Wage Growth and Social Insurance Reform*

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Abstract

This paper uses matched employer-employee data to examine the wage response to a mandatory social insurance reform program. By relying on firm-level differences in alternative pre-reform contributory schemes, we examine the extent to which employers shifted the cost of social insurance to workers in terms of lower wages. We find partial switching that varies by workers' employment history. Wages of recent hires by treatment firms show a decline proportional to the mandatory employer contribution rate. Wages of incumbent workers, however, continued to rise after the reform but at a slower rate relative to the control group. The post-reform reduction in wage growth is larger and significant for production workers and employees of low-wage industries.

Key Words: Wage growth, social insurance reform, wage shifting, firms, Ethiopia.

1. Introduction

There is a growing research interest on the implications of social security reforms for welfare and labor market outcomes. The need for more evidence on such implications remains critical in the context of developing countries where social protection programs, which come in the form of contributory social insurance and noncontributory social assistance schemes, have become increasingly popular (Chetty and Looney, 2006; Jung and Tran, 2012; Palacios and Robalino, 2020). The labor market implications of government mandated social insurance programs that often cover workers in the formal sector hinge primarily on who ultimately bears the cost of social security as it may elicit different responses from employers and employees. Measurement of these responses is crucial in determining whether social insurance reforms entail distortions and inefficiencies in the labor market, and the degree of participation of the labor force in the promised benefits. It is thus unsurprising that concerns remain about the unintended consequences of social protection programs that could potentially stymie the primary objective of consumption smoothing for broader sections of a country's labor force (Levy, 2008). Theoretical models for examining the labor market consequences of social insurance focus on the subjective valuation of the expected benefits in the eyes of employees. If workers have confidence in the promised benefits and consider employers' contributions as deferred cash income, they may accept equivalent wage cuts that would stave off an increase in unit labor cost (Summers,1989; Gruber, 1997). This would prevent distortions in the labor market and leave employment levels largely unaffected by social insurance. Other conditions that allow full switching of the cost of social insurance to workers' wages include inelastic labor supply or infinitely elastic labor demand (Gruber, 1997).

Estimating the effects of social insurance programs on wages and employment is, however, fraught with important challenges as the payroll taxes that fund such schemes are often proportional contributions with nation-wide mandates. A widely used identification strategy relies on cross-firm variation in the degree of compliance with a social security reform based on the observed employer contribution rates, i.e. total employer contribution relative to the firm's wage bill, which often differ from the statutory contribution rate (Gruber, 1997; Kugler and Kugler, 2009; Bennmarker, Mellander and Öckert, 2009). An important challenge in using variation in the empirical contribution rate is measurement error in firm-level wage rate given

that wage enters both sides of the econometric model. Equally important in this approach is the difficulty in isolating adjustments in the firm's compensation structure in response to social insurance reform from adjustments in the skill composition of the firm's workforce as a given firm-level mean wage rate could be consistent with different personnel policies on compensation, hiring and retention. Relying on firm-level data also implies ignoring potential heterogeneity in the effects of social insurance reform across workers based on personal and labor market characteristics. Other researchers attempt to identify the labor market effects of such reforms by using aggregate data at the level of cities or larger administrative units to take advantage of statutory differences in payroll taxes across locations within a given country or variation in enforcement intensity (Alemida and Carneiro, 2012; Curces, Galiani and Kidyba, 2010). Such aggregate studies obviously gloss over differences in firm-level responses to social insurance within a given locality let alone capturing impact heterogeneity across individual workers.

This paper contributes to this literature by using a matched employer-employee data to investigate the labor market implications of a social security reform program introduced by the Ethiopian government in mid-2011. The reform mandates pension and disability benefits for private sector employees — benefits that previously were offered exclusively to government employees. While this scheme constitutes a major expansion of social security in Ethiopia, it only covers permanent employees in the formal private sector. We focus particularly on adjustments in wage rates in response to the reform among formal private manufacturing firms. The paper is among a few studies including Anderson and Meyer (2000), Gruber and Kugler (1991), and Kugler (2005) that use worker-level data to examine the extent to which employers switch the cost of social insurance to workers' wages. Existing worker-level studies on the wage effects of payroll taxes typically do not control for workers' human capital with the exception of Kugler (2005). The latter study, however, relies only on worker-level data and does not control for firm heterogeneity which could potentially bias the estimated reform effect. Taking advantage of the matched employer-employee data that we collected in 2016 for this project, we estimate adjustments in wage rates following the social insurance reform while controlling for firm specific factors as well as worker-level differences in human capital and

personal characteristics. Different from previous studies, our identification strategy relies on a key provision under the 2011 reform that allows two different systems of social insurance to co-exist. One of them pertains to a group of firms which had voluntarily established the so-called "Provident Funds" before the 2011 reform as a form of social security to their employees. The other one is the new scheme introduced by the 2011 reform and managed by the Private Organizations' Employees Social Security Agency (POESSA). While details of the institutional settings will be provided shortly, the firms with pre-existing provident funds serve as our control group given that a contributory scheme has already been in place before the reform. Firms without provident funds will thus be the treatment group as they are forced to make such contributions for the first time under the new pension law.

Our analysis shows that employers most impacted by the social insurance reform for absence of contributory benefits scheme before the reform were able to shift a substantial part of the cost of social insurance to workers in the form of lower wages. There are, however, important differences across groups of workers. Relative to the control group, we find that workers hired by treatment firms after the reform were offered lower wages that are proportional to the mandatory employer contribution rate. For employees who have been on payroll at the time of the reform, however, treatment firms only gradually reduced the rate of growth of wages allowing them to partially offset their contributions. The reduction in wage growth among incumbent workers of treatment firms was concentrated among production workers and employees of low-wage industries which is consistent with our expectation that the reform has significantly increased the unit labor cost of treatment firms. The employment effect of the reform was thus minimal and appears to dissipate subsequently.[1]

The paper is organized as follows. Section two highlights the institutional background that would give proper context to our analysis while section three describes the survey design and

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[1] This paper is part of our IZA-funded research project on the 2011 social insurance reform in Ethiopia. The other part of our project uses firm-level panel data on manufacturing firms from the Central Statistical Authority (CSA) of Ethiopia. An earlier version of our working paper using firm-level data during 2008-2013, shows a reduction in firm-level employment among low-wage workers (Shiferaw et al., 2017). We are now revising this working paper with additional data from 2014 and 2015, and using alternative estimation methods.

data. Section four discusses the econometric models to be estimated. Our main findings and robustness checks are discussed in sections five and six, respectively. Section seven concludes the paper.

2. Institutional Background

Before the June 2011 reform, pension and disability benefits were provided exclusively to government employees (civil servants, armed forces and employees of parastatals) through a social security scheme established in the 1960s. The vast majority of urban employees thus have no formal protection against income shocks from unemployment, workplace injury or old age. Similar to many African countries, the Ethiopian government started to introduce a number of social protection programs since the mid 2000s.[2] The June 2011 social security reform is part of this social protection strategy and introduces the first mandatory pension and disability benefits for private sector employees. This defined benefits scheme applies to permanent employees of formal private companies regardless of their size, and it is managed by the Private Organizations' Employees Social Security Agency (POESSA). Private sector workers not covered by POESSA include the self-employed, informal workers, and employees of private companies who already have Provident Funds (PFs) as of June 2011. Provident funds are voluntary schemes that draw contributions from employers and employees and provide lumpsum payments upon separation. The new pension law allows PFs to co-exist with the new scheme, at least for workers hired before the reform, if both employers and employees agreed to keep them while prohibiting the formation of new PFs. Firms with PFs account for 36% of manufacturing firms and 40% of workers in our sample.[3]

Employer contribution rates under the new scheme started at 7% of gross monthly salary in 2011 and have since been raised three times: to 8% in 2012, to 9% in 2013 and to 11% in 2015. Employee contributions started at 5% in 2011 and increased to 6% in 2013 and to 7% in 2015. Our empirical strategy to estimating the impact of this reform relies on comparison of

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[2] The 2005 Public Safety Net Program (PSNP) that targeted food-insecure farmers in drought prone areas, and the 2010 Community Based Health Insurance Schemes (CBHI) for rural communities are prominent examples of the government's initiatives that have already been carefully studied by researchers.

[3] In the annual census of manufacturing conducted by the Central Statistical Agency (CSA) of Ethiopia, about 20% firms have provident funds in 2011 (see Shiferaw et al., 2017), suggesting that such firms are overrepresented in this sample.

firms with and without pre-existing PFs as the reform brings about a sudden surge in nonwage labor cost for the latter. Once employers and employees with PFs declared their decisions to retain them instead of joining the new scheme, they largely remain outside the purview of POESSA. The PFs thus remain self-regulated with potential heterogeneity in contribution rates. It should also be noted that workers with PFs only receive lump sum payment at the time of separation regardless of retirement age, while those under POESSA receive annuities after retirement. Employees with PFs can also access their savings before separation for company approved emergencies such as hospitalization and large expenses such as buying a house. In our empirical analyses, we distinguish these two groups of firms with the dummy variable NPF that takes the value of 1 for treatment firms without PFs and zero for those with PFs.

As discussed earlier, distortions in the labor market will be minimal if employees accept wage cuts that offset the employer's pension contribution. Such compensating mechanisms could, however, be hampered by labor market regulations such as minimum wage laws and union-negotiated wages that permeate the rest of the labor market. Both of these restrictions are irrelevant in the Ethiopian context since there are no minimum wages that apply to the private sector, despite there being one for civil servants, and labor unions remain historically weak. On the other hand, the social insurance reform was introduced in the midst of strong macroeconomic expansion where Ethiopia's Gross Domestic Product (GDP) has been growing by about 10% per annum. This rapid growth likely allows firms to better absorb the spike in labor cost brought by the social security reform. The economy was also relatively stable during our sample period that spans from 2009 to 2015 without major socioeconomic shocks: it excludes the 2007/08 major price hikes and the post-2016 political upheaval that involved state-of-emergency declarations. The sample period overlaps with the 1st Growth and Transformation Plan (GTP-I) of the Ethiopian government for the 2010-2015 period which, among other things, aims to raise the share of manufacturing in GDP by about 10 percentage points from its historically low 5% share.

While the absence of minimum wage laws and weakness of labor unions may suggest possibilities for shifting the cost of pension benefits to workers' wages, the prevailing macroeconomic conditions do not seem to favor such reallocations. Rapid and sustained

economic growth would certainly increase workers' expectations for pay raises making wage cuts highly unpopular and potentially counterproductive assuming efficiency-wages are relevant. Nonetheless, the reform-induced increase in nonwage labor costs is also very high as described earlier that inaction by employers is unlikely to be an option. While the spike in nonwage labor costs would certainly call for substantial adjustment of wage rates, the sheer magnitude of the spike would also make it harder for employers to fully and immediately shift the burden to workers in the form of lower wages — keeping in mind that workers also make mandatory contributions. What seems tenable under such circumstances is a reduction in the rate of growth of wages in the ensuring years to mitigate the spike in nonwage labor costs. We expect this to be the preferred adjustment margin for treatment firms without pre-existing PFs as compared to their counterparts with PFs.

3. Data and Descriptive Statistics

Since social security reforms are likely to affect the behaviors of firms and workers, investigating their labor market implications requires data that provide both worker- and employer-level information. We thus collected linked employer-employee data during April and May 2016 on a random sample of 300 Ethiopian manufacturing firms and 3000 of their workers. This allows us to address potential biases that arise when researchers attempt to examine wage determination using datasets that do not capture either worker- or firm-level information as discussed in Abowed et al. (1999). Our sampling frame is the 2015 census of manufacturing firms conducted by the Central Statistical Agency (CSA) of Ethiopia that captures all manufacturing firms that use power-driven machinery and employ at least 10 workers[4]. We followed stratified random sampling using regional states as strata. Because of their minimal number of manufacturing firms, we excluded five regional administrations at this stage of sampling[5]. The survey thus includes the Amhara, Oromia, SNNPR and Tigray regional states and the city administrations of Addis Ababa and Dire Dawa. Since manufacturing firms tend to congregate in major urban centers, the scope of our survey was limited to firms located in the capital cities of the respective regions except for the Amhara

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[4] The survey is officially referred to as Large and Medium Scale Manufacturing and Electricity Survey.
[5] These include the Afar, Benishangul-Gumuz, Gambella, Harari and Somali regions, which are often referred to as small states.

region where two large cities were included, i.e., the regional capital Bahir Dar and city of Gondar. Since nearly 70 per cent of manufacturing firms in the CSA census are located in and around Addis Ababa, the same proportion of firms in our sample were selected from the nation's capital. The remaining 30 percent of firms were randomly selected from the other regions each with a six per cent share.

Once the firms were selected, the survey was conducted on 10 randomly selected workers from each firm. Retrospective questions were used to collect data on wages and other worker characteristics from administrative records of firms. This allows us to capture the evolution of wages before and after the pension reform at the worker level without relying on interviewee memories. Such data were collected for the month of March for seven years from 2009 to 2015. Since the reform was introduced in June 2011, we consider 2009-2011 as the pre-reform period. In addition to wages, the survey captures workers' educational attainment, occupation, age, gender, marital status, and parental education. The survey has a module on firm-level information including total number workers, location, and industry.

Table 1 shows the distribution of educational attainment and real monthly wage in our sample. We use industry-level producer price index collected by the Central Statistical Agency (CSA) of Ethiopia to deflate nominal wages. About 41% of workers have completed secondary education while 20 per cent have completed higher education. Only about 13 percent of workers have primary education or less. Panel B of Table 1 shows that female workers earn about 30% less than males at every level of education. Figure 1 shows that real wages rise with education and that all workers have experienced substantial wage growth in the post-reform period. It is worth noticing that while firms with pre-existing PFs pay higher wages than firms without PFs, the wage gap actually widens with the level of education. Moreover, the wage gap between PF and non-PF firms has expanded after the reform. For instance, while workers with secondary education or less earned essentially equal wages regardless of PF status before the reform, a small but clear disadvantage has emerged after the reform for workers without PFs. More educated employees of firms without PFs also experienced slower rate of wage growth after the reform relative to their counterparts with PFs on top of already lower pre-reform wages. In fact, post-reform real wages of college graduates at firms without

PFs are lower than pre-reform wages of college graduated working for PF firms. Post-reform wage growth among firms without PFs is thus inversely related with pre-reform wage rate and lower than wage growth among firms with PFs.

Table 2 provides descriptive statistics on variables that will enter our wage equations in the next section.

4. Empirical Approach

As indicated earlier, our primary interest is in understanding how manufacturing wages respond to the mandatory employer contribution while controlling for other determinants of wages. To this effect, we follow the approach in Abowed et al. (1999) to specify a wage equation that includes both worker and firm characteristics:

$$W_{it} = \mu + X_{it}\beta + Z_{j(i,t)t}\gamma + \theta_i + \psi_{j(it)} + \varepsilon_{it} \qquad (1)$$

where W_{it} is real wage of worker i at time t, X_{it} represent time varying worker characteristics, and $Z_{j(it)t}$ represent time varying characteristics of firm j in which worker i is employed at time t. The parameters θ_i and ψ_j represent, respectively, worker and firm effects that are time invariant. Some of these fixed effects are observed in the data, while others remain unobserved. White noise equation errors are represented by ε_{it}.

The person effects θ_i can further be expressed as:

$$\theta_i = \alpha_i + u_i\eta \qquad (2)$$

where u_i represent time invariant worker characteristics measured in the data.

Similarly, the firm effects ψ_j can be expressed as:

$$\psi_j = \varphi_j + q_j\rho \qquad (3)$$

where q_j represent time invariant firm characteristics that are measured in the data.

Abowed et al. (1999) discuss several econometric challenges of estimating the parameters β, γ, η and ρ in Eq.1 with incomplete data that miss either worker or firm characteristics. While consistent estimates of β and γ can be obtained using the within estimator on matched employer-employee panel data with time varying explanatory variables, this approach cannot identify the effects of time invariant worker and firm characteristics. Abowed et al. (1999) provide alternative procedures to estimating η and ρ in the context of a rich dataset with sufficient worker mobility among sample firms.

While our survey data capture a range of firm and worker characteristics, the design of our survey is such that it does not capture worker mobility across firms. We have selected a random sample of firms and workers in 2015 and collected retrospective data on relevant variables. It is thus hard to directly apply the approach in Abowed et al. (1999) and disentangle the unobserved firm and worker fixed effects in our sample. However, our main interest is to estimate the wage effects of the pension reform based on the time invariant NPF dummy variable that identifies firms with and without pre-existing provident funds. In addition to their PF status, the survey captures the industry and location choices of firms. We thus follow two approaches to estimating the implications of the pension reform on wages.

Difference in Real Wages
In the first approach, we follow a two-step estimation procedure where we first run the within estimator on a version of Eq.1 to obtain consistent estimates of the coefficient vectors β and γ for time-varying variables. Specifically, we run the within estimator on the equation:

$$W_{it} = \beta_1 EXP_{it} + \beta_2 EXP_{it}^2 + \beta_3 Tenure_{it} + \gamma_1 FirmSize_{jt} + \tau_t + v_{it} \qquad (4)$$

where EXP and EXP^2 represent years of potential labor market experience and experience squared, respectively, while $FirmSize$ measures the logarithm of firm-level employment. Eq. 4 also includes interaction terms of these explanatory variables with dummy variables representing 11 4-digit ISIC industries and six regional administrations. Time dummy variables

that are represented by τ account for time varying aggregate shocks that affect wages of all private sector workers equally. Table A1 in the Appendix shows results from Eq.4.

With data that capture worker mobility across firms, the unobserved firm fixed effect could be identified by including a firm dummy variable that changes over time for workers who switch employers (Abowed et al., 1999). Since workers in our sample do not move across firms, the error term v_{it} is essentially a composite term capturing firm fixed effects, worker fixed effects and a time varying random error term. We can thus express v_{it} as:

$$v_{it} = u_i\eta + q_j\rho + \omega_i + \varepsilon_{it} \qquad\qquad (5)$$

Where $\omega_i = \alpha_i + \varphi_j$

Since identification of wage changes attributable to the 2011 social insurance reform relies on firms' PF status, which is time invariant, we need to estimate a version of Eq.5 that includes this indicator variable. Our second step thus involves running OLS on Eq.5 using observable firm and worker characteristics that do not change over time including the NPF dummy variable. The time-invariant worker characteristics, u_i, include education, gender, marital status, parental education and migration status. Our q_j include indicators of the firm's industry, region, initial size and the NPF dummy variable. We also include firm dummy variables in Eq.5 to account for φ_j. To estimate the wage response to the pension reform, we interact NPF with a dummy variable indicating the post-reform period. It is important to note that for workers who are observed throughout the sample period, the interaction term NPF*Reform does not provide identifying information as the firm and worker characteristics in Eq.5 are all time invariant except for the random error term ε_{it}. What this interaction term captures is thus the differential wage rate of workers hired after the reform by firms without PF relative to that of recent hires by firms with PFs. The results from this regression are reported in Table 3. In addition to comparing real wages of worker hired after the reform, we estimate a similar model for changes in allowances and bonuses as important aspects of employee compensation. Allowances include subsidies for food, clothing, housing and transportation.

A major challenge in using this approach is the endogeneity of firms' decisions to offer provident funds. Voluntarily provision of such benefits is arguably indicative of superior productivity. In fact, our data already show that PF firms are larger than non-PF firms. One way to proxy for such dynamic productivity differences is thus by including firm size as we did in Eq.4. Moreover, Eq.5 includes initial firm size and firm dummy variables to control for time invariant characteristics such as managerial capacity and personnel policies that affect both wage and nonwage compensations. It should also be noted that while the decision to offer PFs is endogenous, this option is no longer available for employers which did not have PFs as of June 2011 suggesting that it is a strictly pre-determined variable. The change in the PF and non-PF wage gap after 2011 is thus unlikely to be driven by unobserved heterogeneity between the two groups of firms but rather driven by the policy shift.

Differences in Real Wage Growth

Eq. 5, however, does not allow us to capture post-reform payment dynamics among workers who have already been on payroll before the reform. Our second approach addresses this gap by examining growth rates of real wages for workers observed at the end of the sample period (2015) relative to their pre-reform average wages. We are essentially estimating long-differences in the logarithm of real wages for incumbent workers who are observed both before and after the pension reform conditional on the firm's PF status. The model we estimate is thus:

$$\dot{W}_{i15} = \sigma Base\_Wage_i + \lambda NPF_j + \phi \dot{L}_{j15} + \xi_i \qquad (6)$$

where $\dot{W}_{15}$ is real wage growth in 2015 calculated as the difference (in logarithms) of real monthly wage in 2015 relative to the $Base\_Wage$ which is the mean pre-reform (2009-2011) real wage. We also control for employment growth in 2015, $\dot{L}_{j15}$, capturing growth in firm size in 2015 relative to average firm size during 2009-2011. While experience and experience squared also increased over time, they are excluded from the model as they changed by the same number of years for all workers during 2011 to 2015. The advantage of Eq.6 is that it

accounts for unobserved heterogeneity by taking long-difference in individual real wage while also controlling for initial conditions that may put workers on different earning trajectories. The coefficient λ thus captures the differential growth rate of real wages among incumbent employees of firms without PFs relative to their counterparts with PFs. We use OLS to estimate Eq.6 on 1783 workers for which such growth measurements are available. This is less than the total sample of 3000 workers as some workers were hired after 2011. Since compliance with the new pension law is likely to be incomplete, the model estimates the Intent-To-Treat (ITT) effect of the reform on wage growth.

The results from Eq.6 are reported in Table 4. See Figure 2 for the distribution of real wage growth in 2015. For a better understanding of wage dynamics, we also estimated Eq.6 for each post-reform year individually relative to the average pre-reform wage. The idea is to see how quickly employers began adjusting wages in the aftermath of the reform. This will also allow us to account for the incremental increases in the employer contribution rate since 2011. While initial wage and the firm's PF status allow us to control for initial conditions, we also experimented with an extended version of Eq.6 where we added education and industry dummy variables. While these are time-invariant factors from a statistical point of view, it is quite possible that real wages may grow at different rates across industries — say because of differences in product demand, and across workers with different human capital — say because of skill biased technical change.

5. Discussion of Results

Table 3 presents results from Eq.1 which includes bootstrapped standard errors from 500 repetitions. Consistent with Figure 1, we find significant increase in real wages after the 2011 reform. However, the -0.08 % coefficient on the interaction term NPF*Reform in column 1, which is significant at 11%, suggests that workers hired by firms without provident funds after 2011 earn about 8% less as compared to their counterparts in firms with PFs. Since workers

hired after the reform have to be enrolled under the new pension scheme regardless of the firm's PF status, this difference captures adjustments in wages by employers without PFs in response to the pension reform relative to the control group. The 8% lower wage offered to recent hires by firms without PFs closely tracks the mandatory contribution imposed on them by the new pension law which started at 7% in mid-2011 and reached the planned contribution rate of 11% in 2015. This suggests that treatment firms are able to almost fully shift the cost of pension contributions at least to workers hired after the reform.

We also find substantial reduction in bonuses offered to recent hires by firms without PFs as compared to manufacturing firms with PFs. The two groups of firms show insignificant differences in allowances which are much more common than bonuses. Table 3 also shows returns to education that increase significantly with the level of educational attainment. Moreover, bonuses and allowances tend to rise with workers education. It is worth noticing that firms with PFs pay higher bonuses relative to firms without PFs while the latter provide more generous allowances.

Table 4 reports results from Eq.6 where the dependent variable is real wage growth for incumbent workers who were already on payroll as of March 2011. The coefficient on NPF in column 3 and 4 are negative and statistically significant suggesting about 5.2 and 6.8 percentage points lower real wage growth in 2014 and 2015, respectively, among employees non-PF firms relative to that of PF firms. The coefficients on NPF are statistically insignificant in 2012 and 2013 suggesting insignificant differences in growth rates of real wages among incumbent employees of firms with and without PFs in the immediate aftermath of the reform. Controlling for education in column 5 raises the difference in wage growth to about 7.5 percentage points with a higher level of significance.

The evidence in Table 4 reveals an interesting underlying dynamic where employers did not cut the wages of incumbent workers right after the social security reform. The gradual increase in the size and significance of the negative coefficient on NPF is consistent with the increase in the mandatory pension contribution rate which reached its highest rate in 2015. Employers without provident funds seem to be adjusting the rate of growth of real wages of incumbent

workers to partially offset the cost of pension benefits. This finding also reveals the difference in the introduction of the mandatory pension contribution in 2011 relative to the subsequent increases in contribution rates. While the June 2011 reform was a sudden policy shift, the timing and magnitude of subsequent raises in contribution rates were already announced in June 2011. Employers already know in 2011 by how much contribution rates will go up in 2012, 2013 and 2015. This seems to give employers enough time to internalize the information and incorporate it in their compensation schemes. The estimated 6 to 7 percentage points difference in real wage growth in Table 4 translate to about 4-5% lower real wages among incumbent workers of firms without PFs relative to the control group.

Table 4 also shows negative and statistically significant coefficients on initial wage implying some convergence in real wages among manufacturing workers which is consistent with the patterns in Figure 1. Column 5 shows that real wage growth increases with the level of education. Workers with secondary education experienced real wage growth that is 13 percentage points faster than that of unskilled workers with only primary or less than primary education. College graduates experienced real wage growth rates that are 38 percentage points higher that of the reference group.

6. Robustness Checks

To interpret the coefficients on NPF as the ITT effect of the reform on wage growth, it is important to show that it is actually picking up firms' responses to a differential increase in labor cost after the reform based on PF status. To this effect, we experiment with four robustness checks. First, we split the sample into high- and low-wage industries using the overall sample mean of monthly wage as the cutoff point for mean wages across industries. Our data show that the relative ranking of manufacturing industries in terms of mean wages is very stable over time underscoring a structural feature of the industries. We hypothesize that the social insurance reform would have greater impact on low-wage industries where competitiveness relies heavily on cheap labor as compared to high-wage industries. Results from a wage growth model for the two groups of industries using the 2015 wages are reported in columns 1 and 2 of Table 5. The coefficient on NPF is negative and statistically significant

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for the low-wage industries showing about 11.5 percentage points reduction in real wage growth rate relative to firms with provident funds. While the NPF coefficient is also negative for high-wage industries, the rate of reduction in wage growth is substantially lower and statistically insignificant. This finding supports the notion that the reduced wage growth in Table 4 for firms without PFs is driven primarily by the reform's effect on labor cost among low-wage industries.

Second, we split our sample into production and nonproduction workers based on survey data on occupations. Not only are wages of production workers typically lower than that of non-production workers, firm-level variable cost of production is directly affected by compensation of production workers as compared to that of non-production workers. The results from this sample split are reported in columns 3 and 4 of Table 5. The coefficient on NPF represents a reduction of wage growth by nearly 10 percentage points among production workers of firms without PFs relative to their counterparts with PFs. Non-production workers of firms without PFs, however, experienced modest and statistically insignificant reduction in real wage growth.

Third, Table 6 shows a placebo test on the effects of the reform based on pre-reform wage growth among PF and non-PF firms. The dependent variable in the first column of Table 6 is wage growth between March 2009 and March 2011. Since the reform was introduced in June 2011, the results here correspond to wage growth before the reform. The coefficient on NPF turned out to be statistically insignificant. Columns 2 and 3 report results from a similar regression on low-wage industries and production workers, respectively, given their sensitivity to the pension reform as reported in Table 5. In both cases, the coefficient on NPF is statistically insignificant implying that wage growth before the reform did not depend on PF status across all industries and groups of workers. This reinforces our findings in Table 5 that the slowdown in wage growth among firms without PFs is a response to the reform-induced spike in labor costs.   Similar to Table 5, Table 6 shows negative association of wage growth with initial wage but positive association with firm growth and workers' education.

Our fourth and last robustness check tests the reform effects on employment growth. As stated earlier, employment effects of social insurance reforms would be minimal if employers are able

to shift the cost of such benefits to workers in the form of lower wages. Since the preceding results indicated near complete switching to the wages of new hires coupled with a gradual and partial switching to the wage of incumbent workers, we should expect limited impact of the reform on firm-level employment. We test this effect by estimating the following equation:

$$\dot{L}_{jt} = \pi Base\_Size_j + \delta NPF_j + \tau_{jk} + \varphi_{jr} + \xi_j \qquad (7)$$

where $\dot{L}_{jt}$ is employment growth in firm j calculated as the difference in the logarithm of firm-level employment in the post-reform years relative to mean employment during 2009-2011. The latter also enters the model as $Base\_Size$. In addition to the firms' PF status, we allow trends to vary across industries and regional states by including industry and region fixed effects which are represented by τ_{jk} and φ_{jr}, respectively. Eq. 7 is estimated for each post reform year to show dynamics in employment growth as pension contributions rise.

The results are reported in Table 7. The coefficient on NPF is negative and significant only in 2012 where employment growth among firms without provident funds was slower by 6.8% relative to that of the control group. Since pension contributions rates in 2011 and 2012 were 7% of base salary, this finding shows the full weight of the reform falling on labor demand. This is consistent with the results in Table 4 where there was no wage shifting in 2012. While employment growth among non-PF firms was lower by one percent in 2013, the differences was statistically insignificant with the growth disadvantage disappearing in 2014 and 2015. This is broadly consistent with our findings in Table 4 where sample firms were able to shift a significant part of the cost of pension benefits to incumbent workers in 2014 and 2015. The negative association of employment growth with initial firm size is consistent with the widely recognized empirical regularity where growth declines with firm size.

7. Conclusions

How wages respond to government mandated social insurance programs remains an important research question. This is particularly important for African countries who started to roll out social protection programs in recent years. This paper examines the 2011 social security reform in Ethiopia that mandated employer provided pension and disability benefits for workers in the formal private sector. Using matched employer-employee data from Ethiopian

manufacturing, we examined wage determination in the post-reform period. We used the presence of pre-reform provident funds to distinguish treatment and control group firms and identify the differential effect of the reform. We find partial switching of the cost of pension benefits to workers in the form of lower wages among treatment firms. But the reduction in wages shows substantial heterogeneity across employees. When it comes to workers hired by non-PF firms after the reform, the reduction in wages relative to that of recent hires by PF firms is nearly proportional to the employer contribution rate non-PF firms encountered after the reform. For employees of non-PF firms already on payroll before the reform, there were no immediate wage cuts, but their wages grew 6 to 7 percentage points slower than that of their counterparts with PFs. This amounts to 4 to 5 percent lower real wages by the end of the sample period, which is less than half of the 11 percent increase in nonwage labor costs that treatment firms encountered. A series of robustness checks reveal that this reduction in wage growth is associated with the increase in labor cost that firms without PFs experienced relative to those without PFs. In fact, we find that employment growth suffered only at the beginning of the reform and the effect gradually dissipated as firms started to adjust wage growth subsequently.

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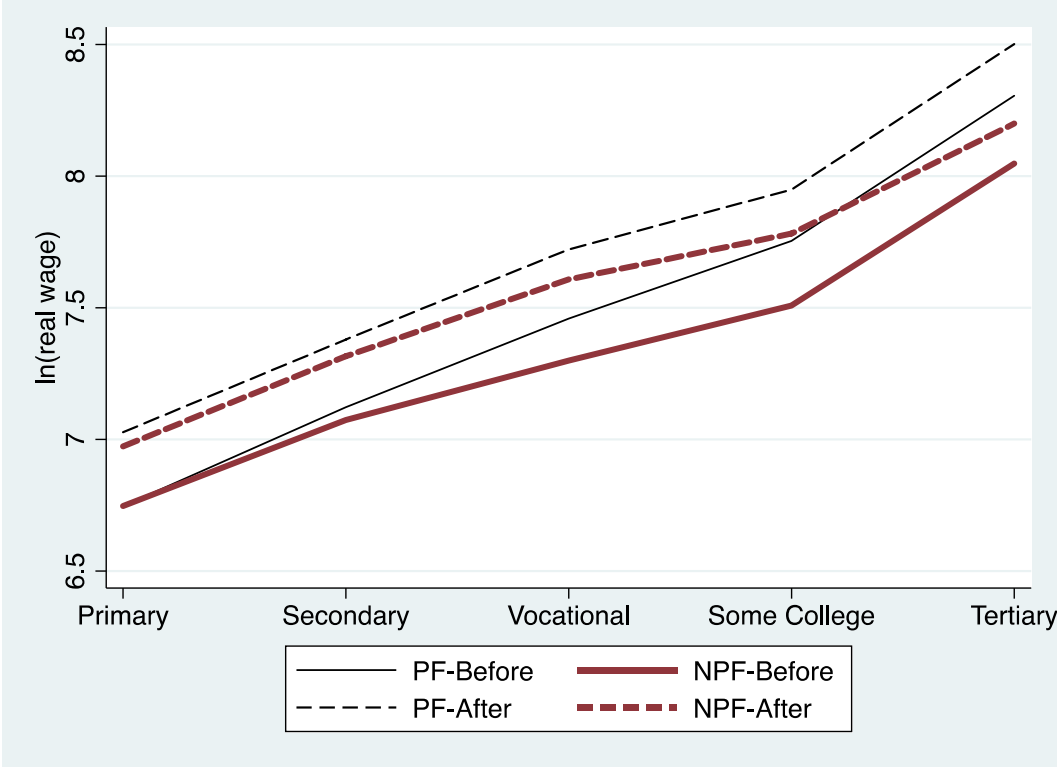
Figure 1: Wage profile by level of educational attainment.

Note: The lines represent the Nadaraya-Watson Kernel Density regressions of real wage on educational attainment where the kernel is Epanechnikov. "Primary" indicates workers with primary education or less.
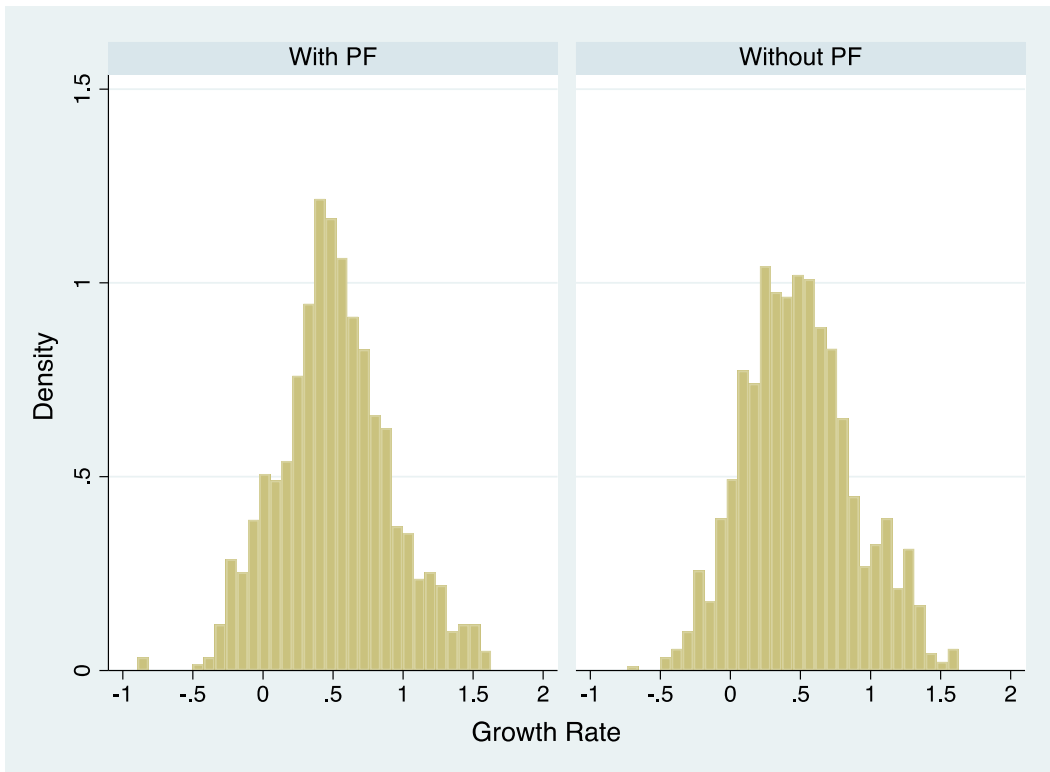
Figure 2: Distribution of real wage growth in 2015 relative to base wage for employees of firms with and without provident funds (PFs). Base wage is mean real wage during 2009-2011

Table 1: Distribution of education and wages by gender

Panel a: Education (%)				
	Male	Female	Total	Number of Workers
Primary or Less	14.6	11.6	13.5	401
Secondary	41.2	40.6	41.0	1,218
Vocational	9.9	11.4	10.5	311
Some College	12.5	19.1	15.0	445
Tertiary	21.8	17.3	20.1	599
Total	100	100	100	2,974
Panel b: Monthly Real Wages (Ethiopian Birr)				
Education	Male	Female	Total	Gender Wage Ratios
Primary or Less	6.9993	6.6977	6.9057	0.71
Secondary	7.3807	7.0209	7.2512	0.66
Vocational	7.6471	7.4289	7.5665	0.80
Some College	7.9082	7.6000	7.7700	0.73
Tertiary	8.4202	8.0679	8.3034	0.69
Total	7.6170	7.3080	7.5047	0.71

Note: Authors' computations based on survey data. Real wage is

in logarithms while gender wage ratios are based on untransformed values.

Table 2: Descriptive statistics

Variable	Mean	Standard Deviation
ln(wage)	7.5300	0.8195
Wage growth	0.9620	0.4353
No Education	0.0277	0.1640
Primary	0.0926	0.2899
Secondary	0.4305	0.4952
Vocational	0.1093	0.3120
Some College	0.1601	0.3667
Tertiary	0.1799	0.3841
Potential Experience	19.5830	11.9346
Potential Experience Squared	525.9147	615.1901
Tenure	11.4969	7.6822
Gender (Female=1)	0.3741	0.4839
NPF	0.6329	0.4820
ln(Initial firm size)	4.1919	1.1544
Single Never Married	0.2735	0.4458
Married	0.6919	0.4617
Divorced	0.0187	0.1353
Widowed	0.0108	0.1031
Separated	0.0051	0.0715
Father Educated	0.4556	0.4980
Mother Educated	0.3002	0.4584
Migrant	0.5074	0.5000

Note: The mean of ln(wage) is the average monthly wage from 2009 to 2015, while wage growth as discussed further below, measures wage growth in 2015 relative to the pre-reform mean wage. "Potential Experience" is calculated as age minus years of schooling minus six. "Tenure" measures years since a worker joined the firm at the time of survey. "Initial firm size" measures the mean pre-reform (2009 to 2011) total number of workers of a firm. "Father Educated" is a dummy variable that takes the value one for workers whose father have at least primary education and zero otherwise. "Mother Educated" is also measured in the same manner. "Migrant" is a dummy variable that takes the value one if a worker is not born in the same city where he/she is working at the time of the survey.

Table 3: Responsiveness of real wages and other benefits to pension reform

	Wages	Allowances	Bonuses
	1	2	3
Secondary	1.1130***	0.0715	0.8507***
	(0.0523)	(0.0581)	(0.0676)
Vocational	1.7737***	0.2020***	1.3237***
	(0.0668)	(0.0757)	(0.0947)
Some College	1.8212***	0.1452**	1.3832***
	(0.0609)	(0.0688)	(0.0801)
Tertiary	2.4508***	0.4541***	2.0372***
	(0.0619)	(0.0786)	(0.0859)
Female	0.0351	-0.3011***	0.0106
	(0.0259)	(0.0358)	(0.0435)
NPF	0.1050	1.8477***	-0.5709**
	(0.4712)	(0.4051)	(0.2543)
Reform	0.0754**	-0.0386	0.1833***
	(0.0376)	(0.0492)	(0.0581)
NPF*Reform	-0.0802[a]	0.0486	-0.2532***
	(0.0500)	(0.0663)	(0.0791)
Father_Educated	0.2503***	0.0812**	0.2335***
	(0.0329)	(0.0391)	(0.0500)
Mother_Educated	0.2127***	0.0874**	0.2114***
	(0.0346)	(0.0396)	(0.0497)
ln(firmsize_initial)	-0.4578	-2.5003***	0.0444
	(0.3857)	(0.3514)	(0.1052)
R^2	0.91	0.87	0.98
Observations	4,480	3,140	2,378

Note: the dependent variables are residuals from first stage regression models of real wages, allowances and bonuses using Eq.4. Nominal values of compensations are deflated by industry-level producer price indices obtained from the CSA. NPF is a dummy variable that takes the value of 1 for firms without provident firms and zero otherwise. Reform is a dummy variable that takes the value of 1 for 2012 to 2015, and zero otherwise. NPF*Reform is an

interaction of NPF and Reform. Bootstrapped standard errors from 500 repetitions are provided in parenthesis. ***, ** and * represent statistical significance of coefficients at the 1 per cent, 5 per cent and 10 per cent levels, respectively, while "a" represents significance at 11 per cent. All specifications include an intercept term.

Table 4: Wage Growth Relative to Pre-reform Average Wage

	2012	2013	2014	2015a	2015b
	1	2	3	4	5
Base-Wage	-0.0660*** (0.0101)	-0.1028*** (0.0119)	-0.1358*** (0.0141)	-0.1623*** (0.0156)	-0.2434*** (0.0166)
NPF	0.0074 (0.0197)	-0.0200 (0.0241)	-0.0521* (0.0303)	-0.0680** (0.0334)	-0.0750** (0.0324)
Firm-Growth$_t$	0.0326 (0.0370)	0.0361 (0.0340)	0.1095*** (0.0382)	0.1244*** (0.0396)	0.1294*** (0.0400)
Secondary					0.1371*** (0.0328)
Vocational					0.1895*** (0.0471)
Some College					0.2544*** (0.0397)
Tertiary					0.3927*** (0.0469)
R^2	0.05	0.07	0.10	0.11	0.21
Observations	1,851	1,851	1,851	1,847	1,799

Note: The dependent variables are growth rates of real wages in each of the post-reform years indicated in the column head relative to the pre-reform average real wage during 2009-2011. "Base-Wage" is the mean of log real wage during 2009-2011. NPF is a dummy variable as defined earlier. "Firm-Growth$_t$" is growth rate of firm size in particular post-reform year indicated in the column head relative to firm size in 2011. ***, ** and * represent statistical significance of coefficients at the 1 per cent, 5 per cent and 10 per cent levels, respectively. The last column also includes industry dummy variables. Standard errors are clustered at the firm level and all specifications include an intercept term.

Table 5: Wage Growth Heterogeneity

	Low-wage Industry	High-wage Industry	Production Workers	Non-Production Workers
	1	2	3	4
Base-Wage	-0.2295***	-0.2611***	-0.2272***	-0.2587***
	(0.0225)	(0.0250)	(0.0227)	(0.0219)
NPF	-0.1147***	-0.0245	-0.1011***	-0.0449
	(0.0418)	(0.0489)	(0.0359)	(0.0375)
Firm-Growth$_{15}$	0.1470***	0.1146*	0.1526***	0.0988*
	(0.0523)	(0.0590)	(0.0430)	(0.0550)
Secondary	0.1150***	0.1722***	0.1360***	0.0404
	(0.0358)	(0.0563)	(0.0310)	(0.0961)
Vocational	0.1115**	0.2896***	0.1770***	0.0905
	(0.0506)	(0.0788)	(0.0537)	(0.1062)
Some College	0.2301***	0.2927***	0.2214***	0.1606[a]
	(0.0493)	(0.0630)	(0.0511)	(0.0982)
Tertiary	0.3135***	0.4921***	0.4319***	0.2871***
	(0.0561)	(0.0743)	(0.0804)	(0.1009)
R^2	0.21	0.23	0.21	0.23
Observations	974	825	984	812

Note: The dependent variable is real wage growth in 2015 for groups of workers indicated in the column heads relative to mean real wage during 2009-2011. "Base-Wage" and NPF are as defined earlier. "Firm-Growth$_{15}$" is growth rate of firm size in 2015 relative to firm size in 2011. ***, ** and * represent statistical significance of coefficients at the 1 per cent, 5 per cent and 10 per cent levels, respectively, while "**a**" represents significance at 11 per cent. Standard errors are clustered at the firm level and all specifications include an intercept term.

Table 6: Wage Growth Before the Reform

	All Firms	Low-wage Industries	Production Workers
	1	2	3
Base-Wage $_{(2009)}$	-0.1268***	-0.1230***	-0.1511***
	(0.0141)	(0.0212)	(0.0218)
NPF	-0.0169	-0.0294	0.0031
	(0.0227)	(0.0290)	(0.0256)
Firm-Growth$_{11}$	0.0674*	0.0777**	0.0670
	(0.0356)	(0.0312)	(0.0425)
Secondary	0.0550**	0.0746***	0.0777***
	(0.0226)	(0.0249)	(0.0237)
Vocational	0.0760**	0.0703*	0.0857**
	(0.0339)	(0.0425)	(0.0431)
Some College	0.1054***	0.1406***	0.2016***
	(0.0328)	(0.0472)	(0.0419)
Tertiary	0.1999***	0.1929***	0.2930***
	(0.0364)	(0.0415)	(0.0583)
R^2	0.34	0.33	0.41
Observations	1,455	785	798

Note: The dependent variable is real wage growth in 20011 relative to 2009 for groups of workers indicated in the column heads. "Firm-Growth$_{11}$" is growth rate of firm size in 2011 relative to firm size in 2009. See notes to Table 4 for other variables and symbols. Standard errors are clustered at the firm level and all specifications include an intercept term.

Table 7: Employment Growth (firm-level analysis)

	2012	2013	2014	2015
	1	2	3	4

Initial Size	-0.0398**	-0.0302**	-0.0247***	-0.0184***
	(0.0198)	(0.0118)	(0.0080)	(0.0066)
NPF	-0.0682*	-0.0107	-0.0049	0.0055
	(0.0377)	(0.0196)	(0.0151)	(0.0126)
R^2	0.08	0.07	0.08	0.08
Observations	287	288	288	288

Note: Dependent variable if firm-level employment growth in each post-reform year relative to average firm size before the reform. Standard errors are clustered at the firm level and all specifications include an intercept term.

Appendix:

Table A1: Panel fixed effect estimates of wage and other benefits

	Wage	Allowances	Bonus
EXP	0.0853***	0.0654**	-0.0130
	(0.0179)	(0.0332)	(0.0429)
EXP^2	-0.0006*	-0.0012**	0.0002
	(0.0004)	(0.0006)	(0.0010)
ln(Firm Size)	0.0396	-0.2918***	-0.1054
	(0.1094)	(0.1079)	(0.2086)
R^2	0.32	0.15	0.21
N	14,643	10,117	7,505

Note: The dependent variables are logarithms of real wage, allowances and bonuses. "EXP" and "EXP^2" represent potential experience and its square term, respectively, while "Firm Size" measures firm-level employment. The model also includes time fixed effects, and interactions of EXP, EXP^2, and ln(Firm Size) with industry and region dummy variables. "Tenure" and "Firm Age" are dropped from the regression due to collinearity. Standard errors are clustered at the worker level.