working paper
2019-10

Low-Skilled Workers and the Effects of Minimum Wage: New Evidence Based on a Density-Discontinuity Approach

Sharon Katzkowicz
Gabriela Pedetti
Martina Querejeta
Marcelo Bérgolo

May 2019

PAGE
policy analysis on growth and employment
IDRC CRDI
pep
UKaid

Low-Skilled Workers and the Effects of Minimum Wage: New Evidence Based on a Density-Discontinuity Approach

Abstract

We estimated the impact of the minimum wage on wages, unemployment, and formal-informal sector mobility for women in the domestic-work sector in Uruguay. Applying the dual-economy, density-discontinuity design developed by Jales (2017), we used cross-sectional data for 2006-2016 from the National Household Survey and found that the minimum wage had significant effects on labor outcomes, with almost 20% of women increasing their wages to reach the minimum. This effect was observed in both the formal and informal sector, though the latter was not covered by the policy. Our results showed a drop in employment as well as a significant effect on sector mobility with negative impacts on formality. Nevertheless, these undesired effects were offset by other labour policies undertaken in the period, by sustained economic growth, and by improvement in labor-market conditions. A novel identification strategy that is particularly suited to developing countries provides empirical evidence regarding the effects of a minimum wage on women workers in the informal sector.

JEL: J08, J16, J21, J31

Keywords: Minimum wage, labour market, gender, informal sector, developing countries.

Authors

Sharon Katzkowicz
CIEDUR
Montevideo, Uruguay
sharon.k.junio@gmail.com

Gabriela Pedetti
CIEDUR
Montevideo, Uruguay
gabypedetti@gmail.com

Martina Querejeta
CIEDUR
Montevideo, Uruguay
martinaquerejeta@gmail.com

Marcelo Bérgolo
IECON
Montevideo, Uruguay
mbergolo@iecon.ccee.edu.uy

Acknowledgements

This research work was carried out with financial and scientific support from the Partnership for Economic Policy (PEP) (www.pep-net.org) and with funding from the Department for International Development (DFID) of the United Kingdom (or UK Aid) and the Government of Canada through the International Development Research Center (IDRC). The authors are grateful to Alma Espino y Soledad Salvador for support and guidance as well as to Guy Lacroix, Luca Tiberti, and all participants to the PEP annual meetings of 2017 and 2018 for excellent technical suggestions and useful comments.

Table of contents

I. **Introduction** p.1

II. **Literature Review** p.2

2.1. Theoretical Considerations

2.2. Empirical Studies

III. **Empirical Setting: Data and Background** p.6

3.1. Data Source and Sample Construction

3.2. The Labor Market and the Domestic Sector in Uruguay

IV. **Analytical Model: Dual-Economy Density-Discontinuity Approach** p.9

V. **Empirical Approach and Descriptive Evidence** p.11

5.1. Assumptions, Identification and Estimation

5.2. Testing Assumptions

5.3. Descriptive Evidence

VI. **Labor-Market Responses to the Minimum Wage** p.19

6.1. Compliance Responses

6.2. Non-Employment Effects

6.3. Sector Mobility and Enforcement

6.4. Dynamic of Minimum Wage Effects

6.5. Heterogeneous effects

6.6. Robustness Checks

VII. **Conclusions and Policy Implications** p.29

References p.32

Appendices p.35

List of tables

Table 1: Personal Characteristics and Working Conditions of All Employed Women and Women Employed in the Domestic-Work Sector, 2006-2016. 15
Table 2: Model Parameter Estimates, Pooled Data 19

Table A1: McCrary Test Statistics: Hourly Wages of Formal, Informal and Total Domestic Workers Near the MW, 2006-2016. 35
Table A2: McCrary Test of Discontinuity on Wages for All Domestic Workers at Different Points, 2006-2016. 37
Table A3: Mccrary Test of Discontinuity in Wages for Total Domestic Workers Using Different Binsize. 37
Table A4: Parametric Linear Regression of Formality vs. Wages Logarithms 38
Table A5: Model Parameter Estimates, 2006-2016 and Pooled Data 40
Table A6: Heterogeneity Analysis. Estimation of Parameters by Variables of Interest. 41
Table A7: Different Choices of Bandwidth 42
Table A8: Different MW STD Fractions and Kernel Density Point Estimation. 43
Table A9: Estimates of Rounding Wages at Different Heaping Points 44

List of figures

Figure 1: Labor-Market Indicators for Women, Uruguay 8
Figure 2: Evolution of Observed Hourly Wages, Hourly Minimum Wage, and Percentage of Workers Below the Minimum Wage, 2006-2016. 16
Figure 3. Empirical Cumulative Distribution Function of Wages, 2006 and 2016 17
Figure 4. Histogram of Normalized Wages for Formal and Informal Workers 18
Figure 5: Labor-Market Indicators for Women, 2006-2016 21
Figure 6: Conditional Probability of Belonging to the Formal Sector 2006-2016, by Wage Level 23
Figure 7: Evolution of Model Parameter Estimates, 2006-2016 26

Figure A1: Mccrary Graph Test of Wages of Domestic Workers around the Minimum Wage, 2006-2016. 36
Figure A2: Non Parametric Analysis of Formality vs. Wages 38
Figure A3. Empirical Cumulative Distribution Function of Wages 39

I. Introduction

The main purpose of minimum-wage (MW) legislation is to protect workers by establishing a livable-wage floor. This tool is considered an important part of redistributive policies aimed at overcoming poverty and reducing economic inequalities (Lemos, 2009; Marinakis & Bueno, 2014). Nevertheless, secondary effects with a potentially negative impact on employment have been documented in the literature, suggesting that these policies could have mixed results on the conditions they are intended to improve (Neumark & Wascher, 2007).

The empirical literature on the effects of MW in developed countries is extensive, though a number of new studies of developing countries have appeared (Dinkelman & Ranchhod, 2012; Lemos, 2009; Maloney & Mendez, 2004). Because the large informal sector is not covered by MW policy, methodological challenges have limited the empirical literature on the MW in developing countries, and few studies have incorporated the dynamics between the formal and informal sector into their analyses (Fajnzylber, 2001; Gindling & Terrell, 2007, 2009; Lemos, 2004, 2009; Maloney & Mendez, 2004). Formality is key, however, because it provides access to such other social rights as healthcare, safety against risks, and income security in old age (Filgueira, 2014).

In addition, gender disparities in the labor market are still a concern in developing countries in which occupational segregation is common and differences exist in both wages and work opportunities for men and women. In this context, the analysis of the domestic-work sector is highly relevant because it is both informal and occupied largely by women: 10.7% of employed women in Latin American countries are domestic workers; of these, only 26.9% have social security coverage. Domestic work is therefore a crucial sector for interventions aimed at reducing gender gaps in labor and for efforts to understand the impact of MW regulations on the informal sector.

We estimated the impact of the MW in the domestic-work sector on wages, employment, and formal-informal sector mobility for women in Uruguay. We applied the dual-economy, density-discontinuity research design developed by (Jales, 2017) and used cross-sectional data from the National Household Survey (NHS) for 2006-2016. We found that the effect of the MW was significant: the wages of nearly 20% of women increased to reach the MW. Negative effects on formality and on employment in the domestic sector (3%) were also noted, however. Using secondary data, we found that these undesired effects were likely to be offset by other labor policies as well as by sustained economic growth and improved conditions in the labor market.

The recent and novel identification strategy we employed had several crucial advantages for developing countries with informal sectors not covered by the MW, and it allowed us to generate new empirical evidence regarding the effects of the MW with a focus on an informal sector largely occupied by women. Unlike other methodologies that have considered each sector separately, our approach allowed us to estimate the effects of the MW on formal-informal mobility by analyzing the joint distribution of sectors and wages. This methodology had the additional advantage of requiring only cross-sectional data and of incorporating relatively flexible assumptions that could be tested with these data.

MW policies have attracted interest as a mechanism for establishing livable-wage floors, but they have undesired effects on employment and formality. Minimizing negative effects requires broad labor policies that include not only wage-fixing but also workplace inspections and campaigns aimed at disseminating information about policies. We expect our results to contribute to the improvement of both MW and formalization policies for the domestic-work sector in Uruguay and other developing countries.

II. Literature Review

2.1 Theoretical Considerations

The neoclassical model, based on competitive markets, predicts that the introduction of a MW will generate compression on wage distribution but have negative effects on employment. Since the 1990s, however, this result has been placed in doubt by a vast empirical literature whose authors report null or even positive effects of the MW on employment as well as by new theories that predict increases in wages without a consequent reduction in employment (Holmlund, 2014). But the findings reported in that literature and the more recent theoretical approaches are all based on imperfect competition: models that allow firms to have some power to set wages (Lustig & Mcleod, 1995).

Studies focused on developing countries have considered the existence of dual labor markets (i.e., with formal and informal sectors) for which MW legislation was not binding (Gindling & Terrell, 2005, 2007, 2009; Lemos, 2009; Maloney & Mendez, 2004). The standard two-sector

competitive model predicts that, following a MW hike, workers displaced from the formal sector will move to the informal one. Hence, employment in the informal sector increases and wages fall, while the opposite occurs in the formal sector. In such a model, total employment would not be affected and wage inequality between sectors would increase. This mechanism works only if there is perfect mobility between sectors and if wages are flexible in the informal sector. Mincer (1976), for example, argued that the effects of the MW depend upon both the direction of the flow of workers and whether workers can move from the informal to the formal sector (for example, to seek better-paid jobs, even assuming the possibility of periods of unemployment). Thus, the final effect of the MW depends upon the size and elasticity of the labor supply and upon demand in the formal and informal sectors, allowing wages to rise in the informal sector if employment in that sector falls sufficiently.

Other studies that find evidence of wage increases in the informal sector in developing countries explain these results with the theory of the lighthouse effect. In this model, the MW, despite operating in the formal sector, becomes a reference price for negotiation in the informal sector as well. If firms in the informal sector have any monopsony power, the implementation of MW in the formal sector will also increase wages in the informal one (Souza & Baltar, 1980; cited in Boeri, Garibaldi, & Ribeiro, 2011). Another justification for the increase in informal wages is shadow-employment and sorting mechanisms according to which workers seek employment in the shadow sector (not covered by the MW) or in the legal sector (covered by the MW). The meeting of jobs and workers is regulated by a sorting mechanism with different transition functions between sectors; in the absence of a MW, then, low-skilled workers are concentrated in the shadow sector. The introduction of a MW changes the sorting mechanism, however: the increase in the skill level of the shadow sector also increases workers' wages (Boeri, Garibaldi, and Ribeiro, 2011; Fajnzylber, 2001).

In Latin American countries it is difficult to build a theoretical model to predict the redistributive/wage effects of the MW on different groups of workers (Gindling & Terrell, 2009) because those effects also depend upon the specific conditions of the labor market (wages and sector mobility, e.g.) and the specific characteristics of MW policy (for example, coverage and size of the increase). As Holmlund (2014) pointed out, economic research on the effects of a MW on labor relied more on empirical studies than on the development of theoretical models.

2.2 Empirical Studies

The possible consequences of raising the MW have become a topic of interest as well as of controversy. Many studies systematize the evidence of these consequences and conclude that the literature is not decisive regarding the effects of a MW (Campos, Esquivel, & Santillán, 2015; Gindling & Terrell, 2009;Groisman, Liniado, Calero, Liniado, & Parra, 2015; Neumark, 2017; Neumark & Wascher, 2007).[1] In developing countries, the debate has focused on the effectiveness of MW in economies with a large informal sector not covered by MW policy (Marinakis & Bueno, 2014).

Gindling and Terrell (2005, 2007, 2009) studied Costa Rica and Honduras and applied the dynamic-panel-data model developed by Arellano & Bond (1991) to industry-level panel data. Gindling and Terrell's definition of uncovered workers was associated with self-employment and unpaid family work, and they studied the effects of changes in the MW on employment, unemployment, and hours worked in several industries.

Lemos (2009) studied Brazil based on the standard Welch-Gramlich-Mincer Two Sector Model and analyzed the effect of the MW on employment and hours worked in both the formal and informal sectors (the informal sector was defined as uncovered workers). Neumark, Cunningham, and Siga (2006) analyzed whether the MW in Brazil had beneficial effects on the distribution of family income, particularly in low-income families. Their analysis reported the effects on wages in the formal and informal sectors combined.

Boeri, Garibaldi, and Ribeiro (2011) also studied the impact of the introduction of a MW in Brazil on formal and informal workers using a shadow-sorting model and a lighthouse-effect framework. Addison and Ozturk (2012) investigated the employment consequences of minimum-wage regulation for women in sixteen Organization for Economic Cooperation and Development countries between 1970 and 2008. They used panel methods to estimate the effects of a MW on teenagers and young adults, and their analysis covered a longer time interval and deployed time-

[1] Some early studies focused on developed countries found that an increase in the MW did not produce adverse effects on employment (Card & Krueger, 1994; Dickens, Machin, & Manning, 1994; Gramlich, Flanagan, & Wachter, 1976; Stewart, 2004) while other studies found that an increase in the MW reduced employment of less skilled workers (Addison & Ozturk, 2012; Butcher, Dickens, & Manning, 2012; Neumark & Wascher, 2007). Neumark (2017) summarized US studies highlighting on the conflicting evidence about labour effects of minimum wages.

varying policy and institutional regressors. Maloney and Mendez (2004) analyzed the impact of a MW on the distribution of wages using both numerical measures and kernel density plots for eight countries (Argentina, Bolivia, Brazil, Chile, Colombia, Honduras, Mexico, and Uruguay). In each country, the informal sector was defined locally but was always associated with disconnection from the social-security system. Dinkelman and Ranchhod (2012), in their analysis of the introduction of a MW in the domestic-work sector in South Africa, used a difference-in-differences approach to take advantage of variation of intensity of treatment across regions.

Latin American studies have found mixed effects of a MW on employment, formality, and wages (Groisman et al., 2015). Wage effects are usually positive, showing an increase in the average wages (Gindling & Terrell, 2009) of both formal and informal workers (Boeri, Garibaldi, and Ribeiro, 2011); an increase in the wages of low-income workers (Neumark, Cunningham & Siga, 2006); and a decrease in the wage gap between formal and informal workers (Gindling & Terrell, 2005). Lemos (2009) found evidence of wage compression in both the formal and informal sectors, concluding that a MW was an effective policy instrument for reducing poverty and inequality. These findings are in contrast with segmented labor-market theories that provide evidence that the formal and informal sectors can behave as integrated competitive markets.

The effects of MW policy on employment in developing countries have generally been negative (Addison & Ozturk, 2012; Gindling & Terrell, 2007, 2009; Maloney & Mendez, 2004; Neumark, Cunningham & Siga, 2006;Wellington, 1991). Gindling & Terrell (2005, 2007, 2009) found negative effects on employment, especially for the informal sector in which fewer skilled people worked. On the other hand, as in developed countries, some studies found no impact on overall employment or on workers in the informal sector (Dinkelman & Ranchhod, 2012; Lemos, 2009).

In terms of methodological approaches, Jales (2017) provided the most relevant empirical reference. He developed a dual-economy, density-discontinuity approach based on Doyle (2006) to evaluate the impact of MW on unemployment, wages, wage inequality, sector mobility, size of the informal sector, and labor-tax revenues for the Brazilian economy between 2001 and 2009. Jales also found evidence of a significant enlargement of the informal sector in response to the MW as a result of the unemployment effects on the formal sector and of the mobility of workers from the formal to the informal sector.

III. Empirical Setting: Data and Background

3.1 Data Source and Sample Construction

Our empirical analysis was based on cross-sectional data from the nationally representative National Household Survey (NHS) performed by the National Institute of Statistics in Uruguay.[2] The sample for this paper included women between 18 and 69 who reported being employed in domestic work and who were not retired from other sectors.[3] Pooling all survey data yielded a sample of 44,326 women domestic workers for the 2006-2016 period. This final sample represented 18.4% of all women employed in the analyzed period (Table 1). All estimations were computed using survey weights calculated by National Institute of Statistics and calibrated to estimate the population according to projections.

The main outcomes under analysis were wages, non-employment, and formal-informal sector mobility. Wages were measured as hourly income from labor in the domestic worker's primary job. The non-employment effect quantified the reduction in employment in the domestic-work sector as a consequence of MW policy. Following Espino and Amarante (2008) and Gasparini and Tornarolli (2009), we defined formality on the basis of whether a worker contributed to social security in her or his primary job. It is common in Latin America to capture informality from a "legalistic" or "social protection" perspective, and we use the terms "formal/informal worker" and "formal/informal sector" interchangeably; both refer to the worker's situation with respect to social-security coverage.

In addition, we used information from the Social Security Institute (SSI) on labor inspections to analyze enforcement of the policy. This information consisted of data from 2007-2015 on the number of workplace inspections carried out in the domestic-work sector and in the total labor market.

---

[2] Microdata and all related documents are available here: http://www.ine.gub.uy/web/guest/encuesta-continua-de-hogares1.

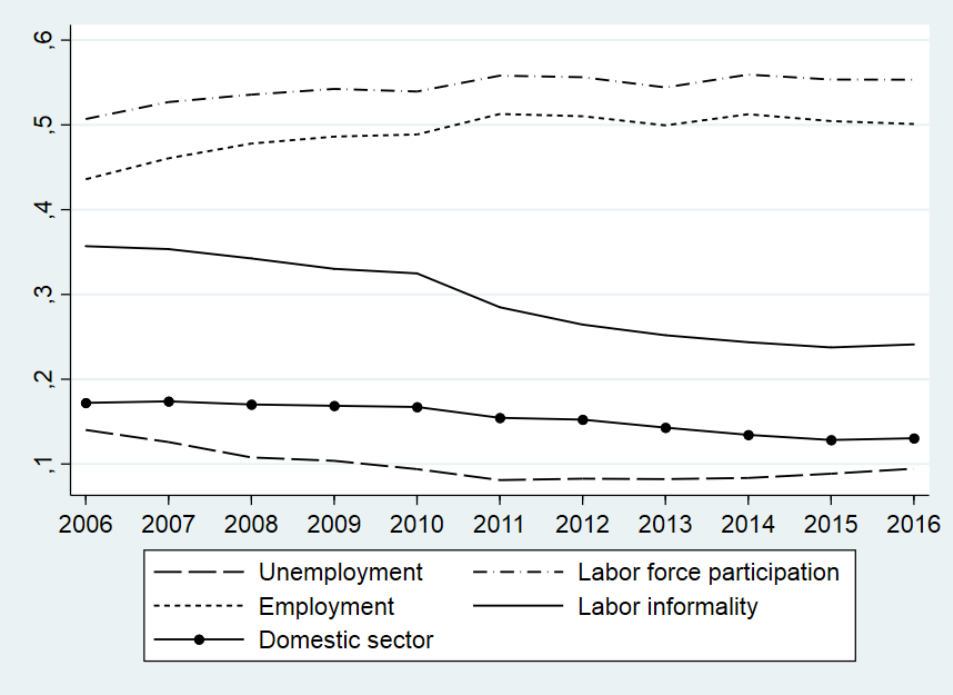
[3] This implies people whose work fell into the International Standard Industrial Classification of All Economic Activities (ISIC) category of "Activities of Households as Employers of Domestic Personnel" and who worked in one of the following occupations, as defined by the International Standard Classification of Occupations (ISCO) system: Child Care Workers (5311), Home-Based Personal Care Workers (5322), Companions and Valets (5162), and Domestic Cleaners and Helpers (9111). Live-in domestic workers were excluded.

3.2 The Labor Market and the Domestic Sector in Uruguay

Uruguay stands out in Latin America for its economic and social performance during the last decade. Between 2006 and 2016, average growth in GDP was 4.7%, and labor indicators improved substantially. Figure 1 shows that the labor-force participation and employment of women increased steadily; in the same period, the unemployment rate decreased until 2011 and then increased slightly, reaching levels below 10% in 2016. Informality in the labor force continued to show a substantial decrease across the entire period.

Nevertheless, the integration of women into the labor market was characterized by strong occupational segregation, and women have largely entered occupations with unfavorable conditions vis-à-vis wages, hours, and informality (CIEDUR, 2017; Espino & Amarante, 2008; Espino, 2016; MIDES-INMUJERES, 2016; Querejeta & Katzkowicz, 2013). The domestic-work sector has been considered "women's work" because of traditional gender-based divisions of labor and, in fact, is largely made up of women workers. In 2016, 99.4% of those employed in the sector were women, a figure that represents 13.1% of women's total employment. The proportion of women's employment made up by domestic labor has, however, been decreasing since 2010. The "feminization" of domestic work has caused the occupation to be undervalued and to be associated with higher levels of informality (approximately 25% in 2016 for all workers but 45.6% for domestic workers). These patterns are similar to those observed in other developing countries. For LAC countries, 93% of the people employed in domestic work in 2013 were women, and 77.5% were informal (OIT, 2016). In South Africa, these figures were 80% and 62% in 2004 (Dinkelman & Ranchhod, 2012).

Figure 1: Labor-Market Indicators for Women, Uruguay



Notes: The proportion of women in the labor market in relation to all women older than 14 ("Labor Force Participation- LFP"), the proportion of women looking for a job but not employed ("Unemployment"), the proportion of employed women not covered by the social-security system ("Labor Informality") and the proportion of women employed in the domestic-work sector ("Domestic Sector"). The dataset was taken from the 2006-2016 NHS. Results may not correspond to Figure 5 because this sample included all men and women older than 14.

Labor informality is 40% on average in Latin American countries; it is lowest in Uruguay and Chile (Gasparini & Tornarolli, 2009).[4] Labor policies adopted as early as the 1960s are the foundation of the Uruguayan social-protection system, while the benefits of social security are closely linked to the formal labor market. There are two main wage policies in Uruguay: the National Minimum Wage (NMW), in effect since 1969, and collective bargaining among workers, chambers of commerce, and the government, which has been in place since 1943.[5][6] These policies apply to formal workers who cannot receive a wage below the NMW or the one negotiated in collective bargaining, and domestic workers were excluded from both until 2005. Despite early

[4] Source: Labor Data Base for Latin America and the Caribbean - LABLAC (CEDLAS and the World Bank). See http://www.cedlas.econo.unlp.edu.ar/wp/estadisticas/lablac/estadisticas-lablac.

[5] This was Law 10.449, which was also known as the "Wage Councils" because one of the main issues negotiated was wages. The Wage Councils did not work continuously but were active in the periods 1943-1957, 1985-1989, and 2005 to the present. Wage Councils are organized in groups related to economic activity. Information about collective bargaining by economic groups is available at: https://www.mtss.gub.uy/web/mtss/consejos-de-salarios.

[6] Decree 1534/969 of November 28, 1969.

MW regulation in Uruguay (as in several Latin American countries), MW policies were not effective in determining wage floors (Marinakis & Bueno, 2014). Since 2005, with the restoration of collective bargaining, these policies have regained importance in establishing a livable-wage floor. The main milestone for domestic workers was Law No. 18.065, passed in 2006, which represented a substantial change in the labor-regulatory framework: it imposed wage fixing, dissemination campaigns to promote formalization of labor, and workplace inspection mechanisms, among others. This positioned Uruguay as a pioneer in the region (OIT, 2016).

IV. Analytical Model: Dual-Economy Density-Discontinuity Approach

We applied the dual-economy density-discontinuity design developed by Jales (2017). The model is based on Doyle (2006), who analyzed the effects of the MW on wages and employment by exploiting the discontinuity in the marginal distribution of wages at the MW point. Jales (2017) developed an extension for the case of a developing country with a large informal sector by analyzing the joint distribution of wages and sectors. Basically, this framework models the joint distribution of wages and sectors both for observed and latent distribution. Empirically, this is implemented by combining a non-parametric density-discontinuity design with a parametric model for the conditional probability of the sector given the wage.

We used S_i to indicate the sector to which worker i belonged, which took the value 1 if the worker belonged to the formal sector and 0 if the worker belonged to the informal one. We let W_i represent the wage of worker$i$. Additionally, we defined pair S_i and W_i $\big(W(1), S(1)\big)$ to indicate the setting for the joint observed wages and sector distribution, while $\big(W(0), S(0)\big)$ identified latent wages and sectors. The latter is the counterfactual or distribution in the absence of a MW policy. Finally, we used $F_0(w)(f_0(w))$ to serve as the CDF (pdf) of $W(0)$ (latent wages) and $F(w)\big(f(w)\big)$ as the CDF (pdf) of $W(1)$ (observed wages).

Following Jales (2017), we made a series of assumptions in estimating the model (see section 5.1). Once these assumptions were made, we were able to complete the model for the effects of a MW by defining these conditions: if the latent wage was lower than the MW in the

domestic-work sector (m) and if the worker was formal in the latent distribution, the worker would maintain the same wage and migrate to the informal sector in probability π_{d}^{1}; would increase her wage to the minimum and remain in the formal sector with probability π_{m}^{1}, and would become unemployed or employed in another sector in probability π_{u}^{1}.

$$If\ W(0) < m\ \&\ S(0) = 1 \rightarrow \big(W(1), S(1)\big) = \begin{cases} (W(0), 0)\ with\ probability\ \pi_{d}^{1} \\ (m, 1)\ with\ probability\ \pi_{m}^{1} \\ (.,.)\ with\ probability\ \pi_{u}^{1} \end{cases}$$

Additionally, if the latent wage was lower than the MW and the worker was informal in the latent distribution, she would maintain the same wage and remain in the informal sector in probability π_{d}^{0}, and increases her wage to the minimum and remain in the informal sector in probability π_{m}^{0}.

$$If\ W(0) < m\ \&\ S(0) = 0 \rightarrow \big(W(1), S(1)\big) = \begin{cases} (W(0), 0)\ with\ probability\ \pi_{d}^{0} \\ (m, 0)\ with\ probability\ \pi_{m}^{0} \end{cases}$$

Given this theoretical model, the objective was to estimate the parameters ($\pi_{\mathrm{d}}^{1}, \pi_{\mathrm{m}}^{1}, \pi_{\mathrm{u}}^{1}, \pi_{\mathrm{d}}^{0}, \pi_{\mathrm{m}}^{0}$) and the joint distribution of latent sectors and wages. Below, we present the economic interpretation of each parameter, considering that in all cases they refer to workers with latent wages lower than the MW:

Probability of non-compliance for formal domestic workers (π_{d}^{1}): shift of workers from the formal to the informal sector. That is, the proportion of formal domestic workers who maintained a wage below the minimum and therefore migrated to the informal sector.

Probability of compliance for formal domestic workers (π_{m}^{1}): effect on the wages of formal workers or the proportion of formal domestic workers whose salaries increased to meet the MW regulation.

Probability of non-employment for formal domestic workers (π_{u}^{1}):[7] effect on employment in the domestic-work sector. Because this study was based on a single economic sector, the parameter that quantified the unemployment effect in the original model quantifies, in this case,

[7] Following Jales (2017), we present results for the model parameter $\boldsymbol{\pi_{u}}$ which accounts for the probability of non-employment for total domestic workers although it refers only to formal workers.

the decrease in employment of the domestic sector without discerning whether it was unemployment or the movement of workers to another sector.

Probability of non-compliance for informal domestic workers (π_d^0): proportion of informal domestic workers who maintained the same pre-policy wage (below the minimum).

Probability of compliance for informal domestic workers (π_m^0): proportion of domestic workers who increased their salaries to match the MW but remained in the informal sector.

V. Empirical Approach and Descriptive Evidence

5.1 Assumptions, Identification and Estimation

Following Jales (2017), we made a series of assumptions regarding the behavior of the domestic-work sector, some of which are tested in the next section: (1) for the methodology to be applied, discontinuity around *m* must exist in the observed wage distribution; (2) the density of latent wages and their first derivative existed, was non-zero, and was continuous at *m*; (3) the conditional probability of the latent sector given latent wages could be described by a parametric model; (4) no spillovers were allowed; that is, both wages and the sector of workers with latent wages above the MW were not affected by the policy;[8] (5) probabilities were the same for all workers and should not be interpreted as an average of the population of all affected workers; (6) the probabilities did not depend upon workers' latent wage; and (7) the wages of informal workers below the MW were not affected by the possible inflow of formal workers.[9] Additionally, to apply this methodology to the case of a single employment sector, it was necessary to assume (8) that there was no migration of workers from other sectors to the domestic-work sector after the introduction of the MW. This would have invalidated the strategy because the density of wages would not have been integrated to one.

Given the assumptions of the theoretical model, the relationship between the latent and observed unconditional wage distributions is given by:

[8] Jales (2017) showed that the magnitude of the estimates changed little when limited spillovers were allowed.
[9] As will be shown in the next section, Assumptions 3 and 4 are critical for the identification strategy.

$$f(w) = I(w < m)\frac{\pi_d(w)f_0(w)}{c} + \delta(w - m)\int^m \frac{\pi_m(w)f_0(w)}{c}dw + I(w > m)\frac{f_0(w)}{c}$$

Where c is a rescaling factor which accounts for the relationship between employment with and without the MW policy and allows the density to integrate to one:

$$c = 1 - \int^m \pi_u^1 \, \Lambda(w) \, f_0(w)dw$$

For the formal sector, wage density is given by:

$$f(w|S(1) = 1) = I(w < m)0 + \delta(w - m)\frac{\pi_m^1 F_0(m|S(0) = 1)}{c^1} + I(w > m)\frac{f_0(w|S(0) = 1)}{c^1}$$

While for the informal one it is:

$$f(w|S(1) = 0) = I(w < m)\frac{\pi_d(w)f_0(w|S(0) = 0)}{(1 - \Lambda(w))c^0} + \delta(w - m)\frac{\pi_m^0 F_0(m|S(0) = 0)}{c^0} + I(w > m)\frac{f_0(w|S(0) = 0)}{c^0}$$

Where the specific factors c are:

$$c^1 = 1 - \, F_0(m|S(0) = 1)(1 - \pi_m^1) \text{ and } c^0 = 1 + \pi_d^1 \int^m \frac{\Lambda(w)}{1-\Lambda(w)} f_0(w|S(0) = 0)dw$$

The first step is estimating the probability of non-compliance for which we exploit the discontinuity around the MW as the ratio of the density of wages below and above the MW:

$$\pi_d = \lim_{\epsilon \to 0} \frac{f(m-\epsilon)}{f(m+\epsilon)}$$

As we validated Assumption 3 of independence between sector and wages (Appendix 2), we estimated the density of wages at the MW by using local linear density estimators and, as suggested by Jales (2017) the plug-in method for the remaining parameters. Thus, the probability of compliance for domestic workers was estimated as the probability of non-compliance weighted by the fraction at the MW in relation to the fraction below MW:

$$\pi_m = \pi_d * \frac{\Pr\left[W(1) = m\right]}{\Pr\left[W(1) < m\right]}$$

The total probability of non-employment in the domestic sector (π_u) was estimated by difference. The parameters for each sector depended upon the identification of the latent size of the formal sector. The main issue in the identification of the separate effects of the MW on the

formal and informal sector, then, assumed that the conditional probability of the sector, given wages, was preserved once the MW was introduced. That allowed us to extrapolate the shape of the relationship above the MW for wages below. Thus, the non-employment probability for formal workers was estimated as π_u rescaled by the latent size of the formal sector (Λ):

$$\pi_u^1 = \frac{1 - \pi_d - \pi_m}{\Lambda}$$

Then, the probability of compliance for formal domestic workers was estimated as:

$$\pi_m^1 = \frac{\Pr\left[W(1) = m / S(1) = 1\right]}{1 - \Pr\left[W(1) = m / S(1) = 1\right]} * \frac{1 - F_0(m)}{F_0(m)}$$

with $F_0(m)$ being the population of all affected workers or workers with latent wages below MW. For informal workers, the probability of compliance was estimated as the difference between the total probability of compliance and the probability for formal workers weighted by the latent size of the formal sector:

$$\pi_m^0 = \frac{\pi_m - \Lambda \pi_m^1}{1 - \Lambda}$$

Finally, the non-compliance probabilities for informal and formal domestic workers were estimated by difference:

$$\pi_d^0 = 1 - \pi_m^0$$
$$\pi_d^1 = 1 - \pi_m^1 - \pi_u^1$$

It is important to mention that the main issue in estimating the effects of the MW in Uruguay under Jales' methodology was that our study included no workers who earned exactly the minimum wage. As a result, we defined the MW fraction as those workers for whom the MW was within 0.05 standard deviations above or below the average hourly wage.[10]

[10] Models estimated with groups defined by different measurements above and below the standard deviation produced similar results (Table A8, Appendix 5).

5.2 Testing Assumptions

Regarding Assumption 1 in Table A1, we provide evidence that validates the hypothesis of discontinuity on observed wages near the MW level. Following McCrary (2008), we analyzed the continuity of wages near the MW with a local linear density estimator. To validate the continuity of latent wages (Assumption 2), in line with Jales (2017), we performed a placebo test at different points of the wage distribution above the MW level (Table A2). The null hypothesis of no discontinuity was rejected for some years but to a lesser extent than in the real test.

Appendix 2 shows evidence that validates Assumption 3 regarding independence between sector and wages: Figure A2 shows evidence in graph form that the formality rate does not vary significantly above the MW level. Table A4 shows the results of a linear regression of formality on wages for domestic workers above the MW level and demonstrates both that the coefficient tended to decrease once we conditioned the sample on higher wages and that the level of significance fell. Assumption 5 is intended to simplify the analysis but was not critical to our methodology. Assumption 8 of no migration seems reasonable based on Figure 1, which shows a decrease in employment in the domestic-work sector, as does the existence since 1969 of a NMW which is similar to the pay received by domestics.[11] This allowed us to confirm that migration between sectors was not expected.

5.3 Descriptive Evidence

Table 1 compares the personal and labor characteristics of all employed women to those of women employed in both formal and informal domestic work. Domestic workers tended to be older, less educated, and more Afro-descendant, and they were more likely to come from households in which children under 18 were present and whose income fell into the lowest 40%. They were also less concentrated in the capital city. Domestic workers were characterized by fewer years of experience and a higher level of informality, and their hourly wages were lower. In fact,

[11] For the period under analysis, the hourly MW was an average of 15% higher for the domestic sector in relation to the NMW.

the percentage of domestic workers below the MW was consistently higher.[12] Domestic workers in the informal sector and below the MW were younger, less educated, and more Afro-descendant. They came to a greater degree from households in which children under 18 were present and whose income fell into the lowest 40%, and they were less concentrated in the capital city than were all employed women in the domestic sector. Additionally, informal workers were characterized by lower tenure and lower hourly wages. The percentage of informal domestic workers below the MW was consistently higher, and workers below the MW belonged mostly to the informal sector.

Table 1: Personal Characteristics and Working Conditions of All Employed Women and Women Employed in the Domestic-Work Sector, 2006-2016.

		All employed women	Domestic sector			
			Total	Informal	Formal	Below MW
Personal characteristics						
Age	18-35	0.39 (0.49)	0.29 (0.45)	0.35 (0.48)	0.22 (0.41)	0.39 (0.49)
	36-69	0.61 (0.49)	0.71 (0.45)	0.65 (0.48)	0.78 (0.41)	0.61 (0.49)
Years of education	Less than 7 years	0.20 (0.40)	0.46 (0.50)	0.47 (0.50)	0.44 (0.50)	0.49 (0.50)
	7 years or more	0.80 (0.40)	0.54 (0.50)	0.53 (0.50)	0.56 (0.50)	0.51 (0.50)
Children under 18 in household	No	0.44 (0.50)	0.39 (0.49)	0.35 (0.48)	0.43 (0.50)	0.36 (0.48)
	Yes	0.56 (0.50)	0.61 (0.49)	0.65 (0.48)	0.57 (0.50)	0.64 (0.48)
Afro	Non-afro	0.91 (0.29)	0.86 (0.35)	0.85 (0.36)	0.86 (0.34)	0.85 (0.36)
	Afro	0.09 (0.29)	0.14 (0.35)	0.15 (0.36)	0.14 (0.34)	0.15 (0.36)
Region	Capital city	0.45 (0.50)	0.34 (0.47)	0.30 (0.46)	0.39 (0.49)	0.18 (0.38)
	More than 5,000 inhab.	0.44 (0.50)	0.53 (0.50)	0.57 (0.49)	0.48 (0.50)	0.65 (0.48)
	Less than 5,000 inhab.	0.11 (0.32)	0.13 (0.34)	0.13 (0.34)	0.13 (0.34)	0.17 (0.37)
Household income quintile	40% lower income	0.28 (0.45)	0.54 (0.50)	0.65 (0.48)	0.40 (0.49)	0.73 (0.44)
	60% higher income	0.72 (0.45)	0.46 (0.50)	0.35 (0.48)	0.60 (0.49)	0.27 (0.44)
Labor conditions						
Hourly wage		140.31 (104.38)	90.67 (55.48)	74.90 (50.72)	109.33 (55.09)	28.79 (12.73)

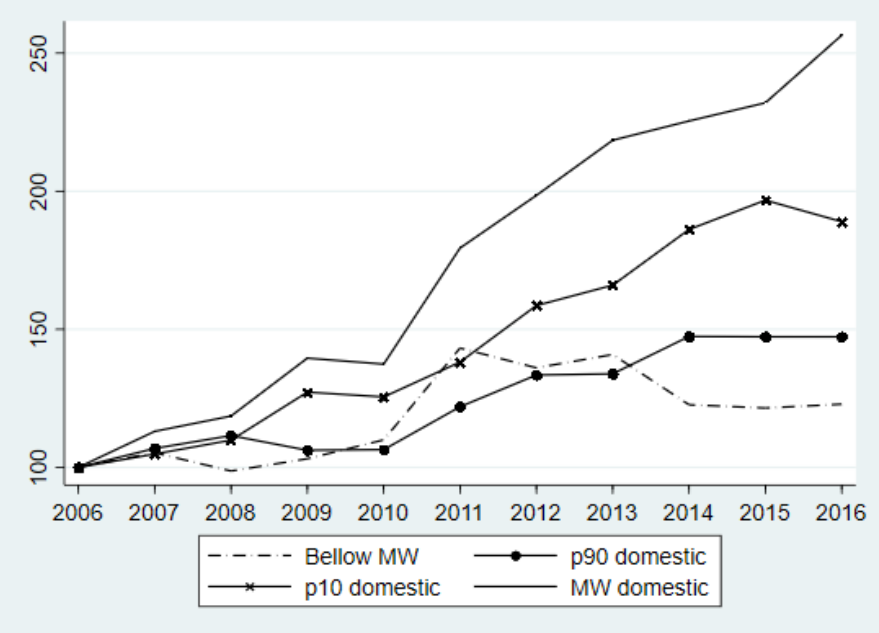
[12] As shown, the characteristics of domestic workers may limit the external validity of this study.

Tenure	7.86 (9.21)	4.73 (6.55)	3.14 (5.46)	6.62 (7.20)	2.65 (5.07)
Informal	0.25 (0.43)	0.54 (0.50)	1.00 (0.00)	0.00 (0.00)	0.85 (0.36)
Workers below MW	0.11 (0.31)	0.16 (0.36)	0.25 (0.43)	0.05 (0.22)	1.00 (0.00)
Obs.	241.502	44.326	24.661	19.665	7,089

Notes: The sample included all employed women between 18 and 69 who had not retired. Each row presents a frequency or mean for each variable. Personal characteristics include age; years of education (both in segments); the presence of children (dummy variable equal to 1 for women in households with children under 18); Afro-descendent (dummy variable equal to 1 for Afro descendants); region of residence and household income (dummy variable equal to 1 if household was within 40% of lower income). Labor conditions include hourly wage (net wage measured in Uruguayan pesos indexed to the CPI of December 2016; 1 USD = 30 Uruguayan pesos); length of time at the same work (in years); informal (dummy variable equal to 1 for workers in the informal sector); and percentage of workers who earned less than the domestic MW. Standard errors in parentheses. Data were drawn from the 2006-2016 NHS.

Figure 2 plots the evolution of hourly MW for domestic workers and observed hourly net wages. A considerable increase is evident at the 10th percentile of domestic workers' observed wages—the one with the largest growth. While the 90th percentile increased by 45%, the 10th percentile increased by almost double that percentage, supporting the hypothesis that changes in wage regulation may have affected workers with the lowest earnings in particular, reducing wage inequality in the sector. The MW has increased 160% since 2006. Combining both analyses, we observed an increase of 26% in workers below the MW, which can be explained by a greater increase in the MW in comparison to wages.

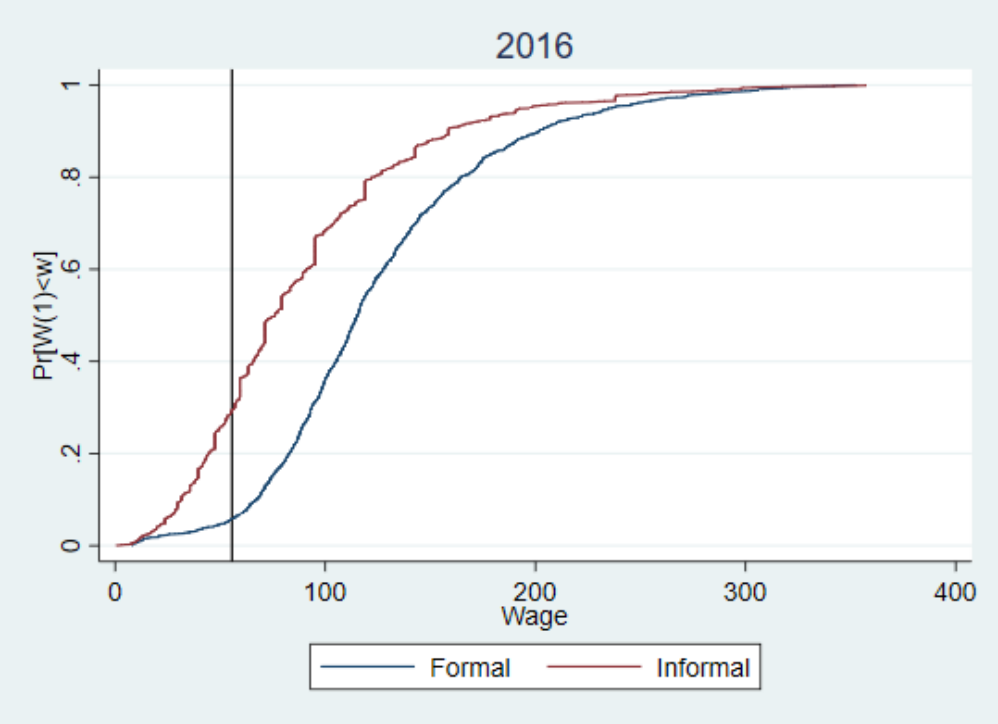
Figure 2: Evolution of Observed Hourly Wages, Hourly Minimum Wage, and Percentage of Workers Below the Minimum Wage, 2006-2016.



Notes: The sample included all women who were between 18 and 69 and not retired. The figure plots the evolution of the following indicators normalized to 2006 values: percentage of women employed in the domestic sector who earned less than the MW ("Below MW"); observed hourly wages for domestic workers for the 10th and 90th percentile ("p10 Domestic" and "p90 Domestic," respectively); percentiles of net hourly wages indexed to the CPI of December 2016 built on a mobile basis for each year); and the minimum wage in the domestic sector for January of each year ("MW Domestic"). Data were drawn from the 2006-2016 NHS.

Finally, we present the empirical cumulative distribution function (Figure 3) and the histogram (Figure 4) of wages for the formal and informal sectors. We observed no spike around the MW level and, consistent with the data presented in Table 1, the proportion of workers below the MW was higher in the informal sector.

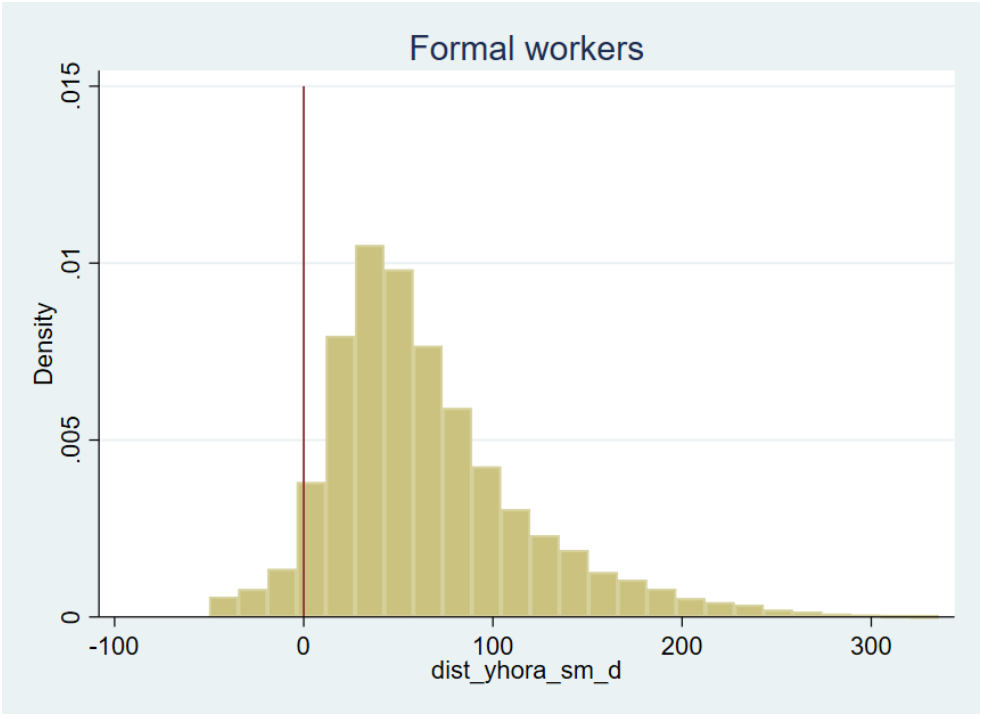
Figure 3. Empirical Cumulative Distribution Function of Wages, 2006 and 2016

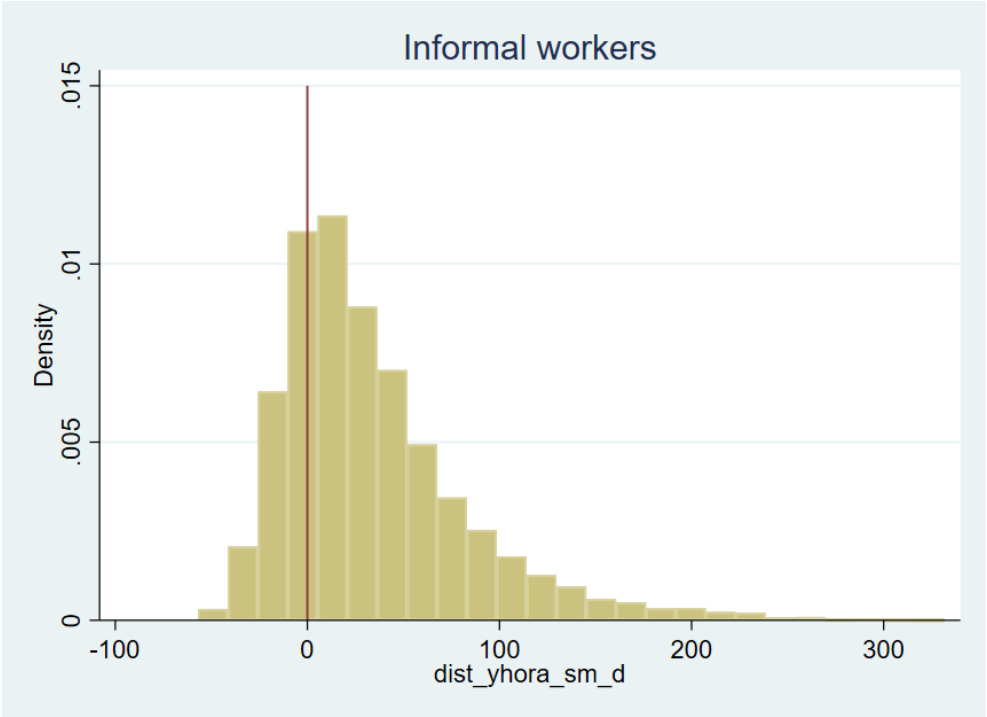


Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Empirical CDF of wages for all years is presented in Figure A3. The data were drawn from the 2006-2016 NHS.

Because of measurement problems related to self-reporting, and despite the fact that the discontinuities are not as marked as they are in the theoretical model, we could observe a discontinuous increase in the MW level for formal workers and a spike in the MW level for informal workers vs. formal ones.

Figure 4. Histogram of Normalized Wages for Formal and Informal Workers





Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Because hourly wages were normalized, red lines indicate the MW level. The data were drawn from the 2006-2016 NHS.

VI. Labor-Market Responses to the Minimum Wage

Table 2 reports all model parameter estimates for the pooled data, showing the significant effects of the MW on wages, employment, and mobility in the domestic-work sector. We note that the probability parameter referred to the population of all affected workers with latent wages below the MW ($F_0(m)$) and accounted for 20.3% of women in domestic work who were affected by the policy. It was also lower than the figure reported by Jales (2017).

The results show that workers were more likely to earn the MW in either the formal sector or in the informal sector not covered by the wage policy. For this to be true, workers in the informal sector must have retained substantial bargaining power. Nevertheless, the drop in employment in the domestic sector may be explained by the decrease in employment in the formal sector as well as by the importance of mobility between sectors, which negatively affected formality.

Table 2: Model Parameter Estimates, Pooled Data

π_m	π_u	π_d	$F_0(m)$	π_d^1	π_m^1	π_d^0	π_m^0	Λ	Obs.
0.193***	0.154***	0.654***	0.203***	0.643***	0.063***	0.665***	0.335***	0.523***	44,326
(0.008)	(0.028)	(0.022)	(0.004)	(0.051)	(0.005)	(0.015)	(0.015)	(0.003)	

Notes: The sample included women between 18 and 69 who were employed in the domestic sector and not retired. The table shows the probability of compliance for the whole sector (π_m), the probability of non-employment for the whole sector (π_u),the probability of non-compliance for the whole sector (π_d), the population of all affected workers ($F_0(m)$), the probability of non-compliance for formal domestic workers (sector mobility) (π_d^1), the probability of compliance for formal domestic workers (π_m^1), the probability of non-compliance for informal domestic workers (π_d^0), the probability of compliance for informal domestic workers (π_m^0), and the latent size of the formal sector ($\boldsymbol{\Lambda}$). Standard errors in parenthesis computed by 500 bootstrap replications. *** p<0.01, ** p<0.05, * p<0.1. Data were drawn from the 2006-2016 NHS.

6.1 Compliance Responses

Overall, we found that 65.4% of women in the domestic-work sector below the MW level in the latent distribution were non-compliers (π_d) and did not receive the minimum wage after the labor policy went into effect. These results are consistent with the poor conditions that existed in the domestic-work sector in Uruguay in in 2006 (in terms of wages and informality). The non-compliance effect was similar for formal (64.3%-π_d^1) and informal workers (66.5%-π_d^0). These parameters were much higher than those reported by Jales (2017).

On the other hand, the proportion of affected workers whose wages increased to reach the MW(π_m) was 19.3% for the whole period. This result was to be expected because the proportion of workers affected by the policy ($F_0(m)$)—those below the MW in the counterfactual distribution—was greater than the observed proportion of workers below the MW (Table 1). The greater probability of earning the MW held true for formal domestic workers (6.3%-π_m^1) but also for informal workers not covered by the wage policy (33.5%-π_m^0). This result is in line with the lighthouse hypothesis that the introduction of a MW in the formal sector acts as a wage-setting signal in the informal sector, increasing the wages of informal workers (Boeri, Garibaldi & Ribeiro, 2011; Gindling & Terrell, 2009; Lemos, 2009; Maloney & Mendez, 2004).

6.2 Non-Employment Effects

We found a significant impact on the probability of non-employment in the domestic sector (π_u) which reached 15.4% for the pooled data. This is explained by the decrease in the employment of formal domestic workers (29.4%-π_u^1) because the model did not allow for non-employment effects in the informal sector.

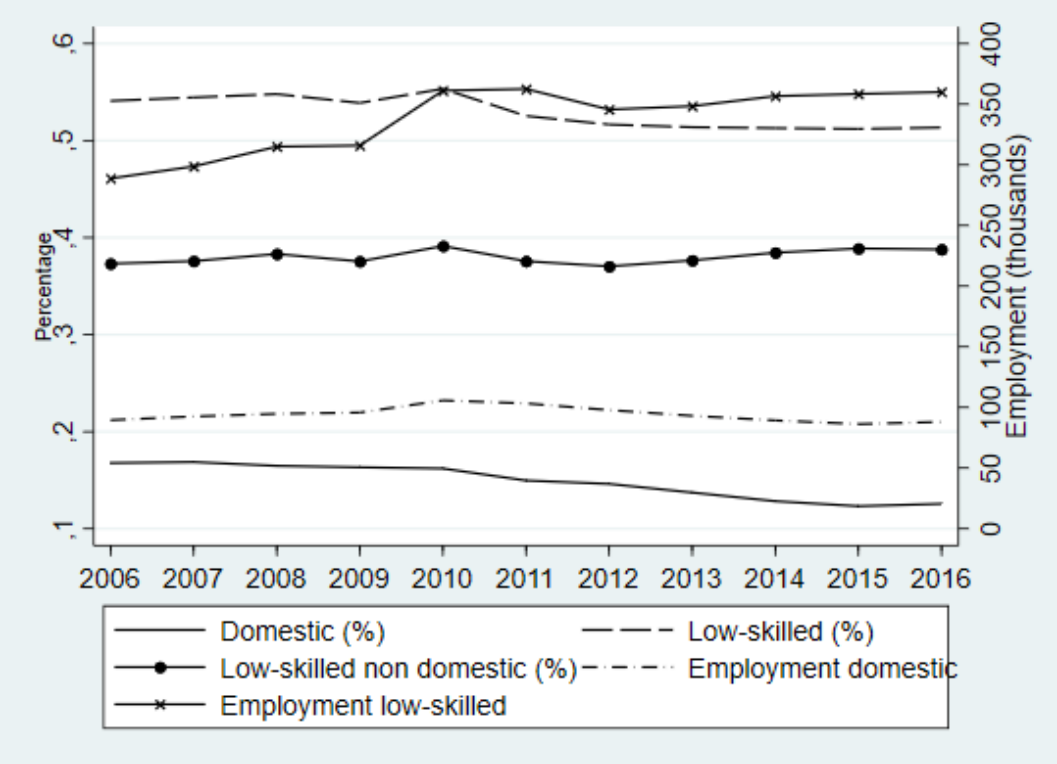
To calculate a comparable parameter of employment effect, we estimated a naive implied employment elasticity in the domestic-work sector with respect to the MW. A linear regression of non-employment effects in the domestic sector on the logarithm of hourly MW resulted in a significant elasticity of 0.3. This effect was lower than that found for developed countries (between 0.4 to 1.6) but was similar to the effect for low-skilled workers in Latin American countries (between 0.15 and 0.33) (Maloney & Mendez, 2004). Considering average MW increases for the period (10%), we found that employment in the domestic sector decreased approximately 3% because of the introduction of a MW. Although the non-employment effect was quite high, it returned to reasonable values when applied to aggregate domestic employment. Although the non-employment effect was much higher compared to the findings of Jales (2017), both the elasticity and the percentage drop in domestic work were quite similar.

To analyze whether this non-employment effect was the result of unemployment or of the shift of workers to other sectors, we presented some patterns of change in the cross-section data because, given the characteristics of the data, we could not analyze labor transitions. As Figure 1

shows, we observed a systematic increase in the LFP rate for women and a decrease in the unemployment rate, as well as a decrease in the proportion of women employed in domestic work. At the same time, Figure 5 shows that, while the number of women employed in the domestic sector remained constant, the number of women employed in low-skilled jobs increased as did their proportion of total number of employed women, excluding the domestic-work sector.[13]

These descriptive data provide evidence for the hypothesis that the non-employment effect could have been the result of the movement of workers to other sectors rather than of the undesired effects of the MW on employment. The years of sustained economic growth and improvement in labor-market conditions allowed women employed in a historically undervalued sector to shift to other sectors. If the economic context were to become less favourable, however, the welfare effects of the MW could be more difficult to understand.

Figure 5: Labor-Market Indicators for Women, 2006-2016



Notes: The sample included all women between 18 and 69 who were not retired. The figure plots the proportion of women employed in the domestic sector ("Domestic"), in low-skilled jobs ("Low-Skilled"), and in low-skilled jobs excluding the domestic sector ("Low-Skilled Non Domestic"), as well as the level of employment in the domestic sector ("Employment Domestic") and employment in low-skilled jobs ("Employment Low-Skilled"). Data were drawn from the 2006-2016 NHS.

[13] Low-skilled jobs are defined as those with code 5*** or 9*** in the International Standard Classification of Occupations (ISCO, 2008).

6.3 Sector Mobility and Enforcement

The proportion of formal workers among total workers affected by the policy (that is, the latent size of the formal sector [Λ]) was 52.3% for the pooled data, a lower percentage than Jales (2017) reported. As a undesired effect of the policy, we observed high sector mobility (π_d^1). Before the MW policy, for example, 64.3% of affected formal domestic workers received wages below the minimum, and they therefore migrated to the informal sector when the MW policy went into effect. Sector mobility is much higher than reported by Jales (2017).

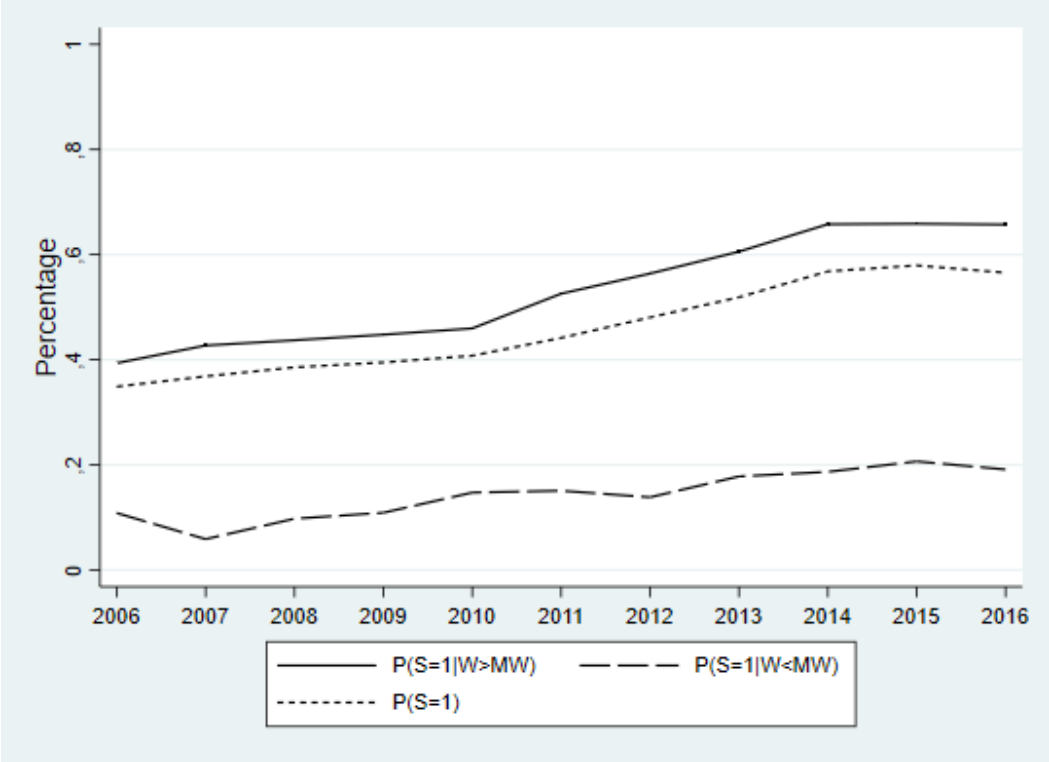
To establish a comparable parameter of the effect of MW on formality, we estimated an elasticity of formality with respect to the MW. A linear regression with formality in the domestic sector as the dependent variable[14] and the logarithm of hourly MW as the independent variable resulted in a statistically significant elasticity of 0.28.

Nevertheless, in the period under review, the proportion of women who contributed to social security in general and in the domestic sector in Uruguay increased substantially. As a result, we analyzed whether high sector mobility due to MW policy contradicted the finding that formality increased.

Figure 6 presents the evolution of the probability of being employed in the formal domestic sector by wage level and shows that the probability of being formally employed for workers below the MW was small and did not change substantially. On the other hand, workers above the MW were more likely to be engaged in formal employment, and their formality rate increased substantially between 2006 and 2016, which explains the increase in the overall formality rate for domestic workers. Because the model estimates were based on the bottom of the wage distribution, these results were consistent with the evolution of formality observed in the domestic-work sector.

[14] This effect is calculated as the sum of non-employment and non-compliance effect for formal workers multiplied by the latent size of the formal sector. That is, the proportion of affected workers that migrates out of formality due to MW.

Figure 6: Conditional Probability of Belonging to the Formal Sector 2006-2016, by Wage Level



Notes: The sample included all women in the domestic-work sector who were between 18 and 69 and not retired. The figure plots the probability of being employed in the formal domestic sector and the degree to which this probability was conditional on wage level—that is, whether the worker earned above or below the minimum wage. Data were drawn from the 2006-2016 NHS.

The relationship between workplace inspections in the domestic sector and those in all sectors remained stable during the period under analysis. Inspections were made in response to complaints or were initiated by the monitoring body, especially in cases in which the anonymity of the complainant was an issue. Although there was a substantial improvement in the handling of complaints, particularly because anonymity had not previously been fully respected, important complexities remained. It was not possible to enter a private home without a search warrant, so permission was requested to enter or to talk with the domestic worker. When noncompliance with any of the regulations was found and summonses were issued, the offending party would make payments of wages due as well as a fine, and be brought into compliance. If the conditions of compliance were not met within an established period, the summons would be renewed, and a new violation would be charged.

Formality increased overall, though that increase was considerably higher in the domestic sector. It is worth mentioning that there was no wage monitoring in the domestic sector until 2007,

so the first years were key for improving working conditions but were not accompanied by a marked increase in formal employment.[15] From 2011 onward, after years in which the policy was in effect and the learning period had been considerable, inspections increased along with the level of formal employment.

In this sense, minimum-wage policy by itself, if accompanied by policies such as workplace inspections and awareness campaigns, could affect formality, contributing to improved formality and working conditions (Almeida & Carneiro, 2012). Nevertheless, Ulyssea (2010) highlighted the fact that a substantial increase in enforcement could reduce the informal sector but have negative effects on employment. Conversely, policies that reduced costs in the formal sector did not involve a tradeoff between employment and informality.

6.4 Dynamic of Minimum Wage Effects

Figure 7 and Table A5 in Appendix 4 present results for the evolution of all model parameter estimates over time and demonstrate an increase in the population of affected workers ($F_0(m)$) from 16.6% in 2006 to 25.1% in 2016 (Panel A). This increase in the proportion of domestic workers with latent wages below the MW level is consistent with the evidence in Figure 2: that the MW grew more strongly than observed wages over the period under discussion. It is additionally consistent with the fact that, since 2005, minimum wages continued to exercise a significant effect on the determination of wages (Marinakis & Bueno, 2014).

Analyzing the labor-responses parameter, we observed a significant decrease (from 32.7% to 12.6%) in the probability that domestic workers would earn the MW (Panel B; compliance [$\boldsymbol{\pi_m}$]). At the same time, we observed a drop in the probability of non-compliance ($\boldsymbol{\pi_d}$) from 64.0% to 54.7% (Panel C) although this difference was small and not statistically significant. Meanwhile, we observed significant increase in the probability of non-employment in the domestic sector ($\boldsymbol{\pi_u}$) from 3.3% to 32.7% (Panel D). One hypothesis is that, during a period of economic growth and improvement in employment conditions, domestic workers might prefer to be unemployed or to

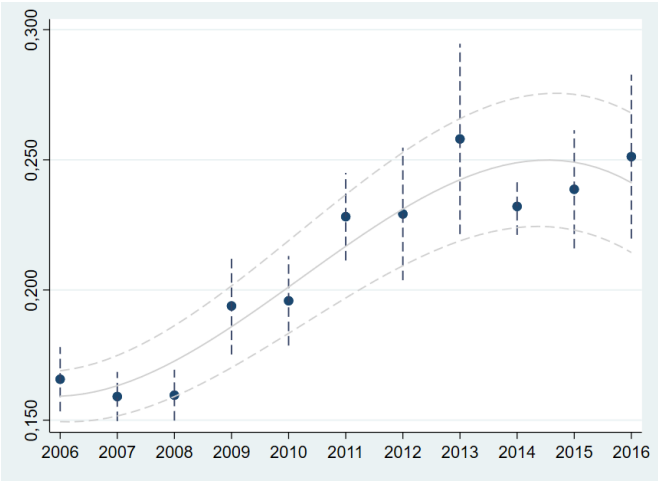
[15] In 2007, the total number of inspections carried out by the SSI was 16,905, while in the domestic sector it was 1,305. These numbers decreased to 10,814 and 797 in 2015, respectively.

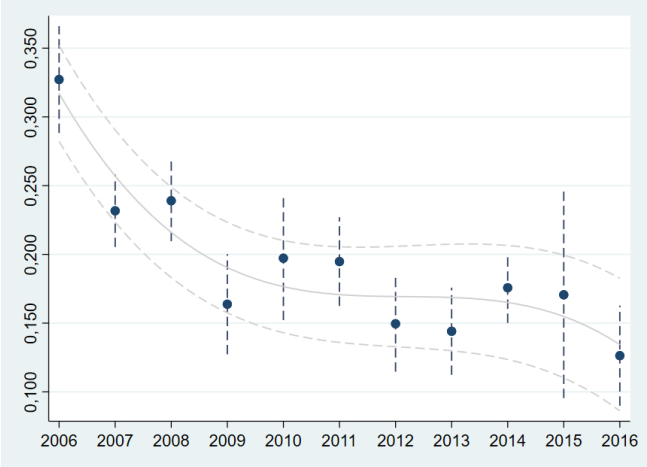
be employed in another sector rather than continue to earn a wage below the MW. Such a choice could be particularly difficult for formal workers who would have found themselves faced with this choice: either shift to the informal sector (and lose all the benefits of social security) or migrate to another work sector. Sector mobility consistently decreased over the period under analysis, and the non-compliance parameter for formal domestic workers ($\boldsymbol{\pi_d^1}$) dropped from 81.3% in 2006 to 44.5% in 2016 (Panel E). The net effect on the formal sector was positive, perhaps mainly in association with Uruguay's economic growth and increased employment between 2006 and 2016. When economic conditions worsen, however, changes in policies may be needed to ensure that workers do not enter the informal sector.

Additionally, we observed an increase in the probability of non-compliance for informal domestic workers ($\boldsymbol{\pi_d^0}$) from 52.8% to 73.3% (Panel F). An analysis of these estimates together with the latent size of the formal sector ($\boldsymbol{\Lambda}$), which increased from 39.4% to 64.6% (Panel G), suggests that informal workers who remained in the informal sector after eleven years of broad labor policies could well be called the hard core of informality. With the increase in both the MW and the number of affected workers, those who remain below the MW have an ever more difficult time reaching the minimum, and the probability that their wages will remain below the MW is higher.

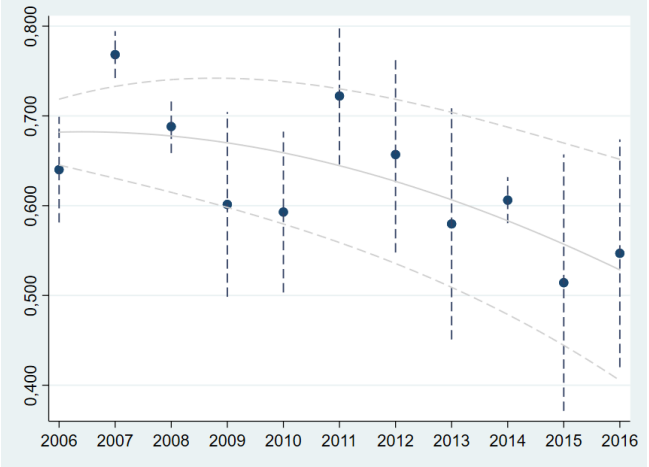
Figure 7: Evolution of Model Parameter Estimates, 2006-2016

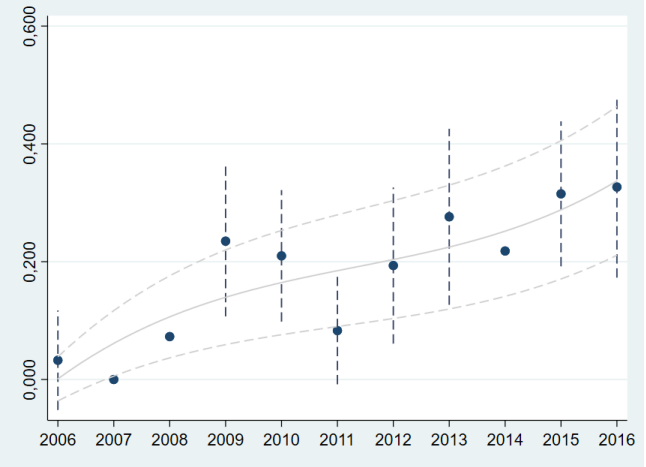
a) Population of all affected workers ($F_0(m)$) b) Compliance (π_m)



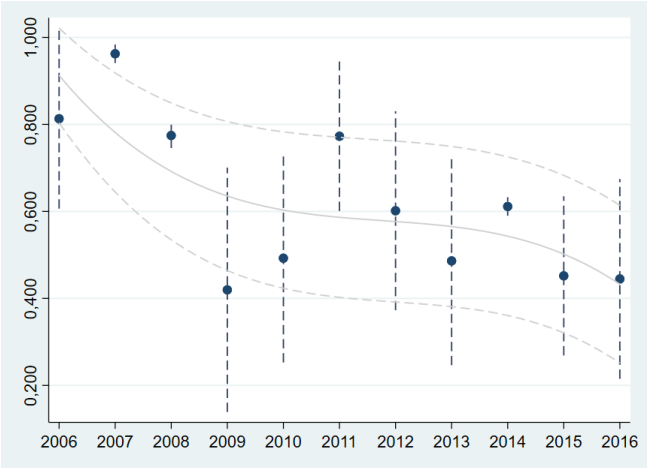


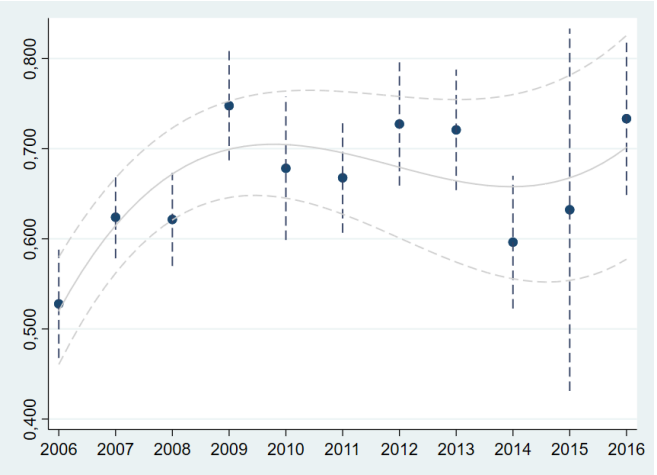
c) Non-compliance (π_d) d) Non-employment (π_u)



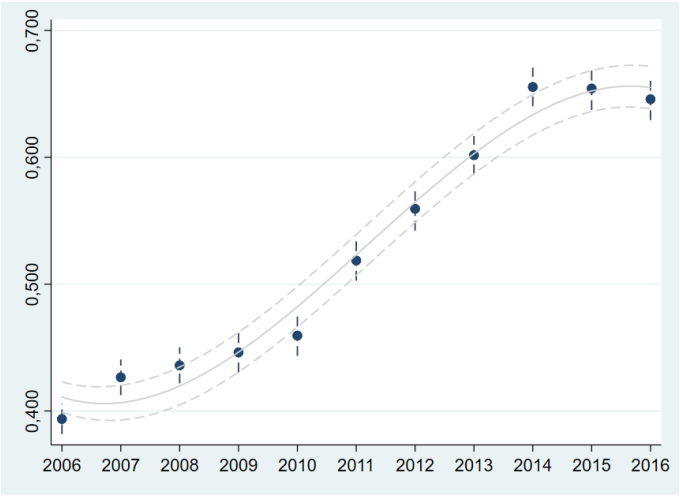


e) Non-compliance formal (π_d^1) f) Non-compliance informal (π_d^0)





g) Latent size of the formal sector ($\mathbf{\Lambda}$)



Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Point estimates and confidence intervals at 90%. Data were drawn from the 2006-2016 NHS.

6.5 Heterogeneous effects

As seen in Table 1, in comparison to all employed women, domestic workers were more likely to be older, less educated, and Afro-descendant; more likely to live in households in which children under 18 were present; and less likely to live in the capital city. Except for age, these same characteristics were associated with less favorable working conditions. One of our analyses thus focused on whether the characteristics mentioned above were a source of inequality within a sector where they were overrepresented and, therefore, whether the policy produced heterogeneous effects.

We analyzed the effects of the policy in three regions: Montevideo (the capital of Uruguay), other urban localities with more than 5,000 inhabitants, and localities and rural areas with fewer than 5,000 inhabitants. In Montevideo, the parameter associated with non-employment in the domestic-work sector (π_u) was higher than in the other regions—perhaps because of greater labor opportunities and, thus, greater labor mobility in the capital. Additionally, the population of all affected workers ($F_0(m)$) was higher in the capital, which may be associated with the fact that many of the workers earned above the MW (Table 1). Furthermore, the probability of compliance for informal workers, (π_m^0), was lower in the capital city than in other regions. Similar results were found for sector mobility within the domestic sector and in movement from the formal to the informal

sector (π_d^1). Taken together, these results are evidence of the deep difference in the effects of the policy between the capital and the other regions.

Our results were also significantly different if we considered workers' age. For women 35 years or younger, the probability of continuing to earn a wage below the minimum after the policy was greater than it was for workers over 35 years, mainly due to a notable shift of young workers from the formal to the informal sector (π_d^1). Moreover, there was a higher non-employment effect for workers over 35 (π_u). These results can be linked to the fact that young workers are employed mainly in the care of children and conceive of work as a source of temporary income but have no interest in the future benefits associated with formalization. These results are consistent with those presented with our descriptive evidence: we observed that informality among workers under 36 was 15% higher than it was among those aged 36 or older.

Households with children were more likely to be low-income; they were, therefore, the population most likely to find that minimum-wage policies conflicted with other social benefits. For workers who lived in households in which children under 18 were present, there was a lower probability of non-employment (π_u). It could be that women in households without children had more incentive to risk unemployment and to seek work in sectors with better working conditions. Non-compliance for formal workers (sector mobility) (π_d^1)—was higher for women in households with children and sector mobility is resultantly higher for this group.

The non-employment effect (π_u) was greater for the workers with seven years of education or more, while sector mobility was lower. On the other hand, the probability of compliance (π_m) was higher for non-Afro-descendant workers, whereas the non-employment effect (π_u) was higher for Afro-descendant women. In addition, the shift of workers from the formal to the informal sector(π_d^1), as well as the probability of compliance for informal workers (π_m^0), were greater for non-Afro-descendant workers. Nevertheless, the model estimates for the variables of ethnicity and educational level were not statistically significant.

6.6 Robustness Checks

Finally, it was important to analyze the sensitivity of our results to different specifications of the models or to methodological decisions. The first step was estimating the probability of non-compliance (π_d) for which we exploited the discontinuity around the MW level by estimating the ratio of the density of wages below and above the MW. Following Jales (2017), we performed the estimate using local linear density estimators with a bandwidth of eight times Silverman's rule of thumb. We found practically no difference in the results of model parameter estimates for the pooled data (Table A7). We did find differences in non-employment, the number of affected workers, and non-compliance of formal domestic workers with a bandwidth of four times Silverman's rule of thumb.

Additionally, we estimated specifications of the models with different choices of the fraction at the minimum wage and different point estimations of the kernel density (Table A8). The main result did not change with these variations. We only found significant differences for the parameters of compliance, non-compliance for informal workers, and compliance for informal workers for fractions at the minimum wage equal to 0.04 and 0.06 rather than 0.05.

Finally, we replicated the estimates by rounding wages at different heaping points (Table A9), understanding that errors of measurement might have occurred in the monthly wages declared by workers (because, for example, of a tendency to report in round numbers). We found no significant differences in the results for the pooled data.

VII. Conclusions and Policy Implications

Our results indicate the significant effects of the MW on the population of all affected workers and show that latent wages below the minimum affect 20.3% of women in the domestic-work sector. Average results show a drop-in employment in the domestic sector (15.4% of affected workers became non-employed in the sector), explained by the decrease in employment in the formal sector (29.4% of formal workers became non-employed). Simultaneously, an important negative effect on mobility between sectors was observed: before the MW policy, 64.3% of affected formal domestic workers maintained a wage below the minimum and therefore migrated

to the informal sector when the MW policy went into effect. The proportion of affected workers whose wages increased to reach the MW level was 19.3%, a shift that affected both formal domestic workers (6.3%) and informal workers not covered by the policy (33.5%). This is consistent with the lighthouse effect. Secondary evidence suggests that the non-employment effect would come from workers shifting to other sectors and not to unemployment. The mobility of workers across sectors, however, was the result of a period of growth and the improvement of working conditions and not to the MW policy itself. Regarding sector mobility, we found that this non-desired effect seemed to be offset by the other labor policies in force during the period, including labor inspections and awareness campaigns.

Analyzing the evolution over time, we observed a significant decrease in the probability of earning the MW and an increase in the probability of non-employment between 2006 and 2016. One hypothesis is that, in the context of general economic growth and improvement in labor conditions, women in domestic work preferred to be unemployed or employed in other sectors rather than continue to earn below the MW in the domestic sector. Such a choice could be particularly difficult for those workers who would have found themselves faced with the choice of either migrating to another work sector or shifting to the informal sector (and losing all the benefits of social security). In fact, the probability of a shift to informality for formal workers (sector mobility) decreased substantially during the analyzed period.

The analysis of heterogeneous effects showed interesting results. Analyzing separately for women in households with or without children under 18 years old, we found higher non-employment effects for women in households with children. This could be due to a greater need to take the risk of being unemployed in order to look for better-paid work. We also found higher non-employment effects in workers in the capital, possibly due to greater employment opportunities in other sectors with better working conditions. Our results were also significantly different if we considered age: there was high sector mobility for younger women, possibly the result of less bargaining power or lack of interest or myopia regarding on the future benefits of formalization and social security coverage.

In summary, this study provides evidence of the importance of minimum wages in establishing livable-wage floors for formal and informal domestic workers. We also found undesired effects of MW policy on employment and formality, however, which were likely to be offset by

other labor policies, by sustained economic growth, and by improvement of labor-market conditions. In this context, this study highlights the importance of applying broad labor policies that include both minimum wages and inspection of labor conditions to ensure the desired effects of the policy.

We expect these findings to contribute to better, evidence-based policies in developing countries in which there are highly feminized sectors, high informality, and little regulation prior to the implementation of a MW wage policy.

References

Addison, J. T., & Ozturk, O. D. (2012). Minimum Wages, Labor Market Institutions, and Female Employment: A Cross-Country Analysis. ILR Review, 65(4), 779-809.

Almeida, R., & Carneiro, P. (2012). Enforcement of Labor Regulation and Informality. American Economic Journal: Applied Economics, 4(3), 64-89.

Boeri, T., Garibaldi, P., and Ribeiro, M. (2011). The Lighthouse Effect and Beyond. Review of Income and Wealth, 57(Special Issue), 54-78.

Butcher, T., Dickens, R., and Manning, A. (2012). Minimum Wages and Wage Inequality : Some Theory and an Application to the UK. Center for Economic Performance (Vol. 1177).

Campos, R., Esquivel, G., and Santillán, A. S. (2015). El Impacto del Salario Mínimo en los Ingresos y el Empleo en México. Serie Estudios y Perspectivas, 162, 119.

Card, D. and Krueger, A. B. (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. The American Economic Review, 84(4), 772-793. Retrieved from https://doi.org/10.2307/2118030.

CIEDUR (Centro Interdisciplinario de Estudios sobre el Desarrollo) (2017). Mapa de Género: Trabajo, Empleo y Negociación Colectiva en Uruguay. Montevideo, Uruguay: CIEDUR.

Dickens, R., Machin, S., and Manning, A. (1994). The Effects of Minimum Wages on Employment: Theory and Evidence from the US. NBER Working Paper No. 4742. Cambridge, MA: National Bureau of Economic Research. Available from https://www.nber.org/papers/w4742.pdfl.

Dinkelman, T., and Ranchhod, V. (2012). Evidence on the Impact ff Minimum Wage Laws in an Informal Sector: Domestic Workers in South Africa. Journal of Development Economics, 99(1), 27-45. Retrieved from https://doi.org/10.1016/j.jdeveco.2011.12.006.

Doyle, J. J. (2006). Employment Effects of a Minimum Wage: A Density Discontinuity Design Revisited. MIT Sloan School of Management Working Paper.

Espino, A. (2016). Resultados de las Reformas Jurídicas Relativas a las Trabajadoras y los Trabajadores Domésticos en Uruguay. Serie Condiciones de Trabajo y Empleo, 84, 1-89. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---travail/documents/publication/wcms_534138.pdf.

Espino, A., and Amarante, V. (2008). Informalidad y Protección Social en Uruguay: La Situación de las mujeres. In Uruguay: Ampliando las Pportunidades Laborales para las Mujeres-. Washington, DC: World Bank, 12-59. Available from http://www.inmujeres.gub.uy/innovaportal/file/19653/1/2_oport_lab_mujeres.pdf.

Fajnzylber, P. (2001). Minimum Wage Effects Throughout the Wage Distribution: Evidence from Brazil's Formal and Informal Sectors. Anais do XXIX Encontro Nacional de Economia. Retrieved from https://doi.org/10.2139/ssrn.269622.

Filgueira, F. (2014). Hacia un Modelo de Protección Social Universal en América Latina. Serie Políticas Sociales, No. 188. Retrieved from http://www.ochisap.cl/index.php/determinantes-y-proteccion-social/politicas-sociales.

Gasparini, L., and Tornarolli, L. (2009). Labor Informality in Latin America and the Caribbean: Patterns and Trends from Household Survey Microdata. Desarrollo y Sociedad, 63, 13-80. Retrieved from http://www.scielo.org.co/pdf/dys/n63/n63a02.pdf.

Gindling, T. H., and Terrell, K. (2005). The Effect of Minimum Wages on Actual Wages in Formal and Informal Sectors in Costa Rica. World Development, 33(11), 1905-1921. Retrieved from https://doi.org/10.1016/j.worlddev.2005.04.017.

Gindling, T. H., and Terrell, K. (2009). Minimum Wages, Wages and Employment in Various Sectors in Honduras. Labour Economics, 16(3), 291-303. Retrieved from https://doi.org/10.1016/j.labeco.2008.10.001.

Gramlich, E., Flanagan, R., and Wachter, M. (1976). Impact Of Minimum Wages on Other Wages, Employment, and Family Incomes. Brookings Papers on Economic Activity, 2, 409--461. Retrieved from https://doi.org/10.2307/2534380.

Groisman, F., Boffi, S., Calero, A., Cuba, M. S., Liniado, J., Sconfienza, M. E., and Vergara, A. (2015). Social Protection to the Informal Sector: The Role of Minimum Wage and Income Transfer Policies. PEP Working Paper Series 2015-05. Retrieved from https://doi.org/10.2139/ssrn.2665225.

Holmlund, B. (2014). What Do Labor Market Institutions Do? Labour Economics, 30, 62-69. Retrieved from https://doi.org/10.1016/j.labeco.2014.06.007.

Jales, H. (2017). Estimating the Effects of the Minimum Wage in a Developing Country: A Density Discontinuity Design Approach. Journal Of Applied Econometrics, 33(1), 29-51. Retrieved from https://doi.org/10.1002/jae.2586.

Lemos, S. (2004). The Effects of the Minimun Wage in the Formal and Informal Sectors in Brazil. IZA Discussion Papers, 1089, 1-17. Retrieved from https://www.iza.org/publications/dp/1089/the-effects-of-the-minimum-wage-in-the-formal-and-informal-sectors-in-brazil.

Lemos, S. (2009). Minimum Wage Effects in a Developing Country. Labour Economics, 16(2), 224-237. Retrieved from https://doi.org/10.1016/j.labeco.2008.07.003.

Lustig, N. and Mcleod, D. (1995). Salario Mínimo y Pobreza: Un Análisis de Corte Transversal para Países en Desarrrollo, Coyuntura Social 013219, FEDESARROLLO. Available from https://ideas.repec.org/p/col/000486/013219.html.

Maloney, W., and Mendez, J. (2004). Measuring the Impact of Minimum Wages: Evidence from Latin America. In E. James J. Heckman and Carmen Pagés, Eds., Law and Employment: Lessons from Latin American and the Caribbean. Chicago: University of Chicago Press, 109-130.

Marinakis, A., and Bueno, C. (2014). Imcumplimiento con el Salario Mínimo: ¿Culpa del Nivel o Debilidad Institucional? In A. Marinakis, Ed., Incumplimiento con el Salario Mínimo en América Latina: El Peso de los Factores Económicos e Institucionales. Santiago de Chile: OIT, 13-55.

McCrary, J. (2008). Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test. Journal of Econometrics, 142(2), 698-714. Retrieved from https://doi.org/10.1016/j.jeconom.2007.05.005.

MIDES-INMUJERES. (2016). Estadísticas de Género 2016. Montevideo.

Mincer, J. (1976). Jacob Mincer. Journal of Political Economy, 84(4). Retrieved from http://www.jstor.org/stable/1831104.

Neumark, D. (2017). The Employment Effects of Minimum Wages: Some Questions We Need to Answer. NBER Working Paper No. 23584. Cambridge, MA: National Bureau of Economic Research.

Neumark, D., Cunningham, W., and Siga, L. (2006). The Effects of the Minimum Wage in Brazil on the

Distribution of Family Incomes: 1996-2001. Journal of Development Economics, 80(1), 136-159. Retrieved from https://doi.org/10.1016/j.jdeveco.2005.02.001

Neumark, D. and Wascher, W. (2007). Minimum Wages and Employment David. Foundations and Trends in Microeconomics, 3(1/2), 1-184.

OIT (2016). Políticas de Formalización del Trabajo Doméstico Remunerado en América Latina y el Caribe. Oficina Regional para América Latina y el Caribe. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_480352.pdf.

Querejeta, M., and Katzkowicz, S. (2013). Evolución de la Segregación Ocupacional y Su Impacto en las Brechas Salariales de Género. Serie Documentos de Investigación Estudiantil, Vol. 1. Montevideo: Instituto de Economía.

Stewart, M. B. (2004). The Employment Effects of the National Minimum Wage. The Economic Journal, 114(May), 110-116.

Ulyssea, G. (2010). Regulation of Entry, Labor Market Institutions and the Informal Sector. Journal of Development Economics, 91, 87-99. Retrieved from https://doi.org/10.1016/j.jdeveco.2009.07.001.

Wellington, A. J. (1991). Effects of the Minimum Wage on the Employment Status of Youths: An Update. The Journal of Human Resources, 26(1), 27. Retrieved from https://doi.org/10.2307/145715.

Appendices

Appendix 1: McCrary Test of Discontinuity

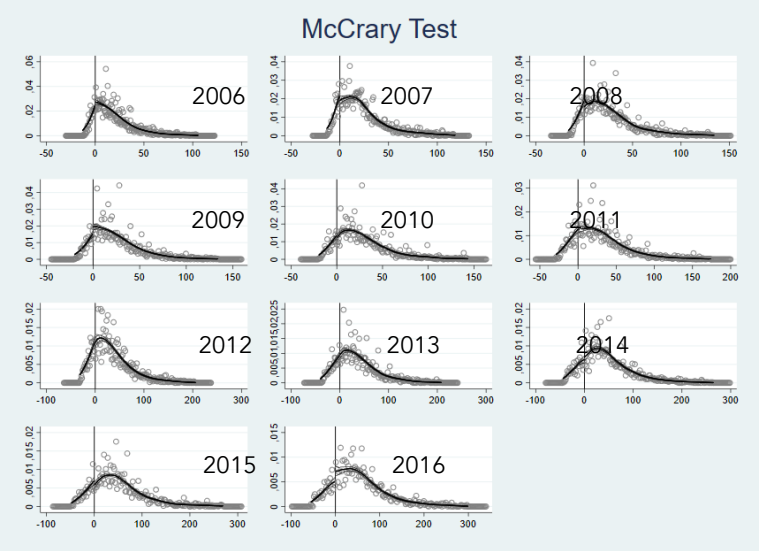
We conducted this test for every year and for total, formal, and informal workers separately, with wages normalized to the MW. Our main variable was the difference between net hourly wages and MW and the breakpoint analyzed was zero. The null hypothesis of no discontinuity was rejected at 10% confidence for the majority of years in the case of total workers, but not for formal and informal workers taken separately.

Table A1: McCrary Test Statistics: Hourly Wages of Formal, Informal and Total Domestic Workers Near the MW, 2006-2016.

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Pool
Total worker	theta	0.100	-0.182	-0.214	0.220	-0.108	-0.004	-0.028	0.002	0.061	-0.221	0.352	0.056
	se	0.055	0.086	0.086	0.074	0.099	0.086	0.086	0.094	0.108	0.117	0.114	0.025
	pvalue	0.069	0.035	0.012	0.003	0.277	0.961	0.741	0.984	0.572	0.060	0.002	0.027
	binsize	0.47	0.71	0.79	0.80	0.91	1.09	1.33	1.40	1.72	1.95	2.18	0.36
	bandwidth	16.94	14.69	17.63	24.67	19.12	25.77	33.01	32.24	35.75	37.18	42.02	23.31
	N	7,140	4,293	4,350	4,080	3,938	3,937	3,549	3,575	3,456	3,036	2,972	44,326
Formal worker	theta	0.287	-1.341	-0.757	0.410	-0.411	0.184	0.201	0.150	-0.033	-0.176	0.370	0.519
	se	0.188	0.595	0.411	0.250	0.357	0.249	0.259	0.248	0.272	0.255	0.249	0.059
	pvalue	0.127	0.024	0.066	0.100	0.249	0.461	0.439	0.547	0.904	0.490	0.138	0.000
	binsize	0.81	1.20	1.27	1.24	1.39	1.59	1.90	1.90	2.21	2.45	2.77	0.57
	bandwidth	10.93	10.10	13.37	14.66	13.79	17.70	21.43	23.41	27.92	33.13	34.93	29.61
	N	2,512	1,582	1,691	1,632	1,649	1,712	1,688	1,840	1,940	1,751	1,668	19,665
Informal worker	theta	0.026	-0.065	-0.031	0.169	0.014	-0.086	-0.166	-0.068	0.024	-0.237	0.197	-0.002
	se	0.060	0.074	0.073	0.077	0.085	0.081	0.091	0.090	0.096	0.104	0.113	0.029
	pvalue	0.664	0.379	0.675	0.027	0.867	0.289	0.068	0.451	0.805	0.022	0.082	0.936
	binsize	0.55	0.81	0.94	0.99	1.15	1.39	1.72	1.87	2.47	2.89	3.14	0.42
	bandwidth	16.49	21.07	26.52	27.68	28.93	34.23	36.34	42.44	53.65	61.18	55.27	21.06
	N	4,628	2,711	2,659	2,448	2,289	2,225	1,861	1,735	1,516	1,285	1,304	24,661

Notes: The sample included all women, 14 years or older, who were employed in the domestic sector. Data were drawn from the 2006-2016 NHS.

Figure A1: Mccrary Graph Test of Wages of Domestic Workers around the Minimum Wage, 2006-2016.



Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Data were drawn from the 2006-2016 NHS.

Table A2: McCrary Test of Discontinuity on Wages for All Domestic Workers at Different Points, 2006-2016.

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Pool
Breakpoint (25)	Theta	-	-0.173	-0.258	0.099	0.070	-	-0.083	-	0.065	0.058	-	0.095
	Se	0.071	0.087	0.071	0.077	0.074	0.069	0.075	0.071	0.068	0.073	0.085	0.038
	Pvalue	0.105	0.046	0.000	0.197	0.348	0.652	0.269	0.040	0.335	0.425	0.886	0.012
	Binsize	0.47	0.71	0.79	0.80	0.91	1.09	1.33	1.40	1.72	1.95	2.18	0.36
	Bandwidth	18.24	17.95	27.28	24.79	27.64	36.64	37.21	45.10	55.01	61.49	54.18	24.24
	N	7,140	4,293	4,350	4,080	3,938	3,937	3,549	3,575	3,456	3,036	2,972	44,326
Breakpoint (40)	Theta	-	-0.002	0.014	0.188	-	-	0.039	-	-	0.092	-	0.095
	Se	0.106	0.125	0.102	0.103	0.091	0.086	0.090	0.076	0.081	0.083	0.080	0.038
	Pvalue	0.251	0.989	0.891	0.068	0.181	0.591	0.666	0.006	0.318	0.267	0.042	0.012
	Binsize	0.47	0.71	0.79	0.80	0.91	1.09	1.33	1.40	1.72	1.95	2.18	0.36
	Bandwidth	19.47	20.18	22.41	26.85	30.00	33.83	37.31	48.58	42.73	47.35	58.72	24.24
	N	7,140	4,293	4,350	4,080	3,938	3,937	3,549	3,575	3,456	3,036	2,972	44,326
Breakpoint (50)	Theta	0.105	0.184	-0.175	0.431	0.364	-	-0.229	0.085	0.073	-	0.001	0.095
	Se	0.141	0.165	0.117	0.134	0.119	0.099	0.099	0.093	0.089	0.082	0.088	0.038
	Pvalue	0.456	0.265	0.136	0.001	0.002	0.534	0.020	0.361	0.410	0.017	0.992	0.012
	Binsize	0.47	0.71	0.79	0.80	0.91	1.09	1.33	1.40	1.72	1.95	2.18	0.36
	Bandwidth	18.12	19.11	32.13	24.27	26.87	36.38	40.21	41.06	41.72	54.85	52.71	24.24
	N	7,140	4,293	4,350	4,080	3,938	3,937	3,549	3,575	3,456	3,036	2,972	44,326

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Data were drawn from the 2006-2016 NHS.

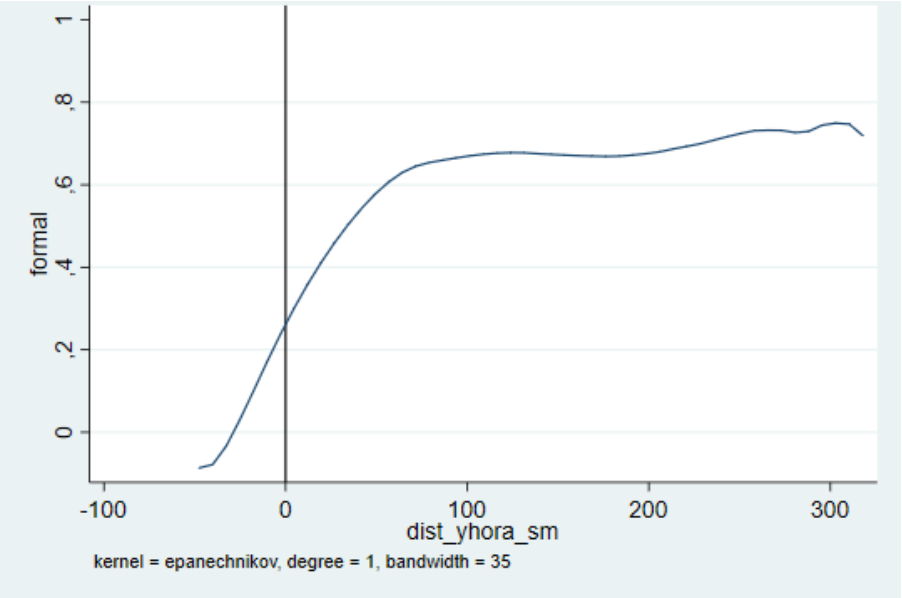
Table A3: Mccrary Test of Discontinuity in Wages for Total Domestic Workers Using Different Binsize.

	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Theta	0.059	0.074	0.091	0.099	0.126	0.143	0.134	0.137	0.144	0.165
Se	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.023	0.023
pvalue	0.020	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. The dataset corresponds to the pooled NHS from 2006 to 2016.

Appendix 2: Independence Test between Sector and Wages

Figure A2: Non Parametric Analysis of Formality vs. Wages



Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. The black line indicates the MW level. Data were drawn from the 2006-2016 NHS.

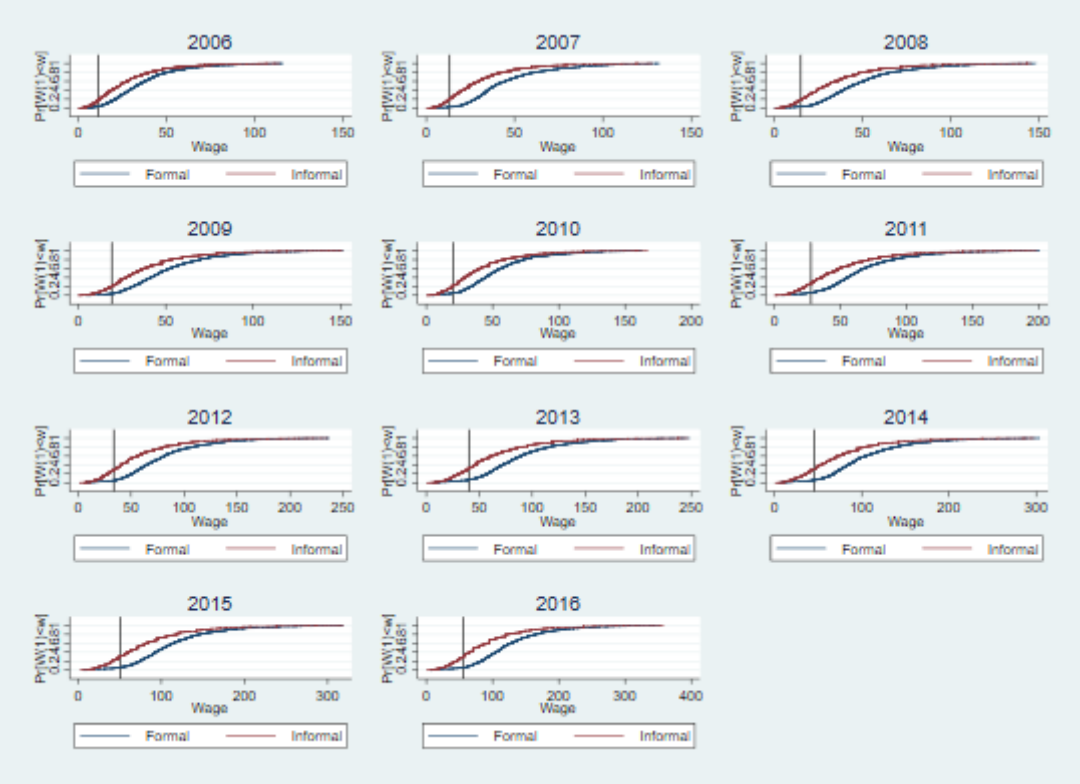
Table A4: Parametric Linear Regression of Formality vs. Wages Logarithms

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
W > 0	0,1800	0,2540	0,2230	0,2190	0,2120	0,2300	0,2630	0,2690	0,2580	0,2550	0,2650
Pval	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
W > m	0,1730	0,2830	0,2470	0,2240	0,2410	0,2200	0,2460	0,2530	0,2390	0,2170	0,2630
Pval	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
W > 1.5m	0,1180	0,2000	0,1750	0,1370	0,1520	0,0740	0,0977	0,0608	0,0705	0,0446	0,0906
Pval	0,0000	0,0000	0,0000	0,0000	0,0000	0,0105	0,0013	0,0597	0,0141	0,1570	0,0072
W > 2m	0,0826	0,1200	0,1070	0,0812	0,0559	0,0230	0,0495	-0,0045	0,0517	-0,0155	0,0211
Pval	0,0001	0,0000	0,0001	0,0222	0,0940	0,5770	0,2640	0,9250	0,2140	0,7370	0,6640

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Data were drawn from the 2006-2016 NHS.

Appendix 3: Data and Descriptive Analysis

Figure A3. Empirical Cumulative Distribution Function of Wages



Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Data were drawn from the 2006-2016 NHS.

Appendix 4: Estimation

Table A5: Model Parameter Estimates, 2006-2016 and Pooled Data

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Pool
π_d	0.640***	0.768***	0.688***	0.601***	0.593***	0.722***	0.657***	0.580***	0.606***	0.514***	0.547***	0.654***
	(0.036)	(0.016)	(0.018)	(0.063)	(0.054)	(0.046)	(0.066)	(0.078)	(0.016)	(0.087)	(0.077)	(0.022)
π_m	0.327***	0.232***	0.239***	0.164***	0.197***	0.195***	0.150***	0.144***	0.176***	0.171***	0.126***	0.193***
	(0.024)	(0.016)	(0.018)	(0.022)	(0.027)	(0.020)	(0.021)	(0.019)	(0.016)	(0.046)	(0.022)	(0.008)
π_u	0.033	0.000	0.073***	0.235***	0.210***	0.083	0.193**	0.276***	0.218***	0.315***	0.327***	0.154***
	(0.051)	(0.002)	(0.004)	(0.078)	(0.068)	(0.055)	(0.081)	(0.091)	(0.001)	(0.075)	(0.094)	(0.028)
$F_0(m)$	0.166***	0.159***	0.160***	0.194***	0.196***	0.228***	0.229***	0.258***	0.232***	0.239***	0.251***	0.203***
	(0.008)	(0.006)	(0.006)	(0.011)	(0.010)	(0.010)	(0.015)	(0.022)	(0.007)	(0.014)	(0.019)	(0.004)
π_d^1	0.813***	0.962***	0.774***	0.420**	0.492***	0.773***	0.601***	0.486***	0.611***	0.452***	0.445***	0.643***
	(0.126)	(0.013)	(0.018)	(0.171)	(0.146)	(0.104)	(0.139)	(0.146)	(0.013)	(0.111)	(0.140)	(0.051)
π_m^1	0.104***	0.038***	0.059***	0.054***	0.051***	0.067***	0.053***	0.055***	0.056***	0.066***	0.049***	0.063***
	(0.017)	(0.012)	(0.015)	(0.012)	(0.017)	(0.014)	(0.012)	(0.012)	(0.013)	(0.016)	(0.013)	(0.005)
π_d^0	0.528***	0.624***	0.621***	0.748***	0.678***	0.668***	0.727***	0.721***	0.596***	0.632***	0.733***	0.665***
	(0.037)	(0.028)	(0.031)	(0.037)	(0.048)	(0.037)	(0.042)	(0.041)	(0.045)	(0.122)	(0.052)	(0.015)
π_m^0	0.472***	0.376***	0.379***	0.252***	0.322***	0.332***	0.273***	0.279***	0.404***	0.368***	0.267***	0.335***
	(0.037)	(0.028)	(0.031)	(0.037)	(0.048)	(0.037)	(0.042)	(0.041)	(0.045)	(0.122)	(0.052)	(0.015)
Λ	0.394***	0.427***	0.436***	0.446***	0.459***	0.519***	0.559***	0.602***	0.655***	0.654***	0.646***	0.523***
	(0.007)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.003)
Obs.	7,140	4,293	4,350	4,080	3,938	3,937	3,549	3,575	3,456	3,036	2,972	44,326

Notes: The sample included women between 18 and 69 who were employed in the domestic sector and not retired. Standard errors in parentheses computed by 500 bootstrap replications. *** p<0.01, ** p<0.05, * p<0.1. Data were drawn from the 2006-2016 NHS.

Table A6: Heterogeneity Analysis. Estimation of Parameters by Variables of Interest.

	Region			Age		Child. in household		Years of education		Ethnicity	
	Capital city	More than 5,000 inhab	Less than 5,000 inhab	35 or less	More than 35	No	Yes	Less than 7 years	7 years or more	Non-afro	Afro
π_d	0.421***	0.704***	0.641***	0.780**	0.574***	0.565*	0.680*	0.734***	0.749***	0.644**	0.655*
	(0.049)	(0.017)	(0.049)	(0.015)	(0.028)	(0.034	(0.015)	(0.028)	(0.028)	(0.023)	(0.055
π_m	0.106***	0.218***	0.183***	0.206**	0.181***	0.168*	0.199*	0.223***	0.214***	0.198**	0.150*
	(0.017)	(0.008)	(0.021)	(0.009)	(0.011)	(0.013	(0.007)	(0.011)	(0.010)	(0.009)	(0.018
π_u	0.474***	0.079***	0.176***	0.014	0.245***	0.267*	0.121*	0.043	0.037	0.158**	0.195*
	(0.061)	(0.020)	(0.064)	(0.016)	(0.036)	(0.044	(0.017)	(0.034)	(0.035)	(0.030)	(0.067
$F_0(m)$	0.162***	0.235***	0.256***	0.238**	0.193***	0.210*	0.206*	0.196***	0.172***	0.202**	0.221*
	(0.006)	(0.004)	(0.013)	(0.004)	(0.005)	(0.007	(0.003)	(0.005)	(0.005)	(0.004)	(0.011
π_d^1	0.126	0.768***	0.602***	0.904**	0.499***	0.481*	0.685*	0.843***	0.859***	0.638**	0.542*
	(0.105)	(0.040)	(0.114)	(0.038)	(0.061)	(0.074	(0.034)	(0.065)	(0.063)	(0.055)	(0.133
π_m^1	0.032***	0.071***	0.071***	0.063**	0.063***	0.052*	0.068*	0.073***	0.071***	0.063**	0.061*
	(0.009)	(0.005)	(0.011)	(0.007)	(0.006)	(0.007	(0.006)	(0.007)	(0.006)	(0.005)	(0.012
π_d^0	0.800***	0.642***	0.686***	0.689**	0.669***	0.677*	0.674*	0.621***	0.621***	0.651**	0.764*
	(0.035)	(0.014)	(0.041)	(0.015)	(0.021)	(0.027	(0.014)	(0.019)	(0.020)	(0.017)	(0.030
π_m^0	0.200***	0.358***	0.314***	0.311**	0.331***	0.323*	0.326*	0.379***	0.379***	0.349**	0.236*
	(0.035)	(0.014)	(0.041)	(0.015)	(0.021)	(0.027	(0.014)	(0.019)	(0.020)	(0.017)	(0.030
Λ	0.562***	0.490***	0.537***	0.424**	0.559***	0.572*	0.491*	0.508***	0.536***	0.528**	0.491*
	(0.005)	(0.004)	(0.009)	(0.006)	(0.003)	(0.004	(0.004)	(0.004)	(0.004)	(0.003)	(0.008
Obs.	14,695	23,324	6,307	12,747	31,579	17,497	26,829	20,837	23,489	38,129	6,197

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Standard errors in parentheses computed by 500 bootstrap replications. *** p<0.01, ** p<0.05, * p<0.1. Data were drawn from the 2006-2016 NHS.

Appendix 5: Robustness Check for Estimation

Table A7: Different Choices of Bandwidth

	4			5			6		
	Estim.	**LL**	**UL**	**Estim.**	**LL**	**UL**	**Estim.**	**LL**	**UL**
π_d	0.730***	0.694	0.766	0.711***	0.675	0.747	0.692***	0.656	0.728
π_m	0.215***	0.202	0.228	0.210***	0.196	0.223	0.204***	0.191	0.217
π_u	0.055**	0.009	0.101	0.079***	0.034	0.125	0.104***	0.059	0.15
$F_0(m)$	0.185***	0.179	0.192	0.189***	0.182	0.196	0.194***	0.187	0.2
π_d^1	0.824***	0.741	0.908	0.780***	0.696	0.864	0.734***	0.65	0.818
π_m^1	0.070***	0.062	0.078	0.069***	0.061	0.077	0.067***	0.059	0.075
π_d^0	0.626***	0.602	0.651	0.636***	0.611	0.66	0.646***	0.621	0.67
π_m^0	0.374***	0.349	0.398	0.364***	0.34	0.389	0.354***	0.33	0.379
Λ	0.523***	0.518	0.528	0.523***	0.518	0.528	0.523***	0.518	0.528
	7			**8**			**9**		
	Estim.	**LL**	**UL**	**Estim.**	**LL**	**UL**	**Estim.**	**LL**	**UL**
π_d	0.672***	0.636	0.708	0.654***	0.618	0.689	0.637***	0.601	0.673
π_m	0.198***	0.185	0.211	0.193***	0.179	0.206	0.188***	0.175	0.201
π_u	0.130***	0.084	0.175	0.154***	0.108	0.199	0.175***	0.13	0.221
$F_0(m)$	0.198***	0.191	0.205	0.203***	0.196	0.209	0.207***	0.2	0.214
π_d^1	0.687***	0.604	0.771	0.643***	0.559	0.727	0.603***	0.52	0.687
π_m^1	0.065***	0.057	0.073	0.063***	0.055	0.071	0.061***	0.054	0.069
π_d^0	0.656***	0.631	0.68	0.665***	0.641	0.69	0.674***	0.649	0.698
π_m^0	0.344***	0.32	0.369	0.335***	0.31	0.359	0.326***	0.302	0.351
Λ	0.523***	0.518	0.528	0.523***	0.518	0.528	0.523***	0.518	0.528
Obs.	44,821			44,821			44,821		

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Standard errors in parentheses computed by 500 bootstrap replications. *** p<0.01, ** p<0.05, * p<0.1. In the table, the estimated parameters for pooled data using different choices of bandwidth are presented. Each column shows the times that Silverman's rule of thumb was applied. In the estimation of the model we considered eight times. Data were drawn from the 2006-2016 NHS.

Table A8: Different MW STD Fractions and Kernel Density Point Estimation.

	a=0.05,b=0.06			a=0.05,b=0.05			a=0.05,b=0.07			a=0.04,b=0.06			a=0.06,b=0.06		
	Estim.	**LL**	**UL**	**Estim.**	**LL**	**UL**	**Estim.**	**LL**	**UL**	**Estim.**	**LL**	**UL**	**Estim.**	**LL**	**UL**
π_d	0.654***	0.618	0.689	0.664***	0.629	0.700	0.643***	0.607	0.679	0.677***	0.641	0.713	0.629***	0.594	0.665
π_m	0.193***	0.179	0.206	0.196***	0.183	0.209	0.189***	0.176	0.203	0.156***	0.143	0.170	0.248***	0.235	0.262
π_u	0.154***	0.108	0.199	0.140***	0.094	0.185	0.168***	0.122	0.213	0.166***	0.121	0.212	0.122***	0.076	0.168
$F_0(m)$	0.203***	0.196	0.209	0.200***	0.193	0.207	0.205***	0.198	0.212	0.201***	0.195	0.208	0.204***	0.197	0.210
π_d^1	0.643***	0.559	0.727	0.669***	0.585	0.752	0.617***	0.534	0.701	0.630***	0.547	0.714	0.690***	0.606	0.774
π_m^1	0.063***	0.055	0.071	0.064***	0.056	0.072	0.062***	0.054	0.070	0.051***	0.043	0.059	0.078***	0.070	0.086
π_d^0	0.665***	0.641	0.690	0.660***	0.635	0.684	0.671***	0.646	0.695	0.728***	0.704	0.753	0.563***	0.538	0.587
π_m^0	0.335***	0.310	0.359	0.340***	0.316	0.365	0.329***	0.305	0.354	0.272***	0.247	0.296	0.437***	0.413	0.462
Λ	0.523***	0.518	0.528	0.523***	0.518	0.528	0.523***	0.518	0.528	0.522***	0.517	0.527	0.526***	0.521	0.531
Obs.	44,326			44,326			44,326			44,326			44,326		

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. Standard errors in parentheses computed by 500 bootstrap replications. *** p<0.01, ** p<0.05, * p<0.1. a is the factor that determines the window in which the fraction of workers who earn MW is defined. b is the factor that determines the point at which kernel density is calculated for the estimation of the non-compliance parameter. Data were drawn from the 2006-2016 NHS.

Table A9: Estimates of Rounding Wages at Different Heaping Points

	25			50			75			100		
	Estimate	**LL**	**UL**	**Estimate**	**LL**	**UL**	**Estimate**	**LL**	**UL**	**Estimate**	**LL**	**UL**
π_d	0.655***	0.619	0.691	0.656***	0.620	0.692	0.654***	0.619	0.689	0.651***	0.615	0.688
π_m	0.192***	0.179	0.206	0.192***	0.179	0.205	0.195***	0.182	0.208	0.191***	0.178	0.204
π_u	0.152***	0.107	0.198	0.152***	0.107	0.198	0.151***	0.106	0.196	0.158***	0.112	0.203
$F_0(m)$	0.202***	0.196	0.209	0.202***	0.196	0.209	0.202***	0.196	0.209	0.203***	0.196	0.210
π_d^1	0.646***	0.562	0.729	0.646***	0.562	0.730	0.649***	0.567	0.731	0.636***	0.552	0.720
π_m^1	0.063***	0.055	0.071	0.063***	0.055	0.071	0.062***	0.054	0.070	0.062***	0.055	0.070
π_d^0	0.666***	0.641	0.690	0.667***	0.642	0.691	0.659***	0.635	0.684	0.668***	0.644	0.692
π_m^0	0.334***	0.310	0.359	0.333***	0.309	0.358	0.341***	0.316	0.365	0.332***	0.308	0.356
Λ	0.523***	0.518	0.528	0.523***	0.518	0.528	0.523***	0.518	0.528	0.523***	0.518	0.528
Obs.	44,326			44,326			44,326			44,326		

Notes: The sample included all women between 18 and 69 who were employed in the domestic sector and not retired. *** p<0.01, ** p<0.05, * p<0.1 computed by 500 bootstrap replications. We estimated the parameters by rounding the total wage to the nearest multiple of 25, 50, 75 and 100. Data were drawn from the 2006-2016 NHS.