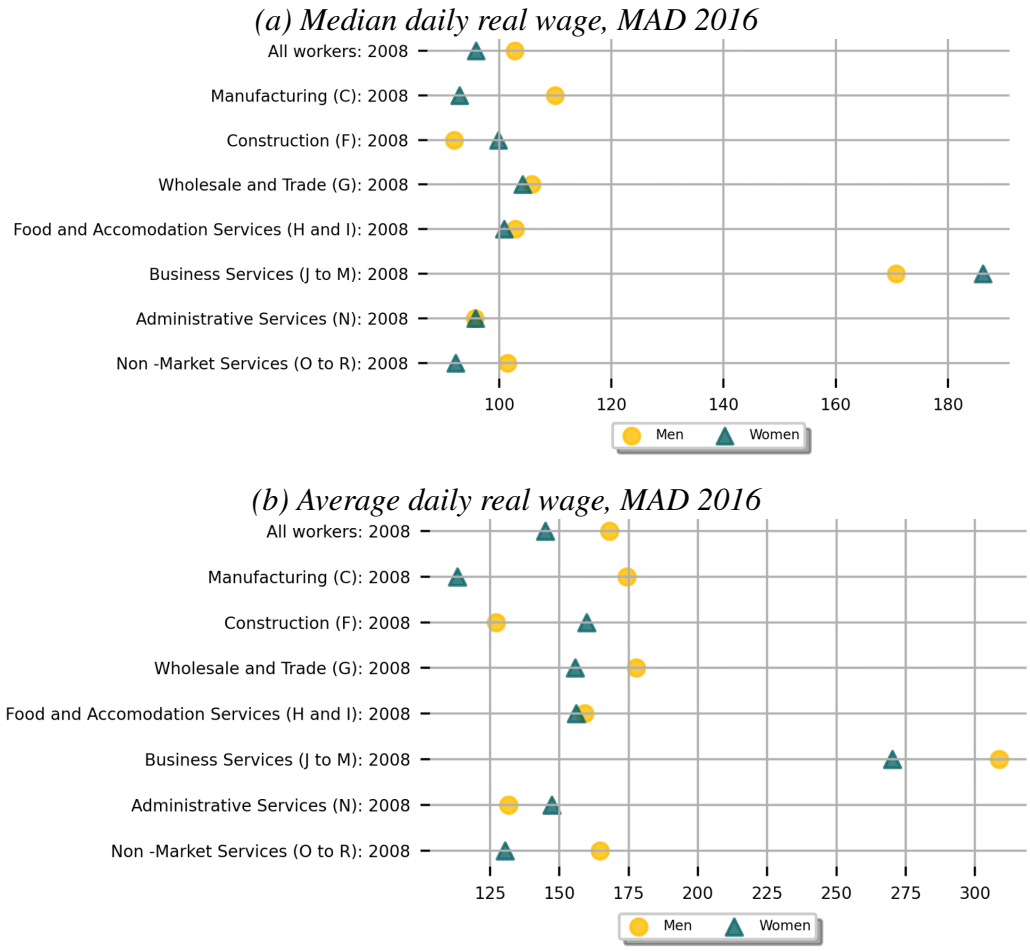
B.3 Descriptive statistics on the formal sector

FIGURE B.2: NUMBER OF FORMAL WORKERS BY SECTOR AND GENDER, 2008



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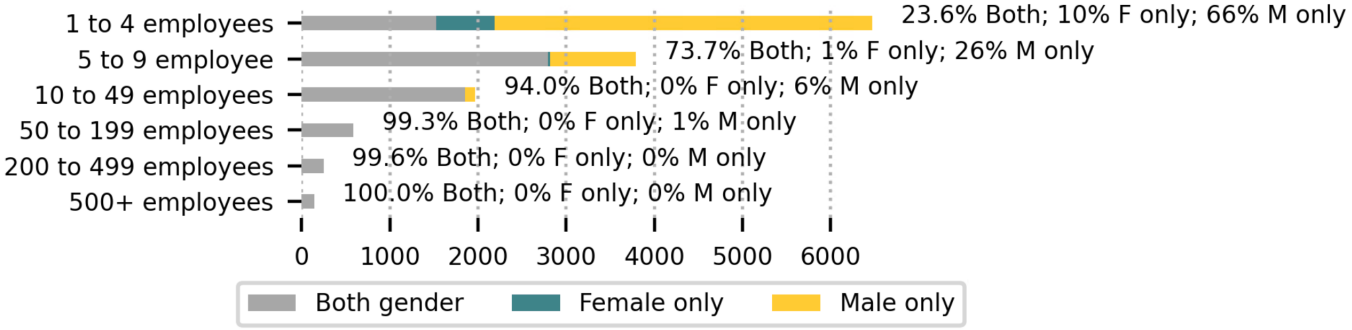
FIGURE B.3: FORMAL WORKERS' MEDIAN AND AVERAGE DAILY REAL WAGE BY SECTOR – 2008



Note: This figure shows the median daily wage by sector and gender in 2008.
Source: CNSS data.

FIGURE B.4: DISTRIBUTION OF FIRM SIZE FOR THE MANUFACTURING SECTOR – 2008

(a) Share of firm by firm size



(b) Share of workers by firm size

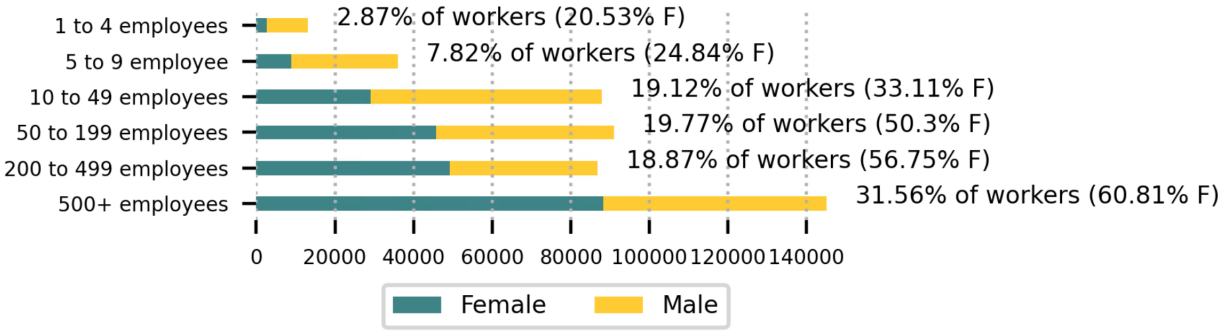
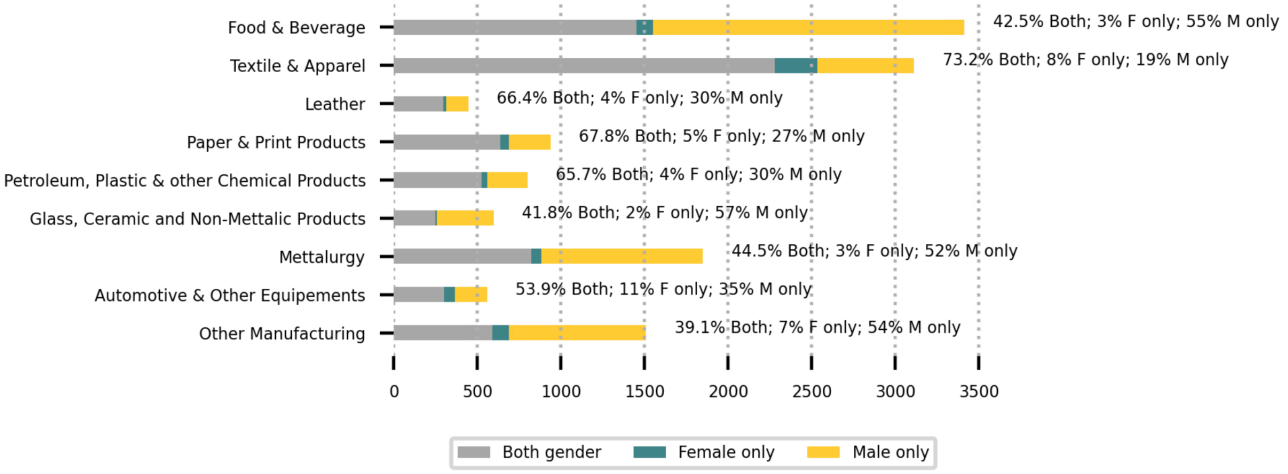
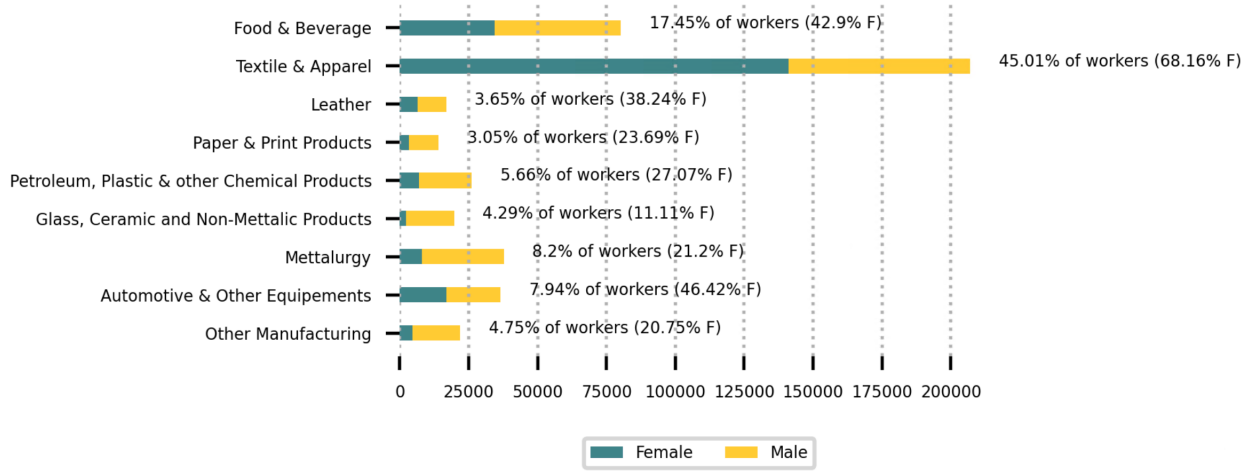


FIGURE B.5: GENDER SEGREGATION ACROSS MANUFACTURING INDUSTRIES AND FIRMS – 2008

(a) Distribution of employers across manufacturing sectors



(b) Share of female and male employers across manufacturing industries



(c) Distribution of the share of female workers across manufacturing firms (firms with at least 5 employees)



C Labor market regulations

C.1 Social Security

All firms governed by private law have to:

1. **Be affiliated to the CNSS**: following the affiliation, the firm will receive a unique identifier and it is the employer's responsibility to make sure the information given at registration (address, sector, legal status, branch offices, date of creation) stay up to date.

2. **Register its employees**: Employers must ensure that all their workers are affiliated with the CNSS before starting their work spell.

3. **Declare its employee and each month**: Each employer needs to report the number of days and the total wage for each employee.

4. **Pay every month its social contributions**: These contributions cover the family allowance, paid leaves, pensions, health coverage, and training funds. The employer's share corresponds to 21% of the reported wage.

5. **Ensure that employees can claim their CNSS benefits**: sick leaves, maternity and birth leaves...

Since its creation, the Social Security coverage has been extended several times. In 1959, it covered only salaried workers from industry, wholesale, and independent professionals (lawyers, doctors...). In 1981, the coverage was extended to agricultural and forestry workers; in 1993, it included the craft sector and in 2011, there was an additional extension to the non-salaried workers of the transport sector.

TABLE C.1: SOCIAL CONTRIBUTION RATES

	Employer's share	Worker's share	Cap	Total
Short-term benefits	1.05%	0.52%	6,000 MAD	1.57 %
Long-term benefits	7.93%	3.96%	6,000 MAD	11.89%
Family Allowance	6.40%	-	-	6.40 %
Basic AMO	2.26%	-	-	2.26 %
Mandatory AMO - Solidarity	1.85%	2.26%	-	4.11
Training Contribution	1.6 %	-	-	1.6 %
Total	21,09 %	6,74 %	-	27,83 %

C.2 Enforcement

Three control and inspection services are in charge of ensuring that the tax and labor code is enforced:

(i) Ministry of Labor Inspection Services: their goal is to ensure that the labor laws are enforced. This includes checking on (i) wage regulations; (ii) leaves (paid; for sickness; maternity, etc.). (iii) rules of procedure and employee representation; (iv) health & safety process.

(ii) The Social Security Inspection Services: Their goal is to ensure that employers respect the declaration process for their employees and pay their contributions as they should.

(iii) The Ministry of Finance Inspection Services: targets only tax enforcement (mostly based on revenue, so other types of controls).

There is close to no coordination between these three services and they do not use administrative data for targeting audits.

The labor control and inspection services have a capacity of 240 inspectors for the country. The verification of compliance with labor laws is done through random and unannounced visits. Both labor inspectors I spoke with mentioned that they think inspection services do not have enough capacity to follow up on all issues they can detect during their first visit. As reported in Table C.2, labor inspectors audit on average 30k firms per year, leading to more than 500k non-compliance notifications. There has been a decreasing trend in the number of fines.

The list of firms to visit is established at the beginning of each year and based on a random selection of firms to be audited, conditional on the yearly national and regional priorities that are either sector (eg pharmacy...) or topic-based (eg child labor, informality, etc.). No data is used to target firms beyond the basic characteristics required to apply filters aligned with annual priorities.

Each auditor has a checklist of processes to verify to make sure that the audited employer is complying with labor regulations. The visit mainly consists of:

(i) Comparing the official reporting documents (provided by the employer) with what can be observed in the company. eg: CNSS declaration form vs. the number of employees present vs. pay slips. Payroll journal; vacation register; company rules of procedure; register of employee delegates; registers and minutes of work council meetings (if ¿ 50 employees); safety regulations...

(ii) Conducting interviews outside the company / separately with the employees to discuss salary and other working conditions.

(iii) Inspection of facilities to ensure that they comply with health and safety regulations.

.

TABLE C.2: EVOLUTION OF INSPECTION VISITS, OBSERVATIONS, TICKETS, AND LEGAL OFFENSES BETWEEN 2010 AND 2017

	2010	2011	2012	2013	2014	2015	2016	2017
Number of inspection visits (in thousands)	23	19	27	34	32	23	33	35
Number of non-compliance notifications (in thousands)	767	633	855	878	877	537	797	933
Number of fines	13896	12694	11665	5872	6018	3570	6320	5226
Number of legal offenses	934	714	804	474	357	237	433	333

Note: This table reports the number of inspections, noncompliance notifications, tickets, and legal offenses.
Source: Ministre du Travail et de l'Insertion Professionnelle.

TABLE C.3: NUMBER OF COLLECTIVE AGREEMENTS IN MOROCCO BETWEEN 2010 AND 2017

Total number of concluded collective bargaining agreements	37
Industry	18
Services	13
Agriculture	3
Wholesale & Trade	2

Note: This table reports the number of collective agreements signed between 2010 and 2017.
Source: *Ministere du Travail et de l'Insertion Professionnelle.*

D Dataset description

D.1 Exhaustive employer-employee panel datasets

As described, over the 2010–2019 sample period, the matched **employer-employee panel dataset** contains detailed information on firms and workers. In particular, we have:

(1) Information on firms:

- A firm identifier that allows identifying the same firm across years.
- Location: region and local social security agency the firm is registered at.
- Sector of activity: aggregate and dis-aggregate.
- Legal status: semi-public; MNEs; cooperatives...;
- Date of the firm's creation.
- Date of registration as a formal firm.
- Number of registered workers and their characteristics.

(2) Information on workers:

- A workers' identifier that allows identifying the same worker across years.
- Basic demographics characteristics: age, gender.
- Work arrangement per declaring firm: the number of months worked in the firm during the year; the number of days worked in the firm during the year; the total yearly income associated with the employment spell in the firm.
- Tenure in formal employment: date of the first declaration to the social security.

Figure D.1 indicates the evolution of the number of workers across years and sectors of activity from 2005 to 2018.

D.2 National labor force surveys

The ENE aims to survey a representative sample of the population each year. The sampling unit is the household and, once a household has been drawn to be included, all its occupants are surveyed. Each year, the survey covers 60,000 households; 40,000 in urban areas and 20,000 in rural areas. It is representative of the different social strata and regions of the country.

- **Primary unit (PU):** The PUs that are part of the ENE survey includes all the primary units (PUs) in the HCP master sample. This represents 1,124 urban PUs and 724 rural PUs.
- **Secondary unit (SU):** Each PU is divided into secondary units (SUs) of around 50 households each, in order to obtain 12 SUs per PU for survey purposes during the inter-census period. Each year, each UP is represented by one of its SUs, the order of representation by year being randomly defined.
- **Households:** Once all the households in a SU have been listed, a sample of 20 households is drawn at random. The census of households living in a SU is carried out shortly before the start of data collection for that SU, so that the draw is based on an up-to-date list of households present in the SU at the start of data collection. The draw of the 20 households is based on automatic computing done by the HCP CAPI application.

Longitudinal dimension: Each year, half of the sample is resurveyed the next year. This renewal takes place at the secondary unit level. The initial sampling plan, determined at the start of the 2006-2016 censorial period, stipulates the two consecutive years for which the secondary units will be surveyed. When a secondary unit should be surveyed in years t and $t+1$, all the sampled households and household members are surveyed.

Sample Size: The Table below reports the number of households and individuals interviewed per year, indicating the share of individuals that is re-interviewed the following year.

To construct the attrition indicator, we assume that if, from one year to the next, at least 25% of the individuals have been interviewed within a secondary unit at year $t-1$, then the entire secondary unit should have been interviewed at year t. This hypothesis allows us to construct two indicator variables to measure attrition at the household and individual levels. Among people that live in the secondary units surveyed in year $t-1$ and to be surveyed in year t, we consider two dummy variables at:

- *the household level*: among households surveyed in year t-1, this indicator equals 1 if at least one household member responded to the employment survey in year t and 0 otherwise.
- *the individual level*: among individuals surveyed in year t-1, this indicator is equal to 1 if the person also responded to the employment survey in year t and 0 otherwise.

Informality indicators: In this survey, I use two questions to construct a proxy for whether the individual has an informal work arrangement:

(i) *All workers: Do you have health insurance associated with your current job? (CNSS, CNOPS....)*

1. Yes **2. No**

(ii) *Salaried worker: Do you have a work contract in your current job?*

1. Open-ended contract 2. Short-term contract 3. Pre-hiring contract **4. Oral contract 5. No contract**

I then consider that a worker is formal if she has a work contract or has health insurance associated with their current job. Additionally, the survey also contains a question on the firm's size.

- *All workers*: What is the size of the establishment you worked in?

1 employee 2 employees 3 employees 4 employees 5 employees [6 - 9] employee [10 - 19] employee [20 - 49] employee [50-199] employee 200 employees and more size unknown Not Reported

If we make the assumption that, above a certain number of employees, firms cannot be operating informally, we can then also have a proxy for the share of workers that are informally employed in formal firms.

E Model Appendix

Agents. The economy consists of:

- a large but discrete number of labor markets $l \in [1, L]$.
- in each labor market l, there are $M_l \sim G(M)$ firms that differ by their total factor productivity z_{jl} (drawn from a location invariant distribution).
- a continuum of workers that can be of two types: $g \in \{f, m\}$. They are heterogeneous along the following two key dimensions:
  - $\eta_{(g)}$: their elasticities of substitution across firms within a labor market.
  - $\theta_{(g)}$: their elasticities of substitution across labor markets.
  - with the additional assumption of $\theta_{(g)} < \eta_{(g)}$ that accounts for the fact that it is easier to transition across firms than move to another market).

Worker problem. Worker i of gender g has a reservation wages $b_{ig} \sim F_g(.)$ and chooses the firm j located in labor market l taking as given the wages $\{w_{gjl}\}$ and the share of formal workers $\{p_{gjl}\}$. Worker i is then picking the firm j located in labor market l such as the associated utility u_{ijl} is higher than the utility associated with any of the alternatives where utilities are defined as:

$$u_{ijl} = \ln(w_{jl}) + \ln(p_{jl}) + \ln(\lambda_l) - \ln(b_i) + \nu_{ijl}$$

- p_{jl} is modeled as an amenity of the firm.
- idiosyncratic workers' preferences $\nu_{ijl} \sim F_g()$ where $F_g()$ is a gender-specific Gumbel extreme value distribution of parameters $\theta_{(g)}, \eta_{(g)}$.

Firm problem. I assume that firms behave strategically and compete *à la Cournot*. When maximizing their revenues, firms know the inverse supply labor curve, take as given the quantities of labor chosen by local competitors and internalize that their labor demand affects the total *within* labor market demand and wages.

The firm j in the labor market l maximizes its profit by choosing wages and the level of employment $\{n_\tau, w_\tau\}_{\tau \in \{FI,FF,MI,MF\}}$ according to the production function:

$$\max_{\{n_\tau, w_\tau\}} \pi_j = z_j \sum_{\kappa \in \{FI,FF,MI,MF\}} R_\tau(n_\tau) - n_\tau \times w_\tau \quad \text{with} \quad R_\tau(n_\tau) = z_j \beta_{j\tau} n_\tau^\alpha \ \sum_\tau \beta_{j\tau} = 1$$
$$s.t. \quad w_g = w_{(g)}(n_{gF}); \quad w_{gF} \geq \underline{w}$$

Equilibrium. Before any introduction of the minimum wage, the labor supplied by gender g to firm j in market l, is given by:

$$w_{gjl} = \lambda_{gl}^{\frac{-\left(1+\theta_{(g)}\right)}{\theta_{(g)}}} p_{gjl}^{\frac{-\left(1+\eta_{(g)}\right)}{\eta_{(g)}}} \left(\frac{n_{gjl}}{\gamma_{gjl}}\right)^{\frac{1}{\eta_{(g)}}} \left(\frac{\gamma_{gjl}}{N_g}\right)^{\frac{1}{\theta_{(g)}}} W_g := w_{(g)}(n_{gjl})$$

$$\Longrightarrow \text{inverse of elasticity of residual labor supply: } \frac{1}{\varepsilon_{gjl}} := \frac{n_g \times \partial w_g / \partial n_g}{w_g} = \left[\frac{1}{\eta_{(g)}} + \left(\frac{1}{\theta_{(g)}} - \frac{1}{\eta_{(g)}}\right) s_{gjl}\right]$$

On the demand side, firm j equates marginal revenue to marginal cost taking others' employment as given:

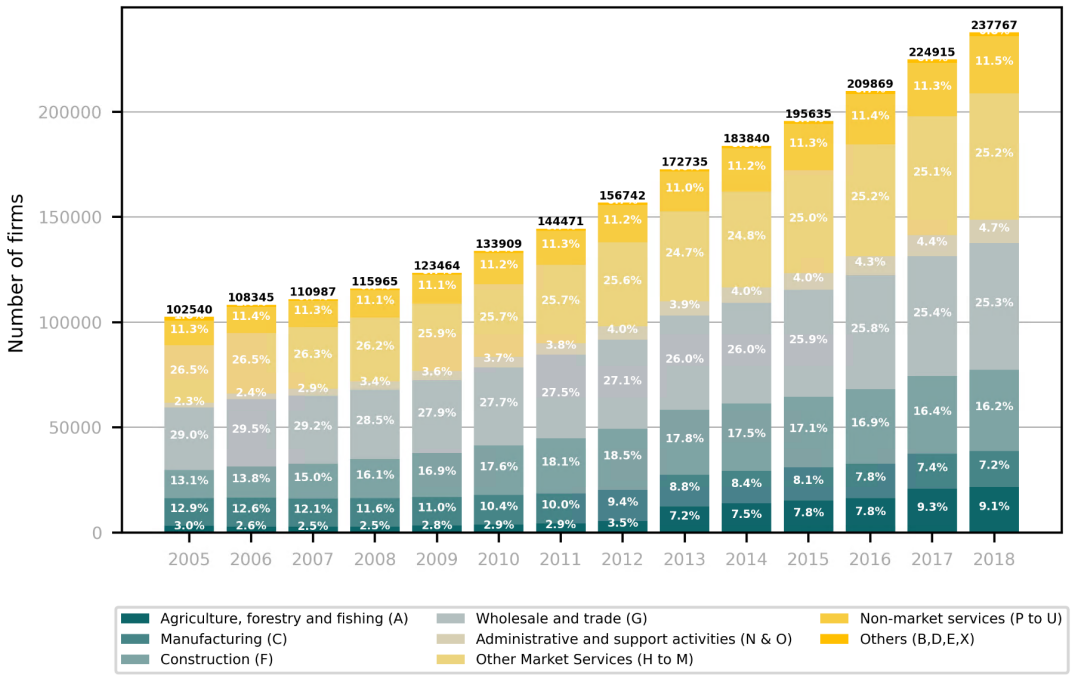
$$\frac{\partial R_z}{\partial n_{gjl}} = w_{gjl} \times \underbrace{\left(1 + \frac{1}{\varepsilon_{gjl}}\right)}_{\mu_{jl}\text{: markdown}} \Longrightarrow \mu_{jl} = 1 + \frac{1}{\eta_{(g)}} + \left(\frac{1}{\theta_{(g)}} - \frac{1}{\eta_{(g)}}\right) s_{gjl} \quad \text{with} \quad s_{gjl} = \frac{w_{gjl} n_{gjl}}{\sum_{j=1}^{M_l} w_{gjl} n_{gjl}}$$

The average wage markdown in local labor market l is then given by:

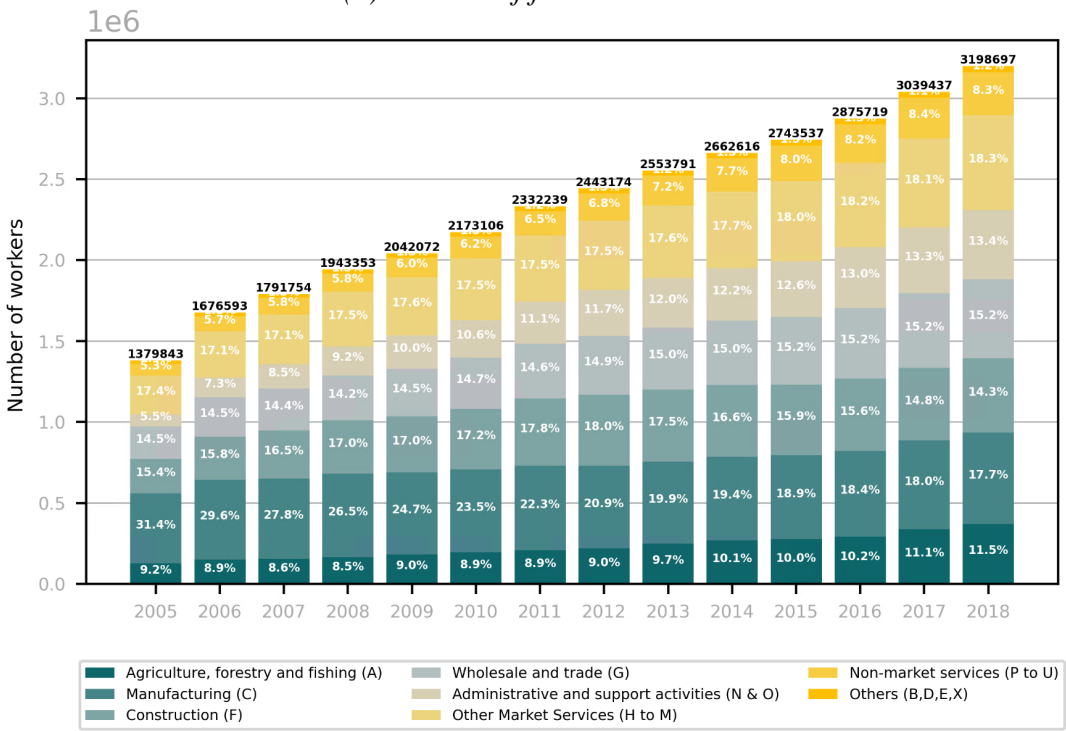
$$\mu_{gl} \equiv \frac{\bar{r}_{gl}}{\bar{w}_{gl}} = 1 + \frac{1}{\eta_{(g)}} + \left(\frac{1}{\theta_{(g)}} - \frac{1}{\eta_{(g)}}\right) HHI_l \quad HHI_l = \sum_{j=1}^{M_l} s_{jl}^2$$

FIGURE D.1: FORMAL FIRMS AND WORKERS PER SECTOR

(a) Number of formal firms



(b) Number of formal workers



Note: This figure shows the number of firms and workers being declared to the social security by year and firms' sector of activity.
Source: CNSS.