Labor demand response to labor supply incentives: Evidence from the German Mini-Job reform

Gabriela Galassi*

European University Institute and IZA
(visiting student Université de Montréal)

May 30, 2018
Please click here for latest version

Abstract

This paper analyzes how firms respond to changes in tax benefits for low-earning workers and how, through equilibrium effects, such policies also affect non-targeted, higher-earning workers. I explore firm-level outcomes around the Mini-Job Reform in Germany in 2003, which entailed a significant expansion of tax benefits for low-earning workers. Firm responses are decomposed in terms of scale effects arising from lower labor costs and substitution effects due to changes in relative prices of low-earning and high-earning labor. Using a differences-in-differences approach I document that establishments with a high intensity of low-earning workers prior to the reform expand relative to low intensity establishments. Interestingly, this relative expansion is biased towards the type of workers not targeted by the tax benefits. In addition, establishments initially less intensive in low-earning workers substitute employment towards low-earning workers without expanding at the same pace. My findings are consistent with a model of the labor market which features tax sharing between workers and firms and simultaneous shifts in labor supply and demand after changes in tax benefits for low-earning workers. In this setting, there is a reallocation of employment and production from firms initially less intensive in low-earning workers to firms with a high pre-reform intensity. These equilibrium effects across different types of workers and firms are relevant for the design of labor market policies targeting low-earning workers.

JEL Classification: H20, H24, H32, E24, E64, I38, J23, J38
Keywords: tax benefit, equilibrium effects, firm outcomes

1 Introduction

Over the last decades, tax benefits for workers with low earnings have become a popular policy in many developed countries. These *in-work benefits* aim to provide incentives to work for individuals with low earning capacity, and to promote their self-sufficiency. There are numerous studies showing the effectiveness of these policies for expanding the labor supply of targeted groups.[1] This paper contributes to a much scarcer literature on demand-side and equilibrium effects of tax benefits for low-earning workers.

A series of recent studies for the UK (Azmat 2014), US (Leigh 2010 and Rothstein 2010) and Germany (Galassi 2016) have documented that, when tax benefits are expanded, firms share the benefit because the before-tax wages of these workers decline.[2] My paper draws on this insight and investigates the response of firms to in-work benefits in terms of demand for both low-earning and high-earning workers. I argue that changes in labor demand induce spillovers from the labor of workers who are explicitly targeted by the policy, to the labor of workers not targeted by the policy. When low-earning and high-earning workers differ in characteristics relevant for the production of goods and services (such as hours worked or skills), they are imperfect substitutes through the lenses of firms. Hence, a change in the pre-tax wage of low-earning workers provides incentives for firms to react to both the lower cost in this segment of the labor market, as well as the relative change in the cost of different types of labor.

Empirical evidence on firm responses to in-work benefits is provided by exploiting the Mini-Job reform in Germany in 2003, which led to a significant expansion of tax benefits for low-earning workers. Since the reform, workers in the so-called "mini-jobs", with gross monthly earnings below €400, are exempt from Social Security Contributions (SSC) and income tax, and workers in "midi-jobs" (between €400 and €800) have a subsidized SSC rate. Mini and midi-jobbers are known in the literature and policy discourse as "marginal workers". Workers whose earnings are above this threshold are considered in "regular" employment and are subject to full taxation. The Mini-Job reform led to a large increase in the number of mini-jobs, from approximately 4 million in 2002 to 7 million in 2004. The Mini-Job program in Germany is therefore comparable, in terms of coverage, to the well-known Earned Income Tax Credit (EITC) in the US.

I use a simple theoretical framework of the firm's decision on the use of heterogeneous labor to derive some testable implications. When low-earning (unskilled or part-time) and high-earning (skilled or full-time) workers are imperfect substitutes, the upward shift in the labor supply of low-earning workers after and expansion of in-work benefits leads to a reduction in the pre-tax wage of these workers relative to the wage of high-earning workers. The reaction of the firm which combines both these types of workers can thus be decomposed in terms of a scale effect (resulting from lower labor costs) and a substitution effect (resulting from changes in the relative cost of different types of jobs). While the scale effect induces an increase in the demand for both low-earning and high-earning labor, the substitution effect leads to a replacement of high-earning jobs with low-earning jobs. Furthermore, the scale effect is strong if a firm has a high ex-ante intensity intensity (or

---

[1]The effectiveness of tax credit programs on labor supply is documented in Eissa and Liebman (1996), Meyer and Rosenbaum (2001), Saez (2002), Eissa and Hoynes (2004), Saez (2010) and Chetty, Friedman, and Saez (2013) for the US, Blundell, Costa Dias, Meghir, and Shaw (2016), Blundell and Shephard (2011), Blundell (2006), Blundell (2000) and Blundell, Duncan, McCrae, and Meghir (2000) for UK, and Blundell and Hoynes (2004) for a comparison. The effectiveness of tax credits as redistributive policies is analyzed in Hoynes and Patel (2015).

[2]Tax shifting from the worker to the employer is a natural consequence of the expansion of the labor supply of workers with low earning capacity, as intended by the policy, and it depends on the sensitivity of labor demand for these workers (Eissa and Nichols 2005).

cost-share) of low-earning workers, and the substitution effect dominates if the intensity is low.

I document the presence of both scale and substitution effects using a panel of German establishments between 2000 and 2007, matched to administrative data of workers. The significant expansion of tax benefits with the introduction of the Mini-Job reform allows to apply a differences-in-differences strategy, in which I exploit the variation in the pre-reform intensity in low-earning workers across establishments. According to the model, this variation determines the heterogeneity in the strength of the scale and substitution effects in response to changes in in-work benefits. The main identifying assumption is that in the absence of the reform firm level outcomes, such as total employment or employment type, would have grown at the same pace in both high-intensity and low-intensity establishments (the so-called "parallel trends" assumption).[3] I verify that this is indeed the case for the years preceding the reform.

My estimates show that after the reform, (i) high-intensity establishments denote a larger increase in the use of high-earning workers than low-intensity establishments, (ii) the increase in employment of low-earning workers is smaller in high-intensity establishments than in low-intensity establishments, and (iii) total employment, in terms of both workers and hours, grows more in high-intensity establishments than in low-intensity establishments. One of the key implications of my model is that this pattern can only emerge when both scale and substitution effects occur simultaneously. Intuitively, firms that exhibited a higher intensity in low-earning workers ex-ante experience a stronger reduction in labor costs and thus manifest a stronger scale effect. On the other hand, low-intensity firms have a stronger incentive to substitute towards low-earning jobs because a larger fraction of their workforce is now relatively expensive.

Overall, the theoretical framework and the empirical results suggest that there is a slight convergence between high-intensity establishments (which grow relatively more and demand relatively more high-earning workers) and low-intensity establishments (which demand relatively more low-earning workers). This convergence across establishments is observed in the data.

To understand how firms change the demand for labor consistent with the previous observations, I analyze relative changes in the labor force composition within establishments. The relative expansion in high-earning workers of high-intensity establishments is driven by an increase in hours per worker (i.e., there are more full-time and less part-time workers), and by a change in the education level of workers (i.e., there are less low educated and more medium educated workers). The change in the educational composition of the workforce takes place in parallel with a larger increase in investment in physical capital (which has a higher complementarity with skilled labor) in high-intensity establishments than in low-intensity establishments. I also provide evidence of a relative change in tasks within establishments: high-intensity establishments tend to shift towards more complex tasks, whereas low-intensity establishments lean towards tasks with lower complexity. Finally, the results also suggest that high-intensity establishments upgrade earnings of incumbent workers and hire disproportionately more workers with high earnings. Multiple alternative specifications that include firm-specific trends, lagged dependent variables, and different definitions of the intensity in low-earning workers support the robustness of these results.

The mechanism explored in this paper relies on two key assumptions, namely the expansion of the labor supply in the low-earning segment, and the imperfect substitutability between low-earning and high-earning workers. The paper also provides additional evidence to support these assumptions.

---

[3]Throughout the remainder, I will use the expression "high-intensity establishments" for establishments with a relatively high intensity of low-earning workers prior to the reform, and "low-intensity establishments" for establishments with a relatively low intensity of low-earning workers prior to the reform.

First, I document that women and workers previously not participating in the labor market represent a substantial part of mini-jobbers, indicating an important role of the tax incentives in activating secondary workers. There is also an expansion of the proportion of workers taking up secondary jobs, which is related to the legal change brought by the reform regarding their tax exempt status if complying with the mini-job earnings threshold. All of these facts support the idea that the Mini-Job reform lead to an increase in the supply in the low-earning segment of the labor market. I also show that marginal and regular workers indeed differ along several dimensions that are crucial for the substitutability between these workers. For some low complexity occupations, substitution between high-earning and low-earning workers seems relatively easy to implement (e.g. by splitting full-time into part-time jobs), whereas for other occupations, the high-earning and low-earning workers appear to be closer to complements.

Finally, I use a parameterized version of the model that is consistent with my empirical results to shed light on the potential effects of the reform on overall employment and output. The main insights from this exercise is that total employment might increase as the decline in high-earning employment does not completely offset the increase in low-earning employment, and that, apart from the reallocation of high-earning employment from low-intensity to high-intensity establishments, the reform also lead to a reallocation of production from low-intensity to high-intensity establishments.

The ongoing political controversy over the Mini-Job reform, which has remained under scrutiny within Germany and other countries considering similar reforms, illustrates the policy relevance of my paper. Pundits and policy makers in Germany have attributed observed increases in labor precariousness to the Mini-Job reform. It is argued that the program mainly favoured firms who substituted high-earning occupations with low-cost workers, increasing precariousness of employment. At the same time, the strength of the German labor market over the last decade has led others to stress that the program may result in beneficial job creation.[4] I provide evidence for both effects, in particular for an unexpected effect on the employment of high-earning workers that were not targeted by the policy. More generally, my results show that the design of policies focusing on low-earning workers should take into account the labor demand response to such interventions, and the spillovers on the high-earning segment of the labor market.

Related literature

This paper makes several contributions to the existing literature. A large body of research documents the effects of tax benefits for low-earning workers on labor supply. In the case of the German Mini-Job reform, several papers suggest that it induced an increase in labor supply by encouraging secondary workers (e.g. married women) to participate in the labor market, and regular workers to take up marginal employment as a second job (Carrillo-Tudela, Launov, and Robin 2015, Caliendo and Wrohlich 2010, Bargain, Caliendo, Haan, and Orsini 2010, Fertig and Kluve 2006, Freier and Steiner 2008 and Steiner and Wrohlich 2005). My paper builds on the documented shift in labor supply to understand how firms respond to the consequent changes in wages of different types of

---

[4]As opposed to the consensus about the positive effect on employment of the EITC (see e.g. the discussion by Hilary Hoynes in 2014 in "Building on the success of the Earned Income Tax Credit"), there is no apparent agreement about the employment effect of the Mini-Job design. Examples of negative opinions include "Fur eine hand voll euro" (Spiegel, 2004) or "The dark side of Germany's job miracle" (Reuters, 2012). Positive views include for instance "Putting Germany's mini-jobs in their context" (El Pais, 2015), "Our jobs market is broken - and Germany may have the answer" (The Telegraph, 2012). Apart from concerns about employment effects, political economy arguments may be contributing to the different opinion about the Mini-Job reform with respect to other in-work benefits, as reflected by the article by Krebs and Schaffer "German labour reforms: Unpopular success" which puts on the table a political economy argument behind the unpopularity of the Hartz reforms: the existence of a very concise group of losers, i.e. the long-term unemployed, more affected by the Hartz IV reform not analyzed in this paper.

workers.

In the spirit of some recent studies, my paper deals with labor demand responses to in-work benefits. The closest paper is Tazhitdinova (2018), which analyzes firms' role in magnifying the labor supply responses to the Mini-Job design, as estimated using the bunching at the tax kinks and notches. The mechanism is similar to Chetty, Friedman, Olsen, and Pistaferri (2011) for Denmark. Firms disproportionately create employment at workers' tax discontinuities because tax-advantaged workers are more attractive for firms than workers slightly above the threshold due to a defacto higher flexibility.[5] Gudgeon and Trenkle (2017) use bunching estimators to analyze sluggish adjustment of workers from lower to higher earning thresholds in the context of the German Mini-Job reform. They show that firms with higher employment dynamics before the reform find it easier to adjust workers' earnings. In a different setting, Shephard (2016) analyzes the introduction of the WFTC in the UK, documenting spillovers from the demand for eligible workers to the demand for similar non-eligible workers which arise in the presence of labor market frictions, following the introduction of the WFTC in UK.[6] All of these studies provide evidence that firms' incentives are affected by tax benefits awarded to workers, which is crucial to the idea conveyed in my paper. However, the effects considered by these studies are confined to workers who compete in the same labor market and are perfect substitutes in the eyes of a firm. In contrast, I provide evidence for a different type of response by firms, which, to the best of my knowledge, has not been considered in the literature so far. I investigate the effects on the demand for both low-earning and high-earning workers, although the latter are not directly targeted by the reform. I show that a labor supply shock to low-earning workers induces a spillover to high-earning employment via firms' incentives to respond to the changes in relative wages. This evidence complements the documented effects on labor demand within the low-earning segment. The idea however is more closely connected to the concept of substitutability among production inputs.[7]

Effects of the Mini-Job reform connected to the labor demand have also been explored with a more structural approach. Jacobi and Schaffner (2008) estimate the labor demand for heterogeneous labor using a flexible cost function framework in Germany, and documents no changes in the elasticity of substitution between unskilled and skilled labor after the Mini-Job reform. Also relying on parameter instability, Bradley and Kuegler (2017) assess the effects of the Hartz reforms on employment and wage levels, by estimating a structural model of the labor market featuring search frictions and heterogenous workers and firms. The main difference of my paper is that I propose a mechanism of labor demand response which relies on changes in relative wages and does not need time variation in structural parameters. This mechanism is confirmed by reduced form results using firm-level data.

My paper also contributes to the literature studying displacement effects of labor market policies, which has focused mainly on job seeker assistance. A paradigmatic example is Crepon, Duflo, Gurgand, Rathelot, and Zamora (2013), which uses a two-step randomized program of job-seeker

---

[5]A similar result is documented by Haywood and Neumann (2017), and the mechanism is theoretically explored in Kolm and Tonin (2011).

[6]In the case of the WFTC and the EITC, workers' entitlements vary according to household structure, i.e. they are different across workers who compete within a unique labor market. This is not the case in the Mini-Job design, in which benefits directly depend on earnings and not on other traits of workers. The mechanism at work in the setting of the WFTC and the EITC is similar in spirit to Beaudry, Green, and Sand (2014). A wage shock for a particular group of workers affects employment of other workers within the same labor market due to the presence of frictions.

[7]See e.g. Acemoglu and Autor (2011) for an extensive review over the vast literature on technological change which has dealt with the input substitutability.

assistance in France to compare the outcomes of untreated workers in treated and untreated areas.[8] The authors document that the positive impact on the job finding probability of a treated worker is partially outweighed by a negative impact for untreated job seekers in treated areas. More generally, the literature on displacement effects of labor market programs focuses on treated and untreated workers who compete for the same jobs, similar in nature to the studies on labor demand and in-work benefits. Instead, the mechanism that I investigate in this paper relies on substitution between low-earning and high-earning workers who operate in different labor markets.

Finally, this paper also contributes to the growing literature on responses of labor demand to labor market policies (Harasztosi and Lindner 2017, Cahuc, Carcillo, and Le Barbanchon 2018, Garcia Perez and Rebollo Sanz 2009). This strand of the literature examines labor demand policies (such as minimum wage, wage subsidies or hiring credits), as opposed to the policy examined here, where the benefit is provided to workers. The empirical strategy based on firm-level data in this paper relies partially on the approach used by Harasztosi and Lindner (2017) and Cahuc, Carcillo, and Le Barbanchon (2018).

The rest of the paper is organized as follows. Section 2 provides details on the institutional context of the Mini-Job reform and describes the data sources used in the analysis. Section 3 presents descriptive evidence, and section 4 introduces the theoretical framework. Section 5 discusses the empirical strategy, and section 6 provides the results. Section 7 uses a parameterized version of the theoretical model to argue about the potential implications for overall employment and output, and section 8 concludes.

2 Institutional Context of the Mini-Job Reform and Data

This section discusses the institutional background of the Mini-Job reform. Next, it presents details about the data used in this paper.

2.1 Institutional context

The Mini-Job reform was part of a wider set of policies, the so-called Hartz reforms, which were gradually implemented between 2003 and 2005. The explicitly stated objective was to simultaneously reduce unemployment and increase competitiveness.

In this paper I focus on Hartz II or Mini-Job reform, one of the most controversial components of the Hartz reforms. Introduced in April 2003, it expanded the exemptions in social security contributions (SSC) and income tax for workers with low earnings.[9] Mini-jobs did already exist in Germany before the reform, but they were restricted to employment with a maximum of 15 hours a week and gross monthly earnings of €325, provided it was the only source of income for the worker.[10] Mini-jobbers were exempted from income tax and from the SSC, which amounted to 21% of gross earnings for regular employment, while employers paid 22% tax on gross wages, slightly above the

---

[8]The double randomized design of Crepon, Duflo, Gurgand, Rathelot, and Zamora (2013) is superior to the non-experimental designs in previous papers (see e.g. Blundell, Meghir, Costa Dias, and Van Reenen 2004, Ferracci, Jolivet, and van den Berg 2010, Pallais 2014, Gautier, Muller, van der Klaauw, Rosholm, and Svarer 2015).

[9]It is common to refer to the employment with tax advantages as "marginal", as opposed to "regular" employment, which is subject to full taxation.

[10]Mini-jobs as low-paid employment without SSC for employees existed in Germany with different labels since the introduction of the welfare state in the late XIX century (Schiller 2016). In 1999 a reform attempted to bring them into the social security system and limit their scope. The hours limit was introduced, and it was further required that earnings from all jobs were considered before determining eligibility. Only if total earnings and hours were below the cutoffs, the worker was eligible for the tax benefit.

5

21% employer rate on regular jobs. If gross monthly earnings surpassed the €325 limit, the entire amount of earnings was subject to the 21% rate of SSC for each the employer and the employee, and to the income tax.

After the reform, the earnings limit was extended to €400 and the hours limit was eliminated. Employers' SSC rate increased to 25%.[11] A phase out category was introduced for monthly gross earnings between €400 and €800, so-called "midi-jobs", for which SSC increase linearly for the worker while employers are subject to the regular 21% rate, and for which the regular income tax applies. Secondary jobs with a different employer than in the main job were allowed to qualify as mini or midi-jobs if they were complying with the earnings limits for this particular job, irrespective of total earnings.[12]

The following example aims at clarifying the importance of the implicit subsidy of the Mini-Job reform: a single worker whose gross monthly earnings are €400 receives the full amount in net terms after the reform, in contrast to €316 (after paying SSC) before the reform. Ceteris paribus, this implies a subsidy of slightly above €1,000 per year. The subsidy is even larger if the worker was subject to income tax before the reform.[13] While the €400 threshold might seem low for a worker, the wage mini-jobbers receive is not unusual: mini-jobbers usually work around 15 hours a week, which yields an hourly wage of €7 for it to be compatible with the earnings limit of €400 (see Table (A2) in the Appendix). The average hourly wage of mini-jobbers is thus similar to the after-tax hourly wage of full-time regular workers, even without controlling for education or other productivity characteristics.[14]

After the reform, the number of workers holding a mini-job surged, from approximately 13% of private wage-employment in the years before to 19% after, though the increase is more modest for workers with mini-job as main employment (15.5%), as shown in Figure (1). Including midi-jobs, marginal employment affects more than 20% of workers in the private sector. The proportion of workers with a tax-advantaged job hence is comparable to the incidence of EITC in the US, and doubles the number of workers with temporary contracts in Germany.

The distribution of earnings is affected by the mini-job design, as shown in Figure (2). In particular, there is a strong spike at the mini-job threshold, at €325 before the reform and €400 after the reform. The additional spike at the €165 level reflects an earnings disregard for the unemployment insurance, a feature that did not change with the reform. The change in the location of the spike happens the year of the reform, 2003, which rules out significant anticipation effects (see Figure (B2) in the Appendix).[15]

Marginal workers are entitled to most of the benefits of regular employees in Germany, including

---

[11]A further raise to 30% in employers' rate of SSC on mini-jobs was introduced in July 1, 2006, simultaneously with a decrease in the workers' and employers' rate for regular jobs to 19.5%.

[12]See Table (A1) for the evolution of SSC rates. A special mini-job regime applies for private households. They however represent a very small amount of mini-jobbers (1.5% in 2004).

[13]The income tax exemption is relevant for mini-jobbers only if they hold a main regular job that surpasses a limit of non-taxable income (between €7,235 and €7,664 in the years around the reform) or if the spouse's earnings are such that jointly they surpass twice this amount. This is not the case for a single mini-jobbers, whose annual earnings are as much as €4,800. There was a Tax Reform in 2003-2004 which raised the minimum exempt and the progressivity in the income tax, but the changes were substantially small as compared with the modifications in the Mini-Job design.

[14]Controlling for observed characteristics (education, square polynomial of age and tenure, and part-time status) and unobserved time invariant heterogeneity, the penalty of mini-jobs in terms of daily wages is 6%, according to social security records.

[15]The Mini-Job Reform was announced, jointly with the other Hartz reforms, during the discussion of Chancellor Schroeder's 2010 Agenda on March 14, 2003. Stock prices reacted strongly to this announcement, indicating that agents were not anticipating the reform ("German recovery: it's the supply side", VoxEU column by Michael Burda).

Figure 1: Proportion of marginal workers out of total employment
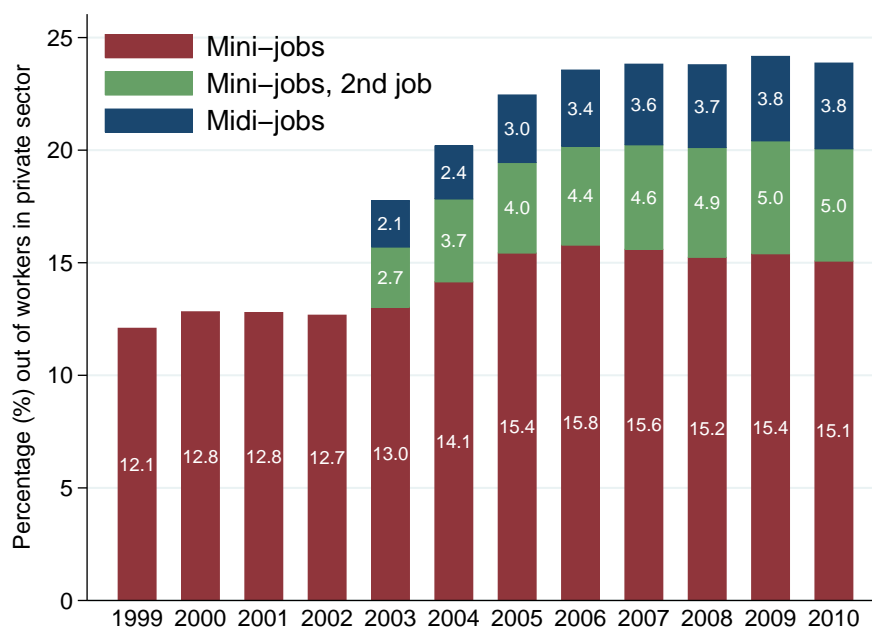
Figure 2: Gross monthly earnings in 2002 (before the reform) and 2004 (after the reform)
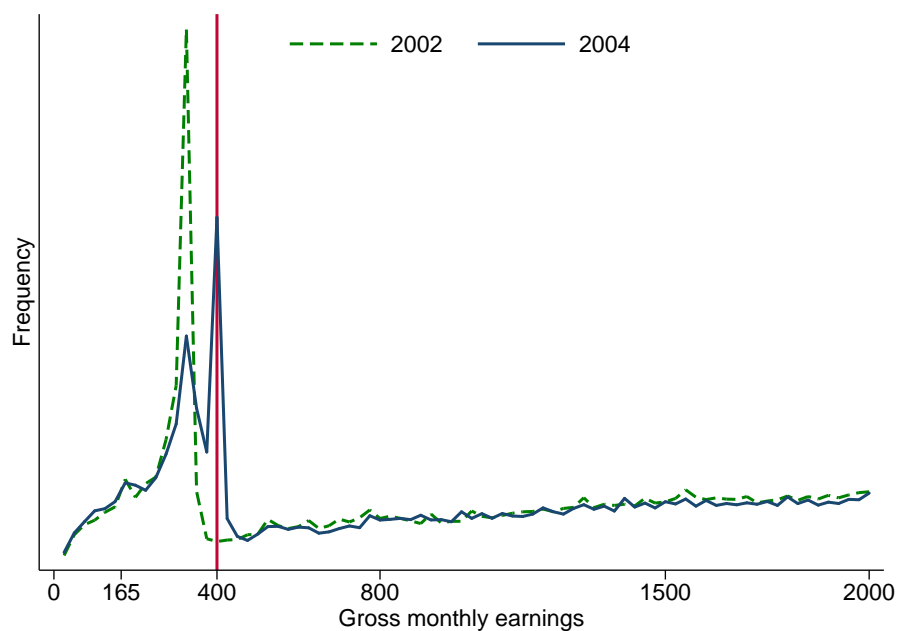
holidays, paid sickness days, employment protection against dismissal and parental leave. They do not have full pension entitlement though, but they can opt to contribute to the pension insurance system voluntarily.[16] Employers only pay insurance for work-related accidents for mini-jobbers, and they do not automatically provide health insurance. However, it is common that mini-jobbers have access to health insurance through their family members.

It is worth clarifying that at the time of the reform, Germany was undergoing a recession which had started at the beginning of 2000. The turning point in terms of labor market indicators coincides with the Hartz reforms, in particular the Hartz IV, which curtailed unemployment benefit and assistance entitlement for long-term unemployed workers. As this reform also affected incentives of low-earning workers, a natural concern is that it confounds effects of the Mini-Job reform. I argue that it is unlikely that conclusions drawn in this paper about the effects of in-work benefits that are affected by this additional reform. First, Hartz IV was introduced in 2005, two years after the Mini-Job Reform, while my empirical results show that the effects of the Mini-Job Reform could already be noticed in 2003. Second, to the extent that the introduction of Hartz IV affected labor supply incentives by curtailing unemployment assistance, the reform should be seen as a complementary measure to the in-work benefits generated by the Mini-Job Reform (Immervoll and Pearson 2009).[17]

The remainder of the Hartz reforms were related to different aspects of the labor market, with little reason to believe that their introduction could confound the effects of the Mini-Job reform. Hartz I (introduced in January 1, 2003) included active labor market policies and obligations for job seekers to keep unemployment insurance, and extended the potential for temporary employment.[18] Hartz III (January 1, 2004) focused on improving the efficiency of the Public Employment Agency. Hartz II (the Mini-Job reform) also included the creation of a centralized office to simplify administrative tasks regarding marginal employment ("Minijob-Zentrale") and the introduction of subsidies for entrepreneurs coming from unemployment. Intuitively, all of these labor market policies affected the German labor market without a clear focus on the bottom of the earnings distribution, as it is indeed the case with the Mini-Job reform.

Another relevant factor is the incorporation of several Eastern European countries to the European Union in 2004. Given the free movement of people, this may have induced entry of low-skilled workers into Germany. However, the effects could only be seen since 2004, with a reasonable lag due to lagged effects on migration. Since I already note effects in 2003, this event is unlikely affecting the conclusions.

To sum up, I argue that the Mini-Job reform acted as the main activation measure for low-earning workers, in particular in a small horizon around the implementation of the reform. This is a relevant observation to interpret the results observed on labor demand as a result of the expansion of tax benefits for low-earning workers.

---

[16]Employers pay 15% on gross earnings to the pension system for mini-jobbers, which implies a difference of 4.9 pp. with respect to the 19.9% contribution in regular employment. Only 3% of mini-jobbers contribute voluntarily paying this difference to gain full-pension entitlement (Guardiancich 2010).

[17]Unemployment insurance and assistance were approximately €700 at the time of the reform. Benefits for long-term unemployed in Germany were much more generous than in the rest of the OECD countries before Hartz IV (see Engbom, Detragiache, and Raei 2015).

[18]Many aspects of temporary work were deregulated by the Hartz reforms. Although an important group of temporary workers are in the low-earning segment, the limited scope of temporary work compared to mini and midi-jobs (approximately 7.5% of workers in fixed-term contracts and 2.5% in temporary agency work) and the lack of change around the Mini-Job reform (see e.g. Eichhorst and Tobsch 2014) potentially dissipate doubts about the possibility to act as confounders.

2.2 Data

My empirical analysis is based on linked employer-employee data provided by the Institute for Employment Research of the German Federal Employment Agency (IAB). These data are available through on-site visits and remote access provided by the Research Data Centre (FDZ) of the IAB. The firm-level analysis draws on the so-called Linked Employer-Employee (LIAB), Cross-Sectional Model 1993-2010. Assembled by the FDZ / IAB, it combines administrative social security data on individuals from the Integrated Employment Biographies (IEB) with establishment data from both the Establishment History Panel (BHP) and the IAB Establishment Panel through a unique establishment identifier. The main advantage of the LIAB is that it allows to follow establishments in time, providing individual information about their employees.[19]

The IAB Establishment Panel, available for West Germany since 1993 and for East Germany since 1996, consists of an annual survey (on June 30th each year) on a representative sample of approximately 16,000 establishments. There are periodical refreshments for establishment death and birth. The sampling design is stratified by establishment size, industry and federal state, it over-samples large establishments and it excludes unipersonal and informal firms. Different longitudinal sections are provided by the FDZ. I use the longitudinal section 2000-2007. Inference about the population of establishments requires the use of weights constructed by the IAB to offset the disproportionalities in the sampling design and account for the attrition. The information on establishments includes a wide range of subjects related to the establishments' employment and some elements of their balance sheets, such as investment and business volume.

For the LIAB Cross-Sectional Model, the IAB draws the social security records of all the workers employed in the sampled establishments on June 30th each year (between 1.6 million and 2.5 million workers per year). Social security records in the IEB contain spells of employment, unemployment benefit receipt and job search. Employment spells are generated from notifications that employers send to the system. In absence of a major event, these notifications are sent annually. They are also sent in the case of new hires, terminations, interruptions, changes in contribution group or health insurance company of the employee, or changes in the payroll system of the employer. Civil servants, self-employed, short-term and family workers are not present in these data since their earnings are not reported via the social security system. The social security records hence cover 80% of the workers in Germany. Information about workers includes age, gender, citizenship, education, daily earnings and benefits, occupation and part-time or full-time status. Additional workplace information, such as industry branch and geographic location is available from the aggregation of social security records in the Establishment History Panel (BHP), which corresponds to June 30th each year.

Although I use the establishment level data for most of the analysis, I also draw descriptives from the Sample of Integrated Labor Market Biographies (SIAB) 1975-2010, which is a 2% random sample from the IEB (1.6 million workers). The SIAB allows to perform longitudinal analysis about workers as it contains all the spells of the labor history for each worker in the sample.

The first year in which marginal workers are included in the social security system is 1999. The window of analysis hence spans from that year to 2007, before the onset of the international crisis. Two important limitations of the data is the lack of information on hours worked and the censoring of earnings at the maximum for social security contributions (approximately €61,000 of annual gross earnings). My analysis relies on measures of employment, hence the lack of information on

---

[19]The unit of observation in the data is the establishment (local economic unit) and not the firm, which may comprise several establishments. I use the words "firms" and "establishments" interchangeably in the analysis to refer to the later.

hours worked is relevant. To circumvent it, I generate a measure of "full-time equivalent" workers which consists in attributing part-time workers a weight lower than one. Regarding the censoring of earnings (which affects approximately 5% of the observations), I apply an imputation procedure which is standard in the literature. It is worth noting that the censoring of earnings is not crucial for my analysis, as the upper limit for social security contributions is beyond the limit for tax-advantaged jobs. I provide more details about the data and these adjustments in section (C) of the Appendix.

3 Descriptives

In this section, I outline the main characteristics of the mini-jobbers relying on SIAB data. I discuss how they differ from other workers in Germany, how labor supply was affected by the Mini-Job Reform. The goal of this section is to show that the Mini-Job reform effectively stimulated labor supply at the bottom of the earnings distribution, and that tax advantaged and non tax advantaged workers are not perfect substitutes on the eye of the firms.

3.1 Who are the mini-jobbers?

Table (1) shows the characteristics of marginal workers, comparing them to regular workers and unemployed, for the year after the reform (the classification is in function of their main job). I focus on the contrast between mini-jobbers and regular workers, as midi-jobbers typically display characteristics in between the other two types.

Mini-jobbers are defined by a threshold of earnings. As earnings are the product of hours and wage, one would expect that they are characterized by either low hours worked, or low wages (productivity or skills), or both. Confirming this intuition, a salient characteristic of mini-jobbers is that they are eminently part-time (90% compared to 16.4% among regular workers). Part-time mini-jobbers represent about half of total part-time workers in the economy. The education level is also lower for mini-jobbers: one third of them do not have "Abitur" (higher secondary school certificate) compared to 13% of regular workers.

There are some demographic groups that stick out among mini-jobbers, potentially because they are sensitive to the incentives created by the tax design. The over-representation of women among mini-jobbers (three out of four mini-jobbers are women) is in line with the well-documented fact that tax benefits are particularly relevant for secondary workers within households, especially in Germany due to the income tax exemptions and the joint taxation system. Previous non-participation seems a relevant trait among mini-jobbers, as suggested by the lower work experience and tenure, and similar average age and duration of reception of unemployment benefit of mini-jobbers as compared to regular workers. Long-term unemployed do not seem represented strongly among mini-jobbers (the history of unemployment benefit reception is much shorter for mini-jobbers than for unemployed). Younger (below 30 years old) and older (above 55 years old) workers constitute more than half of mini-jobbers, compared to one third of regular workers. This is not surprising as students and individuals in partial retirement usually work part-time. Furthermore, these groups are often entitled to particular benefits (BaföG for students and disability insurance or stipends for partial retirement for older workers) subject to €400 means-tests.

There are also large differences in the type of jobs that marginal and regular workers perform. Mini-jobbers carry out more interactive and manual non-routine tasks (15% and 49% of mini-jobs respectively, compared to 10% and 26% of regular workers), and less cognitive tasks (6% are in analytical non-routine tasks and 22% in cognitive routine tasks, compared to 18% and 33% of regu-

lar workers). Mini-jobbers work disproportionately in the service sector and less in manufacturing. They also have a higher representation in younger and smaller establishments. These singularities of demographic traits and the type of jobs performed by mini-jobbers reflects a well-known segmentation in the German labor market between "regular" and "atypical" employment (see for eg. Eichhorst and Tobsch 2013, Keller and Seifert 2012). Although "atypical" employment include other types of workers (part-time above the mini-job threshold), temporary and agency employment, the so-called marginal employment (mini- and midi-jobs) is quantitatively the most important form of atypical employment.

As the reform also allows secondary jobs to be tax advantaged, as long as the income from the second job complies with the earnings limits, an important proportion of mini-jobs (between one fifth and one fourth) are secondary jobs. Table (2) shows the characteristics of secondary job holders, contrasting secondary mini-jobs with secondary regular jobs (included midi-jobs), and compares them to workers who do not hold a secondary job. 91% of secondary jobs are mini-jobs. Age and gender differences between these groups are not as pronounced as those between regular workers and workers with a mini-job as a main occupation. Some disparities in the education level still remain, however, with more low and medium educated workers (workers with "Abitur") among the group holding a mini-job as their secondary job, and more professionals among the group holding a regular job as their secondary job. Whereas half of the workers taking up a regular secondary job are part-time in their main occupation, only one third of those with a secondary mini-job are in this situation.

3.2   Labor supply expansion with the Mini-Job Reform

First, I show some descriptive statistics to convey the idea that the Mini-Job Reform effectively stimulated labor supply.[20] I perform a simple accounting exercise based on changes in the earnings distribution to gauge the supply expansion caused by the Mini-Job Reform. Intuitively, the mass of employment below the mini-job threshold after the reform comprises workers from three groups: (1) workers who were below that earnings' level before the reform, (2) workers who were in non-employment and now find it profitable to work with lower taxes, and (3) workers whose earnings were above the new threshold before the reform and who work reduced hours or for a lower gross wages to qualify for the tax exemptions. Assuming that most workers from the last category where workers with earnings only moderately above the new threshold, the change in the mass below the mini-job threshold, net of the change in the mass moderately above the threshold, must represent additional workers who are incorporated into employment (details are in the Appendix in section (D.1)). For the specific empirical exercise, I set €1,200 as the upper limit for the mass that is "moderately" above the threshold. This choice can be justified by the observation that the earnings distribution above this value are approximately the same. The calculation suggests that the labor supply in the mini-job segment augmented by about 3.6%.[21]

Another way of gauging the degree in which new workers entered the workforce is to look at the transitions from non-employment to different types of employment that occurred between 2002 and

---

[20]The article in the British newspaper "The Telegraph", "Our jobs market is broken - and Germany may have the answer" explains in plain words the labor supply incentives provided by the reform: "Take a lone mother who works 10 hours a week on the minimum wage. If she works 15 hours, she is no better off, because the extra money she earns is offset by the welfare she loses. [...] If the single mother in question were allowed to work under a mini-job contract, she could keep every penny.".

[21]There is an ongoing downward trend in employment and upward in unemployment in the period of reform (see Figures (B3)-(B5) in the Appendix). However, the distribution of earnings seems relatively stable in the pre-reform years (Figure (B7) in the Appendix), which suggests that the error from ignoring time trends in employment the comparison of the earnings distribution over a short horizon is likely to be small.

Table 1: Characteristics of workers according to status: unemployed, mini-job, midi-job and regular employment

	Unemployed	Mini-job	Midi-job	Regular
Female	46.8%	71.3%	76.2%	43.0%
	(0.499)	(0.453)	(0.426)	(0.495)
Age	40.9	43.1	40.0	40.1
	(12.37)	(17.05)	(11.53)	(11.39)
Young (< 30)	22.0%	27.1%	22.2%	20.8%
	(0.414)	(0.444)	(0.416)	(0.406)
Prime age (30-55)	62.7%	43.9%	68.1%	69.7%
	(0.484)	(0.496)	(0.466)	(0.459)
Old (>55)	15.2%	29.0%	9.6%	9.5%
	(0.359)	(0.454)	(0.295)	(0.293)
No "Abitur"	21.7%	31.2%	20.6%	13.3%
	(0.412)	(0.463)	(0.404)	(0.339)
With "Abitur" or apprentices	72.4%	65.4%	75.3%	74.4%
	(0.447)	(0.476)	(0.431)	(0.437)
Professionals	5.9%	3.4%	4.2%	12.4%
	(0.236)	(0.181)	(0.200)	(0.329)
Daily wage/benefit	18.8	8.8	19.9	81.0
	(11.97)	(3.74)	(10.07)	(45.54)
Second job holder	0.4%	4.6%	8.5%	4.8%
	(0.065)	(0.208)	(0.279)	(0.214)
Part-time		90.0%	61.9%	16.4%
		(0.300)	(0.486)	(0.371)
Employment experience (years)	8.1	8.4	9.2	13.1
	(7.559)	(7.546)	(6.865)	(8.710)
Tenure (years)		3.1	4.4	7.3
		(3.864)	(5.058)	(7.272)
Duration of benefit receipt (months)	40.9	9.1	12.5	8.0
	(44.845)	(18.678)	(21.902)	(16.187)
Analytical non-routine tasks		6.4%	7.7%	18.3%
		(0.245)	(0.267)	(0.387)
Interactive non-routine tasks		15.3%	15.0%	10.1%
		(0.360)	(0.357)	(0.302)
Cognitive routine tasks		22.0%	25.4%	33.2%
		(0.414)	(0.435)	(0.471)
Manual routine tasks		7.1%	4.2%	12.2%
		(0.257)	(0.201)	(0.328)
Manual non-routine tasks		49.2%	47.7%	26.1%
		(0.500)	(0.499)	(0.439)
Establishment size (n. workers)		202	339	969
		(766.9)	(1528.7)	(4093.2)
Establishment age (years)		14	15	18
		(10.42)	(10.13)	(10.53)
Median full-time wage		66	58	86
		(26.08)	(32.17)	(30.48)
Agriculture, primary		1.9%	2.3%	2.6%
		(0.137)	(0.149)	(0.161)
Manufacturing		12.6%	8.0%	26.4%
		(0.331)	(0.271)	(0.441)
Construction		3.3%	3.2%	6.4%
		(0.178)	(0.176)	(0.245)
Retail, repair		22.5%	17.6%	14.7%
		(0.418)	(0.381)	(0.354)
Transport, communication		5.4%	5.5%	5.5%
		(0.225)	(0.228)	(0.228)
Financial intermediation		1.2%	2.0%	3.9%
		(0.109)	(0.139)	(0.193)
Services for businesses		19.7%	20.2%	11.6%
		(0.398)	(0.402)	(0.320)
Other services		27.4%	35.7%	20.3%
		(0.446)	(0.479)	(0.403)

Source: SIAB, annual data (2004), main spell. Standard errors in parenthesis.

Table 2: Characteristics of secondary job holders

| | No secondary job | Secondary job holders | |
		Mini-job	Regular-job
Female	47.3%	55.5%	55.6%
	(0.499)	(0.497)	(0.497)
Age	40.6	39.8	40.6
	(12.42)	(11.65)	(11.94)
Young (<30)	21.8%	22.1%	20.9%
	(0.413)	(0.415)	(0.406)
Prime age (30-55)	65.4%	68.7%	66.5%
	(0.476)	(0.464)	(0.472)
Old (>55)	12.9%	9.2%	12.6%
	(0.335)	(0.289)	(0.332)
No "Abitur"	16.6%	18.3%	13.8%
	(0.372)	(0.387)	(0.345)
With "Abitur" or apprentices	73.0%	75.8%	65.5%
	(0.444)	(0.428)	(0.475)
Professionals	10.4%	5.9%	20.7%
	(0.305)	(0.236)	(0.405)
Daily wage, second job		7.6	40.3
		(4.045)	(51.96)
Monthly earnings, second job		231.6	1,203.7
		(123.4)	(1342.4)
Part-time, main job	23.3%	32.5%	50.0%
	(0.300)	(0.486)	(0.370)

Source: SIAB, annual data (2004), workers with secondary job. Standard deviations in parenthesis.

2004 (Table (A3) in the Appendix). 40% of the workers in mini-jobs in 2004 were not employed in 2002, while only 13% of the workers who are in regular part-time or full-time employment in 2004 were not employed in 2002. This indicates a higher proportion of influx of new workers into the mini-job segment. More than one third of the transitions out of non-employment between 2002 and 2004 are through mini-jobs, who represent 15% of workers.[22] Comparing all transitions during 2002 and 2004 (SIAB in spell format), flows from unemployment to mini-jobs as a percentages of unemployment exits increased (from 27% of total outflows to 40%), whereas transitions from mini-jobs to unemployment remained relatively stable (52% and 54% respectively). For women, the raise in inflows from unemployment to marginal employment is stronger than for men (1.4 pp. vs. 1.2 pp.), with a similar decrease in flows from unemployment to regular employment (5 pp.). Similar situation is observed for workers above 55 years old, compared to prime-age and young workers.

Besides the entry new workers, the supply of mini-jobs increased due to secondary job holders. The proportion of workers with secondary jobs increased by around 50%, from 3.4% before the reform to 5% after the reform (shown in Table (A4) in the Appendix). This increase was particularly pronounced for women, prime-age and medium educated workers.[23]

A final source of employment in mini-jobs is constituted by workers who were previously earning above the threshold and whose gross earnings are decreased. A comparison of all transitions in 2002 and in 2004 (using the SIAB spell data) suggests that, while the flows from regular employment to mini-jobs increased (from 1.4% to 5%), flows in the opposite direction also increased (13% in 2002 to 18% in 2004). The conversion of mini-jobs into regular employment within the same

[22]Transitions vary by age and gender, not shown in the table. In particular, flows from non-employment to mini-jobs are particularly relevant among women and workers above 55 years old, whereas they are lower for prime-age men. The proportion of mini-jobbers in 2004 coming from non-employment is higher among young workers, while the share from higher earnings is strong among prime-age men.

[23]Figure (B8) in the Appendix shows the cumulative distribution of earnings, comparing only main jobs and when all jobs (main or secondary) are included. The cumulative employment mass below the mini-job threshold increases dramatically when side jobs are included.

establishment is 3% in 2004, which compares to a small proportion of downgrade from a regular job to a mini-job with the same employer 0.6%.

A closer look at the workers who, in 2004, are closely below the mini-job threshold (i.e., earning between €325 and €400, see Table (A5) in the Appendix) reveals that whereas 36% were non-employed in 2002, only 13.5% were earning more before the reform. This proportion is substantially larger among job movers (37%) than between job stayers (15.5%). The numbers suggest that moving down the gross earnings ladder is not primarily an intra-firm phenomenon. Furthermore, a substantial proportion of workers close to the mini-job threshold seem to have experienced a reduction in hours (11% transit from full-time to part-time) or a change in occupation (23%). Both events are strongly associated with a change in the employer (see Table (A6)).

3.3 Low-earning and high-earning workers as production inputs

A key premise of this paper is that mini-jobbers and regular workers differ along several dimensions that are crucial for determining their productivity and that make them imperfect substitutes. The observed differences in the traits of mini-jobbers and regular workers, in particular in characteristics linked to productivity (such as hours and education), suggest that they can be considered as different inputs that firms combine for the production of good and services. This section provides further evidence in this direction. In line with the formal definition of mini-jobbers, which depends exclusively on earnings, I refer to mini-jobbers more broadly as low-earning workers, and high-earning workers are those in regular employment.

The type of jobs typically carried out by mini-jobbers have a large variability in terms of skills requirements (e.g., around one half of household cleaners, craftsmen, artists and sportsmen, auxiliary office workers, and teaching and research assistants at Universities are mini-jobbers). Certain workers (e.g., cooks, assistants, salespersons, drivers, workers in stores and transportation, office specialists and household workers) display frequent transitions between mini-jobs and regular employment, suggesting these employment types are close to substitutes for some occupations. It seems thus plausible that positions with low or medium skill requirements can be carried out by either full-time (high-earning) or part-time (low-earning) workers. This type of substitutability has also been at the core of the public debate about the consequences of the Mini-Job Reform in Germany.[24] This type of substitutability is similar in flavor to the one associated with the raise of female labor force participation. Goldin and Katz 2016 discusses how pharmacists' jobs have allowed for substitutability between part-time and full-time workers led by technological change: improvements in the information flows within the organization, and through new remuneration schemes that make pay more output dependent, and thus less directly dependent on the hours worked. Another argument in favor of substitutability of low-earning workers and high-earning workers is that similar workers in similar firms can have very different levels of earnings depending on the hierarchy level, or the degree of control over their own job, as documented by Bayer and Kuhn (2016).

At the same time, this type of substitutability has a limit. For example, technological constraints may limit the possibility of splitting occupations in shifts, or certain occupations may require particular skill levels. The variability in the proportion of workers with different educational backgrounds and part-time / full-time splits across industries suggests that this is indeed the case (Table (A7) in the

---

[24]For example, it is possible to find references in news articles arguing that "regular full-time jobs are being split up into mini-jobs" and that "there is little to stop employers paying mini-jobbers low hourly wages given they know the government will top them up and there is no legal minimum wage" ("The dark side of Germany's job miracle", Reuters, 2012). The article also quotes a worker saying "a lot of my friends work as carpenters, but companies describe them as janitors in their contracts to avoid paying the salary negotiated in the collective wage agreement".

Appendix). Full-time workers with medium and high education are more strongly represented in the manufacturing sector. This contrasts to the service sector, where low-educated part-time workers are more strongly represented. Such differences are also observed for all tasks, but are particularly noticeable for manual routine tasks.

Furthermore, table (A8) in the Appendix shows that there is an important amount of variability in the use (intensity or cost-ratio) of low-earning and high-earning workers within the same (narrowly defined) industry, fact that has been shown to be related to the degree of substitutability between inputs (Raval (2011)). For the median industry (classification 224 categories), the establishment at the 75th percentile of firms has 0.25 more low-earning workers per high-earning worker (0.08 in full-time equivalent terms) than the establishment at the 25th percentile. At the extreme, i.e., in the industry for which establishments intensities are more dispersed, the establishment at the 75th percentile has 10 low-earning workers more per higher-earning worker than the establishment at the 25th percentile. The substantial variability in the cost ratio within industries as well suggests that the production function features non-neutral productivity, motivating the specification of the production function in the next section.

Overall, the existing evidence supports the premise that mini-jobbers are imperfect substitutes of regular workers. As shown in the next section, the degree of substitutability is important for understanding the labor demand response to in-work benefits.

4 A Stylized Model of the Labor Market

Motivated by the evidence discussed earlier, I start from the premise that the Mini-Job Reform stimulates labor supply in the low-earning sector. The theoretical framework then explains how the reform affects labor demand. To do so, I present a simple model of the firms' profit maximization problem, in which I derive the changes in equilibrium wages and demand for low-earning and high-earning workers. To motivate my empirical strategy, I focus on the relationship between the firm response and the pre-reform intensity in different types of labor. A more thorough theoretical analysis that shows that the intuition provided in this section also holds in general equilibrium is presented at the end of this paper.

4.1 Framework

There are two types of jobs, indexed by $j \in \{1,2\}$, that are characterized by different before-tax hourly wages w_1 and w_2, and different tax rates, $\tau_1 < \tau_2$. Type-1 jobs comprise workers with gross earnings below a threshold K, that qualify for a lower tax rate. I delay the discussion of the individual labor supply decision to the final section of the paper. At this point, it suffices to say that individuals in type-1 jobs can be understood as low-educated part-time workers who in equilibrium have low-earnings, and individuals in type-2 jobs, as highly-educated or full-time workers whose earnings are higher. This distinction is motivated by the descriptive evidence provided earlier. The aggregate labor supply (in hours) in type-1 jobs is N_1^s, and in type-2 jobs, N_2^S.

There are two firms, indexed by $k \in \{H,L\}$, which produce an homogeneous output Y sold for consumption at price p. H and L stem for "high-intensity" and "low-intensity" in low-earning workers respectively. Firms combine the hours in the different jobs according to a common elasticity of substitution σ, and are heterogenous in terms of θ, the distribution parameter of factor returns,

such that $\theta_H > \theta_L$.[25] The production function has a CES specification:

$$Y = F_k(N_{1k}, N_{2k}) = A[\theta_k N_{1k}^{\frac{\sigma-1}{\sigma}} + (1-\theta_k)N_{2k}^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \qquad (1)$$

where A is the total factor productivity, and N_{jk} is the amount of labor (hours) in type-j jobs in firm k.[26]

Firms solve the static problem of profit maximization: $\max_{Y,N_{1k},N_{2k}} pY - w_1 N_{1k} - w_2 N_{2k}$, which yields the standard first order condition:

$$\frac{w_1}{w_2} = \frac{\theta_k}{1-\theta_k}\left(\frac{N_{1k}}{N_{2k}}\right)^{-\frac{1}{\sigma}} \qquad (2)$$

From equation (2), the intensity in low-earning jobs with respect to high-earning jobs is higher in firm H, $N_{1H}/N_{2H} > N_{1L}/N_{2L}$. The aggregate labor demand for hours in each type of job is simply given by: $N_1^D = N_{1H} + N_{1L}$ and $N_2^D = N_{2H} + N_{2L}$.

4.2 Expansion of in-work benefits and equilibrium wages

The expansion of tax-benefits for workers in low-earning jobs induces an increase in the labor supply in this segment, N_1^S, relative to the high-earning segment, N_2^S. Overall, the ratio N_1^S/N_2^S increases. As in equilibrium labor demand and supply for each job are equal, an increase in N_1^S/N_2^S is only possible if N_1^D/N_2^D also increases. If labor in the low-earning segment is not perfect substitute of labor in the high-earning sector ($\sigma \nrightarrow \infty$), the simultaneous movements in labor supply and labor demand of both jobs occurs along with a decrease in w_1/w_2 decreases (for derivations, see section (D.2.3) in the Appendix).

4.3 Scale and substitution effects

The fall in the relative before-tax wages, w_1/w_2, in equilibrium leads to the demand for labor to respond differently across firms that are heterogeneous for different types of labor.[27] I assume competitive markets and free entry. Using the Hicks-Marshall rules of derived demand (derivations are in section (D.2.4) in the Appendix), and assuming, for expositional purposes, that w_1 falls and w_2 remains constant, the following expression shows the marginal changes in demand for each type of job:

$$\frac{d\ln N_{1k}}{d\ln w_1} = -[s_{1k}\eta + (1-s_{1k})\sigma]$$
$$\frac{d\ln N_{2k}}{d\ln w_1} = -[s_{1k}\eta - s_{1k}\sigma] \qquad (3)$$

where η is the absolute value of the price-demand elasticity for each good.[28] $s_{1k} \equiv w_1 N_{1k}/pY_k$ denotes the cost-share of type-1 jobs in firm k.

The common term of both equations in (3), $s_{1k}\eta$, captures the scale effect. The lower w_1 represents lower labor costs for firms. As free entry drives profits to zero, firms expand production and increase labor demand for type-1 and type-2 jobs. On the other hand, the substitution effect, reflected in the remaining term in both equations, induces an increase in labor demand for type-1 jobs, but a

---

[25]The assumption that different types of jobs, such as part-time vs. full-time, or skilled vs. unskilled, have different productivities is standard in the literature (see, e.g., Kunn-Nelen, de Grip, and Fourage 2013). The difference in factor returns across firms can be motivated by differences in technology, which are obviously present for firms of different industries (e.g., manufacturing vs. services).

[26]The CES specification nests other common cases as Cobb-Douglas ($\sigma = 1$), perfect complements ($\sigma = 0$) or perfect substitutes ($\sigma \to \infty$). The intuition of this modelling choice is similar to the literature of technological change and wage premium of skilled and unskilled workers (for eg. Acemoglu and Autor 2011).

[27]This section is based on the ideas in Hamermesh (1986).

[28]I delay the modelling of the demand for the output to the final section, for now, I consider it is fixed, constant across firms, and that $\eta > \sigma$.

reduction in labor demand for type-2 jobs.

The crucial insight from this expression is that the variation in the demand for labor in type-1 and type-2 jobs is heterogenous and varies with the share of type-1 jobs in total labor costs, s_{1k}. In Appendix (section D.2.5), I show that $s_H > s_L$. Thus, the scale effect is stronger in firm H and the substitution effect dominates in firm L. Overall, if $0 < \sigma < \eta$, the demand for type-1 jobs increases in both firms (mainly driven by the scale effect in firm H, and mainly driven by the substitution effect in firm L), but it remains ambiguous in which firm the effect stronger. In contrast, the increase in the demand for type-2 jobs is unambiguously larger in firm H than in firm L.

To test these predictions empirically, I use a measure of intensity in low-earning workers at the firm-level capturing the proportion of low-earning workers out of total employment, as a proxy for the cost-share of low-earning workers. I show in the Appendix, section (D.2.5), that there is a positive relationship between two variables.

5   Empirical Strategy

The theoretical framework predicts that the labor demand response of firms varies with their pre-reform intensity in low-earning workers. To test this hypothesis, I use a differences-in-differences approach (DiD hereafter), similar to other studies that have investigated the employment effects of minimum wage changes (Harasztosi and Lindner 2017, Machin, Manning, and Rahman 2003).[29] My results are based on the longitudinal section 2000-2007 of the LIAB. The main specification relates establishment-level outcomes to pre-reform intensity in low-earning workers as follows:

$$y_{jt} = \alpha_j + \lambda_t + \beta_t IntLE_j + \varepsilon_{jt} \tag{4}$$

where y_{jt} stands for the outcome of establishment j in period t (mainly employment, but also wages and workers' flows among others), α_j are establishment fixed effects to capture time-invariant heterogeneity across firms such as in productivity, λ_t are year fixed effects to absorb common macroeconomic shocks. $IntLE_j$ measures the fraction of workers that were below the mini-job threshold according to its new definition in 2003 at the establishment j in 2002, the year before the reform.[30] Standard errors are clustered at the establishment level to account for auto-correlation. The following discussions focus on the results based on the specification (4). I provide later a series of robustness checks that show that the results do not change with less parsimonious specifications.

The coefficient of interest, β_t, is computed for each year (as in Autor 2003). It captures differences in the outcome paths between high-intensity (with respect to low-earning workers) establishments and low-intensity establishments, relative to the year before the reform (the baseline year is 2002). β_t measures the effect of the Mini-Job Reform as the difference in the labor demand by firms with different pre-reform intensities, after controlling for heterogeneity at the establishment level and common macroeconomic shocks. The main identification assumption is that, in the absence of the

---

[29]Similar strategy for analyzing firm profitability and productivity has been applied in Draca, Machin, and Van Reenen 2011 and Mayneris, Poncet, and Zhang 2017.

[30]The threshold effectively used is €400 net-of-SSC earnings, which amounts to €506.33 of gross earnings under pre-reform regulations ($400 = 506.33(1 - 0.21)$, where 21% is the pre-reform SSC rate). The regressions do not include establishment level controls as the fixed effects absorb time-invariant characteristics. Since $IntLE_j$ is not observable for establishments born after 2002, I also exclude establishments born in 2000-2002. Establishment death is very low during the observation window. Still, I perform the analysis on the subgroup of surviving establishments until 2007 as a robustness check. I include the 1999 observation for the establishments in the panel for which it is available (68%) to add one year for pre-trend tests, but the results are virtually the same when excluding this year.

reform, the evolution of outcomes would follow parallel trends across establishments with different pre-reform intensities. Although it can not be tested directly, I show that this parallel trend assumption is not violated for the pre-reform years: during this period, the estimates of β_t are small and insignificant.

It is worth pointing out that in this specification, there are, strictly speaking, no treatment and control groups, and hence the assumption that some production units are not affected by the reform needs to be dispensed (the stable unit treatment value assumption does not hold). Establishments with a high pre-reform proportion of low-earning workers are more exposed to labor costs savings and will experience a stronger scale effect, whereas establishments with a low pre-reform intensity in low-earning workers are more affected by the substitution effect. Hence, the post-reform differences in outcome trends as measured by β_t are informative about the relative response of the pre-reform intensity in low-earning workers. As such, β_t captures the "excess" scale effect in high-intensity establishments net of the "excess" substitution effect in low-intensity establishments.

Tables (3) and (4) show summary statistics of the panel of establishments for 2002.[31] There are 3,770 establishments in the sample, matched to 621,900 workers. 2,746 establishments have a share of low-earning workers below the (weighted) median of 21%, and 1,024 above. On average, 4.6% of the workers in low-intensity establishments are low-earning workers as defined by the post-reform mini-job threshold (14.5% under the midi-job threshold), while in high-intensity establishments, 53.8% of workers are below the mini-job threshold (60.7% under the midi-job threshold). Establishments with different pre-reform intensities in low-earning workers differ along several dimensions. In particular, high-intensity establishments are smaller, younger, more intensive in part-time and low-educated workers, and have higher churning. High-intensity establishments also pay lower average daily wages, but the gap is smaller among similar type of workers. High-intensity establishments have a higher representation in retail, repair and services, and use more interactive non-routine and cognitive routine tasks than low-intensity establishments. Low-intensity establishments have a higher representation in manufacturing, construction, primary activities and financial intermediation, and and rely more on analytical non-routine and manual routine tasks. Table (A10) in the Appendix shows descriptive statistics with a finer disaggregation in terms of intensity in low-earning workers (by quintiles). This disaggregation shows that there is still a high variability of establishment characteristics within firms of similar pre-reform intensities in low-earning workers. E.g., low-intensity establishments (quintiles 1 and 2) include both small and big establishments. More generally, there is only a weak relationship between the intensity in low-earning workers and other establishment characteristics. Even though the proportion of high-intensity establishments is larger in certain industries (it reaches almost two thirds in services, retail and repair, compared to one third in agriculture and construction), there is a significant presence of high-intensity-establishments in all industries (Figure (3)).[32]

---

[31] The analysis uses the longitudinal sampling weights constructed by the IAB for the longitudinal section 2000-2007 to account for the disproportionately stratified sampling. Table (A9) in the Appendix shows summary statistics for 2002 for both the cross-section and longitudinal section. Characteristics of the cross-section and the panel units are similar. A comparison of characteristics using weights and not using weights is illustrative of the sampling (specifically, the over-sampling of big establishments).

[32] This observation also holds with a finer definition of industries (224 categories). For example, while processing and preserving of most food products is done by mostly establishments with low-intensity in low-earning workers (less than 5% low-earning workers), high-intensity establishments are present in meat processing (more than 75% of workers with low-earnings). Coexistence of establishment with very disperse intensity is also noteworthy in manufacturing of plastic, glass and ceramic. The same happens for services, as for example retail stores, tourism and travel agencies. This indicates that on top of technological differences at the industry level, firms have particular features in their own production function that affects the composition of of low-earning and high-earning workers.

Table 3: Characteristics of establishments by proportion of low-earning workers (below/above median), 2002

|	Below median	Above median
Proportion of workers below 2003 MJ threshold	4.6%	53.8%
	(0.0685)	(0.251)
Proportion of workers below 2003 MidiJ threshold	14.5%	60.7%
	(0.234)	(0.251)
Establishment age	15.6	12.9
	(9.088)	(8.328)
Establishment size (n. of workers)	28.4	8.5
	(132.2)	(28.88)
Employment, full-time equivalent	25.2	5.8
	(120.7)	(20.59)
Proportion of part-time workers	16.5%	47.7%
	(0.251)	(0.318)
Proportion of low-educated workers	10.8%	12.2%
	(0.201)	(0.206)
Proportion of medium-educated workers	64.6%	51.4%
	(0.350)	(0.349)
Proportion of highly-educated workers	6.2%	2.4%
	(0.171)	(0.0904)
Vacancies/employment	2.5%	1.1%
	(0.0884)	(0.0494)
Median daily gross wage	61.4	28.5
	(24.88)	(21.36)
Median daily gross wage (growth)	12.2%	10.0%
	(0.959)	(0.643)
Median daily gross wage of full-time	68.6	53.3
	(26.10)	(26.60)
Median daily gross wage of full-time (growth)	2.9%	3.7%
	(0.165)	(0.285)
Median daily gross wage of part-time	32.7	11.8
	(22.94)	(9.733)
Median daily gross wage part-time (growth)	18.5%	9.3%
	(0.716)	(1.009)
Median daily gross wage of low-earning workers	9.3	9.1
	(3.600)	(3.043)
Median daily gross wage of low-earning workers (growth)	9.5%	7.1%
	(1.460)	(0.900)
Median daily gross wage of high-earning workers	62.9	53.9
	(24.98)	(22.06)
Median daily gross wage of high-earning workers (growth)	2.0%	4.6%
	(0.172)	(0.229)
Average monthly labor cost	1,720	1,071
	(1,044.6)	(749.4)
Monthly wage bill	75,929	10,725
	(471,472.9)	(45,367.3)
Inequality (P75/P25) full-time workers	1.41	1.93
	(0.512)	(20.17)
Observations	2,746	1,024

Note: Panel 2000-2007. Establishments classified according to whether they are below or above the (weighted) median of the proportion of low-earning workers (20%). Standard errors in parenthesis.

Table 4: Characteristics of establishments by proportion of low-earning workers (below/above median), 2002 (continuation)

	Below median	Above median
Hirings/employment	0.16	0.22
	(0.206)	(0.244)
Separations/employment	0.25	0.27
	(0.481)	(0.564)
Investment (million)	0.200	0.036
	(2.159)	(0.256)
Sales (million)	5.328	0.667
	(60.039)	(1.777)
Exports/revenues	5.2%	3.0%
	(21.94)	(19.01)
Work council	16.5%	3.4%
	(0.372)	(0.180)
Collective agreement	49.6%	39.5%
	(0.500)	(0.489)
Agriculture, primary	5.5%	2.5%
	(0.228)	(0.158)
Manufacturing	15.5%	10.3%
	(0.362)	(0.305)
Construction	15.4%	5.5%
	(0.361)	(0.229)
Retail, repair	18.7%	24.4%
	(0.390)	(0.430)
Transport, communication	5.6%	4.0%
	(0.230)	(0.196)
Financial intermediation	3.0%	1.7%
	(0.170)	(0.130)
Services for businesses	11.7%	19.7%
	(0.321)	(0.398)
Other services	19.3%	27.1%
	(0.395)	(0.445)
Public administration	5.4%	4.7%
	(0.226)	(0.211)
Workers in analytical non-routine tasks	14.6%	7.6%
	(0.268)	(0.181)
Workers in interactive non-routine tasks	9.9%	12.8%
	(0.240)	(0.272)
Workers in cognitive routine tasks	32.7%	39.2%
	(0.361)	(0.371)
Workers in manual routine tasks	11.4%	6.1%
	(0.262)	(0.184)
Workers in manual non-routine tasks	29.4%	30.8%
	(0.374)	(0.354)
Observations	2,746	1,024

Note: Panel 2000-2007. Establishments classified according to whether they are below or above the (weighted) median of the proportion of low-earning workers (20%). Standard errors in parenthesis.

Figure 3: Proportion of establishments by intensity in low-earning workers (above/below median) by industries, 2002
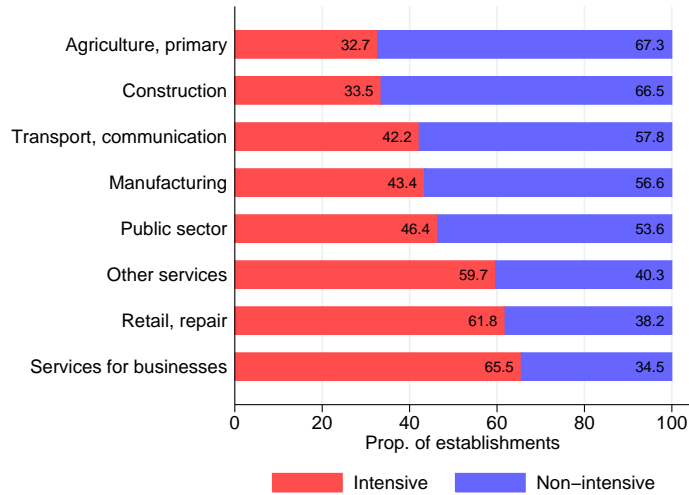
Note: Panel 2000-2007. Intensive and non-intensive establishments refer to whether they are above or below the (weighted) median of proportion of low-earning workers.

Importantly though, the differences in characteristics of firms with different intensities in low-earning workers do not invalidate the DiD identification strategy. This strategy is motivated in the theoretical framework presented before, and relies on the parallel trends assumption, which, despite the observed heterogeneity, is verified for during the years that preceded the reform. The DiD strategy allows to overcome confounding effects from macroeconomic shocks, which is particularly relevant as Germany found itself in a strong economic slump around the years of the reform.

For the empirical strategy to be successful, the variation in the pre-reform intensity in low-earning employment has to be sufficiently large. Figure (4) shows that while close to 35% of the establishments have a very low proportion of low-earning workers in 2002 (0-5%), the remaining 65% are distributed across a wide range of intensities. Half of the establishments have more than 20% of their workforce in the low-earning sector, 15% of the establishments have between 20% and 30% of their workers below the mini-job threshold, while 28% have more than half of their employees below the mini-job threshold. The next section presents the estimation results.

6 Results

In this section, I present the estimates of the coefficient β_t in equation (4) for a variety of firm level outcomes. Even though the independent variable $IntLE_j$ is continuous (between 0 and 1), I refer to the results as difference between "high-intensity" (in low-earning workers) establishments and "low-intensity" establishments.[33] The results are presented in graphical format in Figures (5) to (13); Table (A12) shows estimates in a compressed format.

---

[33]In the section on robustness checks, I show that changing the continuous variable $IntLE_j$ for a binary variable which takes the value 1 for establishments with a pre-reform intensity in low-earning workers above the median, and 0 for establishments with below median intensity, does not change the results.

Figure 4: Distribution of establishments according to the proportion of low-earning workers, 2002
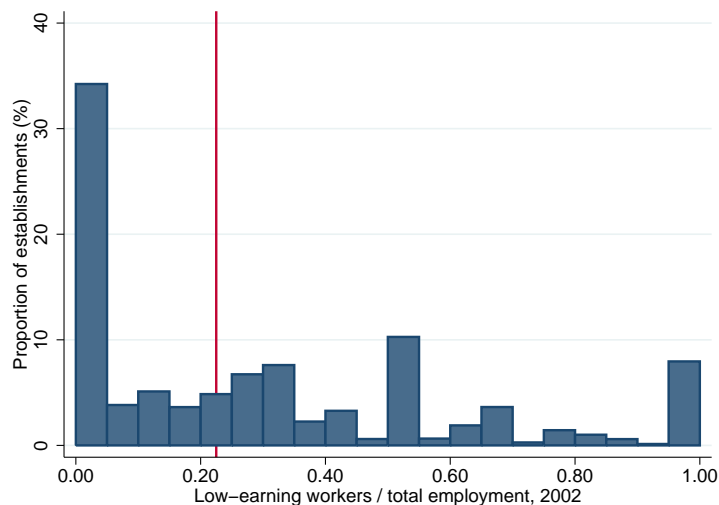
Note: Panel 2000-2007.

6.1 Effects on employment

The estimates of β_t from equation (4) for the outcome of total employment are shown in Figure (5). The left panel shows the differential paths in the total number of workers across firms with different pre-reform intensities in low-earning workers.[34] High-intensity establishments, which exhibited similar changes as low-intensity establishments in the number of workers before 2003, show a noticeable expansion (relative to low-intensity establishments) after the reform. The estimated coefficients are statistically significant for 2005 and 2006 and borderline significant for 2004. Economically, the magnitude of the estimated coefficients implies an increase of 4% with respect to the average establishment size in the pre-reform year, and 8% with respect to the size of establishments with above-median intensity in low-earning workers, two years after the reform.

Employment as measured in full-time equivalent terms (a proxy for hours worked) also increases in high-intensity establishments, relative to low-intensity establishments, as shown by the right panel of Figure (5). The difference is statistically significant for all years following the reform. It represents 2 full-time equivalent workers more in high-intensity establishments, as compared to low-intensity establishments, which amounts to 7% of the initial full-time equivalent employment in the sample, and 22% of the initial full-time equivalent employment in high-intensity establishments, two years after the reform.

---

[34]Within establishment regressions imply that results correspond to the difference in the number of workers in each period with respect to the base-line year (2002). Here, I focus on the effect of the Mini-Job Reform on the change in the employment level. In this case, the parallel trend assumption requires that the employment level was changing in similar magnitudes for establishment with different pre-reform intensities in low-earning workers. Empirically, I find that the parallel trend assumption holds for the level of employment, but not its growth rate. This finding has an intuitive interpretation. Specifically, it implies that the elasticity of total employment with respect to the wage of low-earning workers (targeted by the reform) is not constant along the labor demand curve. This is indeed reasonable in a setting in which the labor cost shock induced by the reform impacts high-intensity firms more strongly, since these firms are, on average, smaller than low-intensity firms. Instead, a constant elasticity would imply that the impact of the labor cost shock increases with firm size, which seems implausible. My specification with respect to employment is hence assuming an additive treatment effect, as opposed to a multiplicative treatment effect (see Fisher and Ciani 2014). Below, I provide additional evidence, based on considering low-earning and high-earning workers separately. Here, the (pre-reform) parallel trends assumption holds for growth rates, indicating a constant elasticity within each type of labor. The theoretical framework is also consistent with these results.

Figure 5: Effect on total employment

Note: Confidence intervals correspond to 95% level.

Figure (B9) in the Appendix also shows the trend in total employment at the establishment level, comparing high-intensity and low-intensity establishments. Whereas the number of workers in total and in full-time equivalent employment is declining for low-intensity establishments, it is slightly increasing for high-intensity establishments in the post-reform years.[35]

Looking at the employment of low-earning and high-earning workers separately, Figure (6) shows the estimates of β_t for the growth rate of these workers. Here, the estimation excludes firms with only one type of worker (i.e., firms that are in the 1st and 5th quintile of the intensity distribution). High-intensity establishments exhibit a relatively higher growth rate of higher-earning workers after the reform (statistically significant for 2003, with point estimates of 44 pp.) and a relatively lower growth of low-earning workers (significant in 2003 and 2005, with point estimates of -78 pp. and -61 pp., respectively). Figure (B10) in the Appendix shows the evolution of both types of employment across establishment with different pre-reform intensities. In high-intensity establishments, the time trend in low-earning employment seems to change with the reform (i.e., a noticeable upward trend turns into a downward trend) while the reverse occurs in low-intensity establishments.

Overall, the estimates suggest that the effect of the reform is a relative expansion in terms of total employment of high-intensity establishments as compared to low-intensity establishments.[36] The growth in the number of low-earning workers slows down in high-intensity establishments and speeds up in low-intensity establishments. The number of high-earning workers, on the contrary,

---

[35]Average employment in the sample is declining, as it is to be expected due to the cohort nature of the sample. It is a well known fact that the main contributors to employment growth are new entrants, which cannot be included in the analysis by construction since I study outcomes in firms according to their pre-reform intensity.

[36]The fact that the gap closes since 2006 is not surprising, given the reversal in the tax benefits implied by the increase in the SSC rate for the employer to 30% for mini-jobs, and the decrease of the SSC rate for both employer and employee to 19.5% for regular jobs. Furthermore, reversal in the incentives even under the same level of tax benefits would be expected as low-intensity firms become relatively more intensive in low-earning workers.

Figure 6: Effect on the growth rate of low-earning and high-earning workers
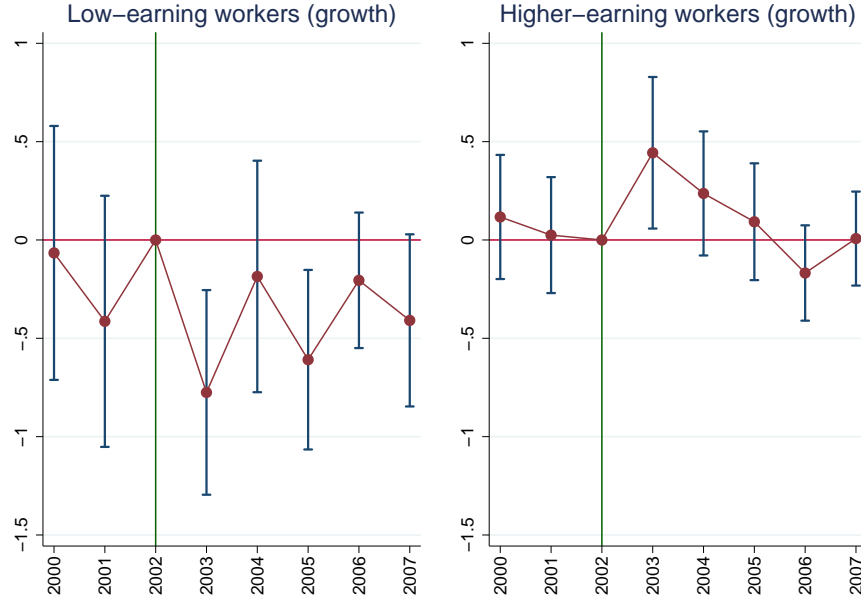
is growing faster in high-intensity establishments than in low-intensity ones. Going back to the discussion of the mechanism, these results are actually expected (see expression (3)), and they are consistent with imperfect substitution between the types of jobs performed by low-earning and high-earning workers. The scale effect has a stronger bite on high-intensity establishments, for whom labor costs are reduced by virtue of the reform. The substitution effect instead, due to the change in the relative cost of low-earning workers, affects more those low-intensity establishments.

Unfortunately, the empirical strategy does not allow to tier apart scale and substitution effects, because the coefficients of the DiD measure a excess of scale effect in high-intensity establishments, net of the substitution effect in establishment with low-intensity. A crucial question is whether the empirical results are compatible with only one of these effects in place. Let us start by discussing the case with only substitution effect, i.e. $\sigma > \eta$ in terms of the model presented earlier. Expression (3) suggests that the growth rate of low-earning employment (N_1) should be higher in low-intensity establishments than in high-intensity ones, which is consistent with the results. However, there would be a decrease in high-earning workers (N_2), stronger in high-intensity establishments, which implies a negative coefficient in the DiD estimation for this type of employment as outcome, which is rejected by the results.

The case with only scale effect is also counterfactual ($\sigma = 0$). Employment in both types of workers should increase more in high-intensity establishments, which should be reflected in a positive coefficient in the DiD estimates for the growth of both low-earning and high-earning workers. Hence, the negative coefficient for low-earning workers contradicts the possibility of only scale effect in place. Table (A11) in the Appendix provides more intuition regarding this discussion.

Figure 7: Effect on employment by part-time and full-time status
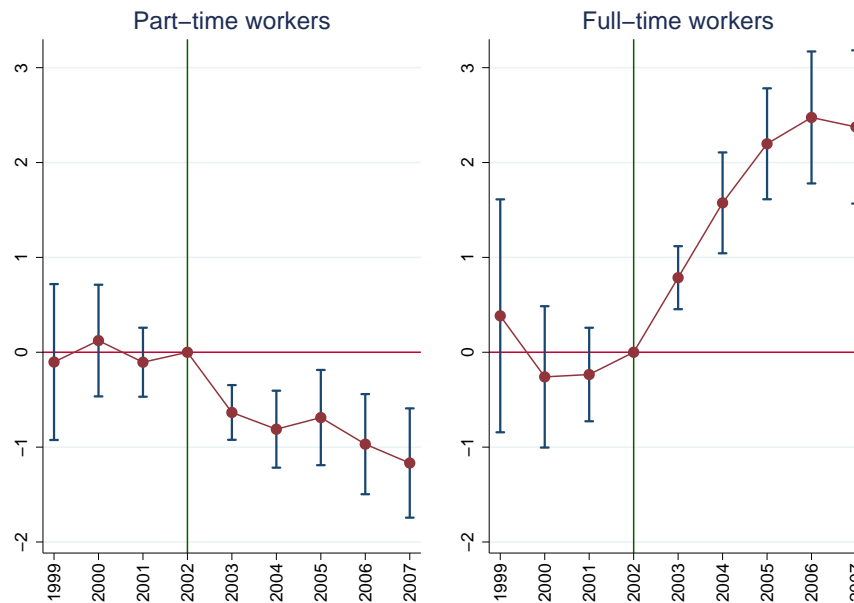
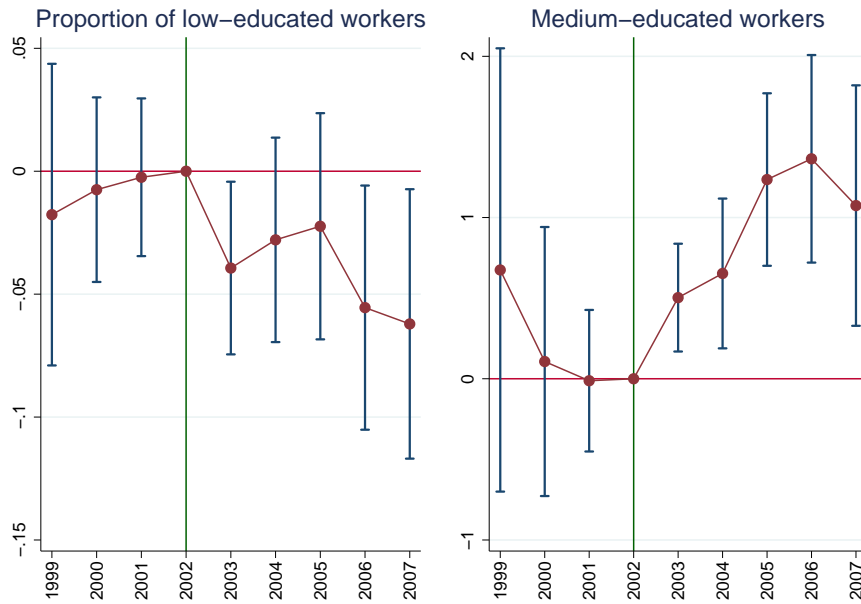Note: Confidence intervals correspond to 95% level.

6.2 Effects on hours and wages

The relative expansion of high-intensity establishments in terms of high-earning employment may be driven by either a relative increase in wages ("productivity channel", or change in the education of the workforce) or by an increase in the number of hours per workers ("hours channel", or change in full-time vs. part-time mix). Here I discuss that the evidence is suggestive of both channels in place. Figure (7) shows that after the reform the number of full-time workers increases in detriment of the number of part-time workers in high-intensity establishments with respect to low-intensity establishments. The coefficients in 2004 represent 0.8 fewer workers in part-time jobs in high-intesity establishments than in low-intensity establishments, and 1.6 more workers in full-time in high-intensity establishments than in low-intensity establishments (20% and 35% respectively with respect to the baseline number of workers of each type). Figure (B11) in the Appendix shows a pick-up in the trend in part-time employment after the reform, leaded by establishments with low-intensity in low-earning workers. On the other hand, high-intensity establishments seem to reduce the speed of the downward trend in full-time employment.

Figure (8) shows that high-intensity establishments increase relatively the number of medium-educated workers (with "Abitur" and/or vocational training), with a difference of 0.6 worker more as compared to low-intensity establishments (3% with respect to the baseline). High-intensity establishments also experience a relative reduction in the proportion of low-educated workers (without "Abitur") of 3 pp., which represents one fourth of the baseline proportion in 2002 (see Figure (B12) in the Appendix for the trends).

Further support regarding the change in the workforce skill level, investment in physical capital (more complementary with skilled labor) increases more in high-intensity establishments than in low-intensity establishments after the reform, as shown in Figure (9). The DiD coefficient for 2004 (significantly different from 0) is €32 thousand, close to the initial value of investment in high-

Figure 8: Effect on employment by education level

Note: Confidence intervals correspond to 95% level.

intensity establishments, and almost one third of the average amount in the sample (trends are in Figure (B13) in the Appendix).

The increase in both hours worked and wages is further supported by a higher growth rate of median daily wages in high-intensity establishments than in low-intensity establishments (10). The after-reform upward trend holds when splitting between part-time and full-time workers, though estimates are not statistically significant (see Figure (B14), and Figures (B15) and (B16) for trends, in the Appendix).

6.3 Effects on workers' flows and promotions

For high-intensity establishments to expand in high-earning workers relative to non-intensive establishment, they either hire more high-earning workers (net of separations) or upgrade earnings of incumbent workers.[37] Vacancy openings increase more in high-intensity establishments than in low-intensity establishments after the reform (Figures (B17) and (B18) in the Appendix). Differences in hiring are significant for workers with earnings above the mini-job threshold, as shown in Figure (12). Figures (B19) and (B20) in the Appendix further show that low-intensity establishments increase hiring of workers below the €400 threshold, whereas separations of these workers seem larger in high-intensity establishments. Separations of workers above the midi-job threshold appear to decrease in low-intensity establishments as compared to high-intensity establishments, although there is also less hiring of these workers.

The raise in full-time workers in high-intensity establishments seems supported by the fact that these firms are hiring these workers at lower wages than low-intensity firms, as shown in Figure

---

[37]The results of the DiD estimates in this section become highly imprecise, because workers' flows are particularly small. I hence show in the text those for which coefficients are significant, and I discuss more descriptive evidence observing the raw trends for the rest.

Figure 9: Effect on investment in physical capital

Investment (euros/year)*
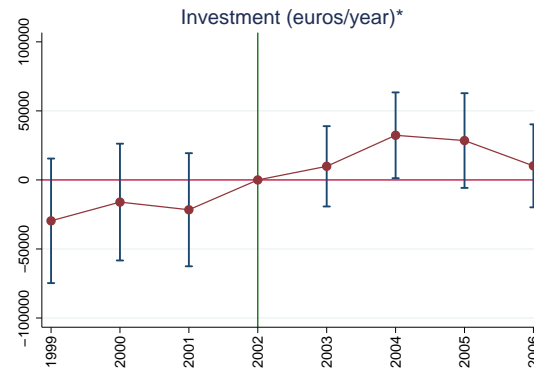
Note: Using as regressor a binary variable: 1 for above median and 0 for below median intensity in low-earning workers. Confidence intervals correspond to 95% level.

Figure 10: Effect on median daily wages

Median gross daily wage (growth)

Note: Confidence intervals correspond to 95% level.

Figure 11: Effect on hirings of workers by gross monthly earnings
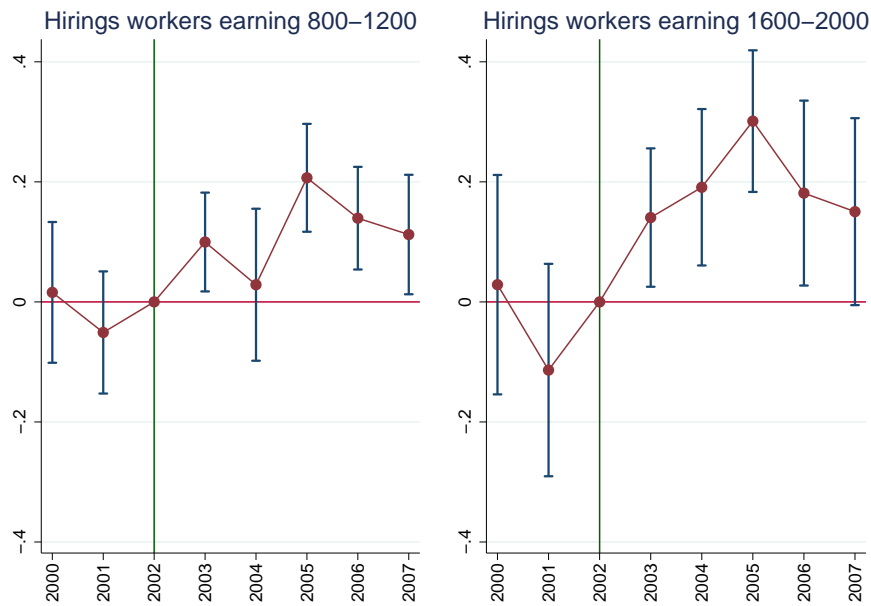
Note: Confidence intervals correspond to 95% level.

(**??**). Similarly, inflows of part-time workers in low-intensity units is accompanied by lower relative wages offered to them by these establishments, as compared to high-intensity establishments.

Incumbent workers seem to be taking part in the process of change in the workers' structure as well. From Figure (13), a smaller proportion of workers suffer reduction in gross earnings in high-intensity establishments than in low-intensity establishments. Wage upgrades also seem more frequent in high-intensive establishments than in low-intensity establishments ((B21) in the Appendix).

6.4 Effects on task composition of the workforce

Figure (B23) in the Appendix shows the evolution of the task composition. Some trends appear to change after the reform, e.g., high-intensity establishments increase relatively the proportion of workers carrying out analytical and manual non-routine tasks, and low-intensity establishments take up in terms of interactive non-routine and cognitive routine tasks. No apparent differences in the number of job titles (344 categories) can be seen across establishment intensity in low-earning workers after the reform. However, the downward trend in the number of occupations within establishments for the years before the reform seems reverted afterwards in all types of firms. This is suggestive of both highly intensive and non-intensive establishments changing their occupational structure to accommodate the changes in the earnings mix of the workforce induced by the reform.

6.5 Heterogeneous effects

In this section I investigate whether the effects on total employment, part-time and full-time employment, and workforce by education level, are heterogeneous by industry, establishment age, size, and status with respect to collective agreements.[38] The econometric specification is a modification of

---

[38]This results, except for those regarding industries and size of the establishment, need to be taken with caution, as the stratification of the sample does not consider all these dimensions.

Figure 12: Effect on wages of hirings of part-time and full-time workers
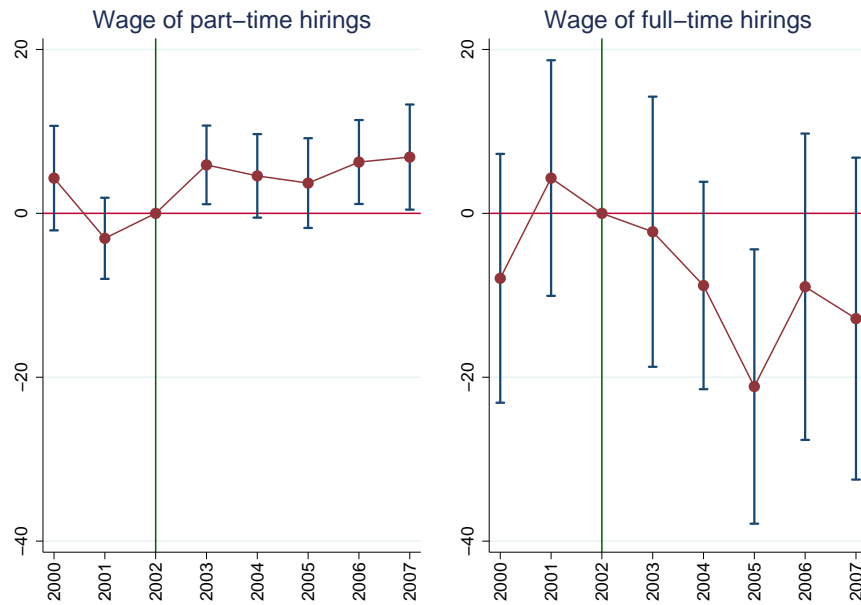
Note: Confidence intervals correspond to 95% level.

Figure 13: Effect on wage changes for workers within establishments
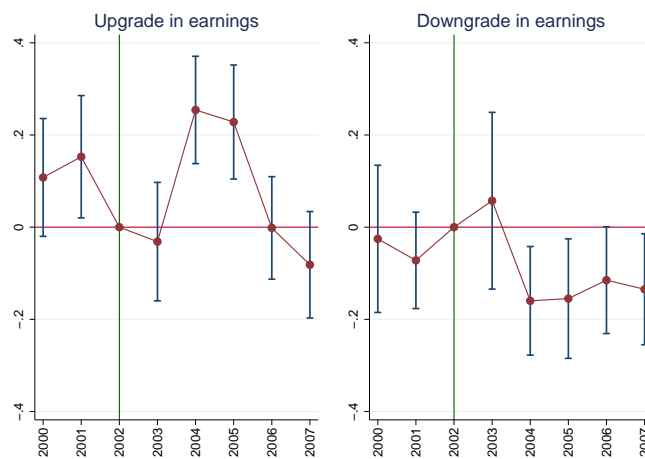
Note: Confidence intervals correspond to 95% level.

equation (4), as follows:

$$y_{jt} = \alpha_j + \phi Post_t + \sum_m \beta_m IntLE_j \times Post_t \times Heter_{mj} + \sum_m \gamma_m Heter_{mj} + \sum_p \lambda_p t^p Ind_j + \varepsilon_{jt} \quad (5)$$

where $Post_t$ is a dummy which takes the value 1 after the reform, and 0 otherwise, $Heter_{mj}$ is a set of dummies that take the value 1 for the establishments which belong to the group m, and $\sum \lambda_p t^p * Ind_j$ control for a quadratic polynomial on the industry-level (224 categories) trend. Table (A13) in the Appendix shows the estimates of coefficients β_m (the baseline in each case is specified, and the coefficients on the remaining categories show the differences with respect to the baseline). I base the discussion here on the size of the point estimations. I discuss statistical significance of the differences in each case, as estimates are highly imprecise when performing cuts on the data.

Differences across industries are not statistically significant. The point estimates though suggest that the relative changes in employment (in high-intensity establishments with respect to low-intensity establishments) are stronger within manufacturing than within services.

Employment effects are larger for more mature establishments, statistically different for full-time and part-time employment within establishments above 20 years old. Regarding establishment size, bigger establishments seem to experience the stronger employment effects. Differences are significant for establishments with more than 200 workers in terms of full-time workers, and between 20 and 200 workers with respect to total employment and medium-educated workers.

The relative employment expansion of high-intensity establishments, specially in full-time employment, is significantly higher in establishments under industry or company level collective agreement. As collective agreements impose limits to wage reductions, this observation indicates scale effect may be important in this group of firms.

6.6 Robustness and validity of the empirical results

In this section, I discuss a series of sensitivity checks for robustness of the results. Regarding the definition of the variable of interest $IntLE_j$, the results do not change qualitatively (nor quantitatively, as coefficients estimates and significance are virtually the same) for different specifications of this variable. First, I defined low-earning workers as those earning below the midi-job €800 threshold. Second, I define $IntLE_j$ as a binary variable which takes the value 1 for establishments with an intensity above the median in the sample, and 0 otherwise, instead of the continuous variable $IntLE_j$. This exercise also suggests that outliers are not driving the results. The similarity of the coefficient estimates to those under specification (4) further implies that the pre-reform intensity in low-earning workers has an effect close to linear on the outcomes analyzed. In addition, I only consider prime-age workers (26-59 years old) to exclude younger and older workers who were disproportionately affected by the policy, and again results do not change. Finally, results hold qualitatively if I use the intensity in part-time and low-educated workers at the firm and industry level instead of the intensity in low-earning workers. The invariance of results to these different specifications of the variable $IntLE_j$ reinforces its interpretation as capturing a feature of the production function of firms, which is related the use of occupations and tasks which require short hours or low skill level as implied by low level of earnings. Results of these robustness checks are available upon request.

Although the longitudinal section 2000-2007 is meant to avoid attrition between one wave and the following, and I exclude establishment birth during the whole observation window in the main estimations, some establishments die during the period (7%). I verify that the analysis does not change if I use the subgroup of establishments which survived until 2007 (3,494). The invariance of the results also suggest that the effects of the reform may have been negligible for establishment

death. To maximize the pre-reform period, I use the observation in 1999 when it is available for establishments in the 2000-2007 panel.[39] Even though one-third of them does not have information for 1999, estimates for 2000 on do not change when excluding this year. These results are also omitted and available upon request.

I further estimate a variant of equation (4) controlling for specific trends. I perform several exercises, following the specification:

$$y_{jt} = \alpha_j + \lambda_t + \beta_t IntLE_j + \sum_p \lambda_p t^p \times Indicator_j + \varepsilon_{jt} \tag{6}$$

First, I control for quadratic trends at the industry level, where $Indicator_j$ is a set of binary variables which take the value 1 for the industry (224 categories) to which the establishment corresponds. Second, I do a similar exercise but for different levels of pre-reform intensity in low-earning workers (quintiles). A third exercise controls for a establishment specific linear trend, by taking first differences of (6):

$$\Delta y_{jt} = \Delta \lambda_t + \Delta \beta_t IntLE_j + \varepsilon_{jt} \tag{7}$$

Furthermore, I control for variables that are arguably exogenous to the effect of the reform at the establishment level, by estimating the following specification:

$$y_{jtci} = \alpha_j + \lambda_t + \beta_t IntLE_j + \phi_0 Int_{i(-c)} + \phi_1 Int_{c(-i)} + \varepsilon_{jt} \tag{8}$$

where $Int_{i(-c)}$ is the proportion of low-earning workers in industry i in all commuting zones except where the establishment is, and $Int_{c(-i)}$ is the proportion of low-earning workers in the commuting zone c in all industries except the one in which the establishment operates. This exercise is aimed at controlling for omitted pre-trends in local labor markets and industry level, which can be considered related to labor supply shifts. Tables (A14) to (A22) in the Appendix show the estimates for β_t for all these specifications, as compared to the benchmark from equation (4). The main lesson from these exercises is that estimates remain virtually unaffected after controlling for specific trends in a variety of ways. The specification in first differences to control for firm-specific trends though yield lower point estimates and precision levels, given the variations are year to year and not with respect to the pre-reform year as in the rest of the estimations.

Finally, I address concerns about potential biases in the estimators that would arise if the dependent variables were persistent (Nickell 1981). The specification with lagged dependent variable is:

$$y_{jt} = \alpha_j + \rho y_{jt-1} + \lambda_t + \beta_t IntLE_j + \varepsilon_{jt} \tag{9}$$

Due to the endogeneity introduced by the lagged dependent variable in the fixed effects estimation, I estimate this model using dynamic panel data techniques. The system of equations in levels and in differences is estimated by General Method of Moments (GMM), instrumenting differenced lags and lagged levels of the dependent variable by further lags of this variable. I also use lags of other covariates (average gross wages and investment) to improve efficiency, following the approach by Blundell and Bond (1998), with the Arellano and Bover (1995) transformation to use forward orthogonal deviations (the implementation follows Roodman 2009). Estimates of β_t are shown in Figures (B24) to (B26) in the Appendix. I conclude that results hold qualitatively, as point estimates preserve the signs as reported in the main results in general (except for some particular cases as the total number of workers). However, there is an important loss of precision due to the use of instruments and most estimates are not statistically significant. An important exception is the results regarding the differential evolution of part-time and full-time workers, which remain statistically significant.

---

[39]The Establishment Panel provides a limited number of longitudinal sections, and there is no section starting in 1999, first year for which marginal employment is available in the social security records, comprising the period of the reform.

I further estimate the model both via OLS (ignoring the establishment fixed effects) and introducing the lagged dependent variable in the within estimation directly. According to Angrist and Pischke 2009, these two estimates should provide bounds for the true value of the parameter, as the former is downward biased and the latter upward biased. Point estimates are in Figures (B24) to (B26) in the Appendix.

6.7 Discussion and interpretation

The empirical findings suggest that the Mini-Job Reform had important consequences for employment, no only for workers who were targeted (low-earning) but also for workers who were outside the scope of the policy (high-earning). Actually, establishments intensive in one type of worker seem to lean towards employment in the other type of workers after the reform. Intuitively, this would lead to a convergence, establishments decreasing the gap in terms of intensity and becoming more similar to each other. Some pieces of evidence seem to support this intuition.

Figure (B27) in the Appendix shows that within the panel of establishments used for estimation, there is more mass with medium levels of low-earning workers and less mass with low levels of them. Changes in the earnings distributions of workers across establishment pre-reform intensity in low-earning workers (Figure (B28)) also point in the direction of production units become more similar in their payroll, and establishments in the bottom of the intensity in low-earning employment to respond stronger in terms of bunching at the threshold than more intensive establishments.

Figure (B29) shows that within the panel of establishments 2000-2007, the proportion of those which are highly intensive in low-earning workers decreases after the reform in industries in which they were initially abundant, such as services and retail commerce. At the same time, some originally high-paid activities, such as agriculture or primary, see an augmented portion of high-intensity establishments. This does not hold when looking at the whole universe of establishments (cross-sections of the LIAB), as shown in Figure (B30). Most industry branches seem to be either keeping or increasing the proportion of high-intensity establishments in low-earning workers. This is the case if lower labor costs in certain industries due to the reform not only induce incumbents to to expand, but also encourages entry of new establishments with similar characteristics. The number of establishments in fact increases in industries with initially high intensity in low-earning workers relative to industries initially less intensive, as shown in Figure (B31). Establishments in services and retail commerce account from 60.5% of the total in 2002 and 62.8% in 2007, whereas production units in manufacturing and construction shrink from 22.7% in 2002 to 21.6% in 2007.

Complementing the evidence about convergence at the industry level, the proportion of low-earning workers increases more in local labor markets with initially low presence of these workers. The maps in Figures (in Figures (B32) and (B33) in the Appendix show that whereas the German Northwest had a higher presence of low-earning workers in 2002, the increase is stronger in the Northeast. Table (A23) in the Appendix confirms this result, showing that the correlation between the initial proportion in low-earning workers and its variation at the local labor market level, is negative (-0.33 for 2002-2004, and -0.71 for 2002-2007).

7 Implications

The empirical analysis suggests that the expansion of tax benefits for low-earning workers induces a relative expansion of firms with originally high-intensity of these workers. In particular, high-earning employment increases in detriment of low-earning employment. The empirical strategy does not allow to evaluate total employment effects within each firm class, as it provides relative

statements. To discuss the potential macroeconomic implications of the results, I enrich the theoretical framework used for the discussion about the mechanism. I introduce the labor supply decision, following the literature on labor supply and taxation (for eg. Saez (2010), Chetty, Friedman, Olsen, and Pistaferri (2011), Tazhitdinova (2017)). I further model the product market and the government budget. I compute the general equilibrium of the model and discuss the role of the degree of substitution between different workers.

7.1 Framework

Labor supply: There is a continuum of workers, who are heterogeneous in a parameter α that captures taste for work. α is distributed with a cumulative distribution function $F(\alpha)$ and a density function $f(\alpha)$. Workers choose whether to participate or not in the labor market, and the number of hours worked depending on the take-home wage and their taste for work. Their labor supply decision determines their sorting in two jobs, indexed by $j \in \{1, 2\}$. Jobs differ in the before-tax hourly wage w_1 and w_2, and in the tax rate on gross earnings, $\tau_1 < \tau_2$.[40]

The utility maximization problem of the worker is:

$$\max_{c,n} U(c,n) = c - \alpha^{-\frac{1}{\varepsilon}} \frac{n^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} - \beta I\{n > 0\} \tag{10}$$

s.t.

$$c = \begin{cases} b + tr & \text{if } n = 0 \\ (1 - \tau_2)w_2 n = \hat{w}_2 n + tr & \text{if } n > 0 \\ (1 - \tau_1)w_1 n = \hat{w}_1 n + tr & \text{if } n > 0 \text{ and } w_1 n \leq K \end{cases} \tag{11}$$

where c is consumption, n is hours of work in efficiency units, β is a fixed cost of working, b is the non-labor income in case of non employment (unemployment benefit or social assistance), and tr is a lump-sum transfer from the government. I denote the take-home hourly wage as $\hat{w}_j \equiv w_j(1 - \tau_j)$. The utility function is quasi-linear and hence implies no income effects, and ε is the constant elasticity of labor supply with respect to the wage. This specification is standard in the literature of labor supply and taxation. I extend the model to include the participation decision (see, e.g., Blundell, Bozio, and Laroque (2011)), as it is relevant for the discussion of in-work benefits.

As pointed out by Tazhitdinova (2017), the interesting case for the Mini-Job setting is such that $(1 - \tau_1)w_1 = \hat{w}_1 > \hat{w}_2 = (1 - \tau_2)w_2$. Otherwise, all workers would take up type-2 jobs, which are not subject to the earnings means test K. There exist α_0^*, α_1^* and α_2^* such that the individual labor supply is (derivations are in section (D.2.1) in the Appendix):

$$n = \begin{cases} 0 & \text{if } \alpha \leq \alpha_0^* \\ \alpha \hat{w}_1^\varepsilon & \text{if } \alpha_0^* < \alpha \leq \alpha_1^* \\ \hat{K}/\hat{w}_1 & \text{if } \alpha_1^* < \alpha < \alpha_2^* \\ \alpha \hat{w}_2^\varepsilon & \text{if } \alpha \geq \alpha_2^* \end{cases} \tag{12}$$

where $\hat{K} = (1 - \tau_1)K$. The region between α_1^* and α_2^* corresponds to the bunching in the earnings distribution at the cutoff K of gross earnings. The aggregate labor supply is:

$$N_1^S = \int_{\alpha_0^*}^{\alpha_1^*} \alpha \hat{w}_1^\varepsilon f(a) da + \int_{\alpha_1^*}^{\alpha_2^*} \frac{\hat{K}}{\hat{w}_1} f(a) da$$
$$N_2^S = \int_{\alpha_2^*}^{\infty} \alpha \hat{w}_2^\varepsilon f(a) da \tag{13}$$

---

[40]The tax rates are defined as $\tau_j \equiv \frac{(\tau_j^w + \tau_j^e)}{(1 + \tau_j^e)}$, where τ_j^w and τ_j^e are the worker and employer paid tax rates respectively, in type-j job. There is a direct relation between τ_j and τ_w. The purpose of this simplification is to define the take-home (or net) wage of the worker as a linear function of the tax rate and the before-tax wage (labor cost per hour). In this section, I use the terms "before-tax" and "gross" interchangeably for simplification, as they move one-to-one with the labor costs for the employer, for whom taxes virtually did not change with the reform.

It is straightforward to show that when there is an expansion in tax benefits for low-earning workers, given the wages, aggregate supply in jobs type 1 increases, while aggregate supply in jobs type 2 decreases (derivations in section (D.2.1) in the Appendix). As a result, N_1^S/N_2^S increases.

Labor demand, product market and government budget: Both the output and the labor market are competitive. The labor demand is specified as in section (4). There are two firms, indexed by $k \in \{H, L\}$, and they produce two differentiated goods, Y_H and Y_L. The prices in the output market are p_H and p_L, with $p_L = 1$ as a normalization. The production function of the firms is defined by equation (1), with the difference that goods, Y_k, and total factor productivity, A_k, are firm-specific. Aggregate labor demand is: $N_1^D = N_{1H} + N_{1L}$ and $N_2^D = N_{2H} + N_{2L}$. Aggregate output is: $Y = Y_H + Y_L$.

Aggregate income in the economy, *Inc*, equals consumption. The goods are imperfect substitutes at the aggregate level, and each of them faces an aggregate downward sloping demand. The government collects revenues from payroll taxes, T, and finances the benefits for non-employed workers with them, distributing the remainder in lump-sum transfers. All these elements are specified in the Appendix, section (D.2.6).

Equilibrium: The competitive equilibrium of this economy is defined as the set of prices, w_1, w_2 and p_H, such that the labor market for each job clears, the output market clears, workers and firms optimize, and profits are zero.

7.2 Simulation exercises

The model is solved and parameterized as explained in the Appendix, section (D.2.7). I set the parameter values to match the moments in the data for the pre-reform period. Then I simulate the reform by changing the earnings limit K up to which workers receive the lower tax rate τ_1. Table (5) shows that this framework is able to generate qualitatively the results obtained by the DiD analysis. In terms of the pre-reform averages, the model accounts for 60% of the change in hours in the high-intensity firms with respect to low-intensity firms. The relative increase in high-earning employment is 4% in the model and 12% in the data, and the relative decrease in low-earning employment is 3% in the model and 19% in the data.

Importantly, the simulation of the reform using the model allows to tier apart the changes in employment by type (bottom panel of Table (5)), which was not feasible using the DiD strategy. According to the model, total employment in firm H increases by 9%, with a 46% increase in hours in low-earning jobs, and 5% in hours in high-earning jobs. Total employment in firm L shrinks by 1%, through a reduction in the hours in high-earning jobs (-2%) which more than compensates the increase in the hours in low-earning jobs (36%) as the latter are more scarce to begin with.

It is worth noting that the key parameters for these results are σ and κ, given that they drive the scale and substitution effects, as explained in section (4). In this exercise, $\sigma = 2.462$, a value which is pinned down from the estimation of the equation corresponding to the first order condition of the firms. I set $\kappa = 10$ for this exercise. Table (A27) in the Appendix shows that if the elasticity of substitution is much higher (20 times more), representing a case where the substitution effect is very strong, the model generate counterfactual predictions. Importantly, in this case the firm which is expanding is L whereas H is contracting. Understanding what is the elasticity of substitution between different types of labor and its role facing policy changes has generated a substantial amount of interest in labor economics (Hamermesh and Grant 1979, Hamermesh 1982).

Table (6) shows further insights from the theoretical framework. In the first column, I show the benchmark for which the model is computed, the pre-reform period, in which tax-benefits exist

Table 5: Simulation of the Mini-Job Reform in the model vs. DID estimates

	Model	Data
DiD_{N_1}	-0.02	-0.81
DiD_{N_2}	1.34	1.57
DiD_N	1.32	1.09
In terms of baseline averages (2002)		
DiD_{N_1}	-2.8%	-18.5%
DiD_{N_2}	4.3%	12.4%
DiD_N	4.1%	7.0%
Changes in % of pre-reform levels		
$\dot{N}_{1H}$	46.2%	
$\dot{N}_{1L}$	36.3%	
$\dot{N}_{2H}$	5.4%	
$\dot{N}_{2L}$	-1.7%	
$\dot{N}_H$	8.9%	
$\dot{N}_L$	-1.1%	

Note: Mini-Job Reform simulated by setting: $K = 400$, $\tau_1 = 20\%$, $\tau_2 = 35\%$. The DiD estimates in the top panel are the values of the coefficient estimates of regression (4) corresponding to 2004. I use the estimates corresponding to the number of part-time and full-time workers for N_1 and N_2 respectively, and for full-time equivalent employment for N. The intermediate panel shows the DiD estimates as a proportion of the pre-reform average across firms, both in the model and in the data. The bottom panel shows the changes simulated by the model in terms of the pre-reform employment of each firm.

already. The second column contains the values of the simulation of the Mini-Job Reform, the "reform" counterfactual. The third column shows the counterfactual results in absence of in-work benefits, denoted "no policy" scenario (although N_1 is delimited by monthly gross earnings of €325, as before the reform, all the workers pay the SSC rate of regular workers). The other two columns show the variation in the two simulations with respect to the benchmark. The "no-policy" and "reform" counterfactuals are particularly interesting as they illustrate the changes in employment (and output) across different firms for different levels of in-work benefits. Whereas the comparison of the benchmark to the simulated reform shows the effects of expanding in-work benefits, the contrast between the benchmark and the no-policy scenario is illustrative of the introduction of in-work benefits.

Let us focus on the consequences of the Mini-Job Reform as compared to the pre-reform scenario (columns 1 and 2, and 4). The comparison is of particular interest as it allows to understand the potential general equilibrium effects of the policy, that were not possible to disentangle in the empirical analysis. The model predicts that before-tax wages of low-earning workers drops by 12%, whereas the before-tax wage of high-earning workers remains constant. The drop in w_1 embeds the tax benefit shifting from the workers to the employers, and is driven by a stronger increase in labor supply than in labor demand for these workers. In equilibrium, both the total number of hours and of workers in tax-advantaged occupations increases. The constant w_2 is accompanied by a decrease in the total number of workers in these occupations, particularly due to the receding labor supply.

An interesting prediction of the model is that, as a consequence of the labor expansion in firm H and contraction in L, the configuration of total output shifts towards the former. This is not trivial as firms have different productivities for different workers and firm H has a lower total factor productivity, as suggested by the data.

	Pre-Reform (benchmark)	Mini-Job Reform (counterfactual 1)	No-Policy (counterfactual 2)	Variation Count. 1 vs. Benchm.	Variation Count. 2 vs. Benchm.
w_1	24.5	21.5	30.5	-12%	24%
w_2	24.8	24.8	24.8	0%	0%
w_1/w_2	1.0	0.9	1.2	-12%	24%
$\hat{w}_1$	20.1	17.2	19.8	-14%	-1%
$\hat{w}_2$	16.1	16.1	16.1	0%	0%
Employment rate	94.6%	93.3%	94.5%	-1.2pp.	-0.1pp.
Workers in mini-jobs (%)	14.9%	16.9%	10.1%	14%	-32%
N_1	1.6	2.3	0.9	40%	-43%
N_2	63.6	63.0	64.4	-1%	1%
$N_1/(N_1+N_2)$	2.5%	3.5%	1.4%	40%	-43%
N_1+N_2	65.2	65.3	65.3	0.1%	0%
N_{1H}	0.7	1.0	0.4	46%	-46%
N_{2H}	7.4	7.8	6.8	5%	-8%
N_{1L}	0.9	1.3	0.6	36%	-40%
N_{2L}	54.7	53.7	56.3	-2%	3%
N_1/N_2 in H	0.092	0.127	0.054	39%	-42%
N_1/N_2 in L	0.017	0.023	0.010	39%	-42%
T	558	557	568	-0.1%	2%
Inc	1,614	1,614	1,623	0%	1%
Y	1,570	1,567	1,581	-0.1%	1%
p_H	1.25	1.24	1.27	-1%	2%
Y_H/Y	10.2%	11.1%	8.9%	9%	-13%
Y_L/Y	89.8%	88.9%	91.1%	-1%	1%

Note: No-Policy: $K = 325$, $\tau_1 = \tau_2 = 35\%$. Pre-reform: $K = 325$, $\tau_1 = 18\%$, $\tau_2 = 35\%$. Mini-Job Reform: $K = 400$, $\tau_1 = 20\%$, $\tau_2 = 35\%$.

Shifting attention to the no-policy scenario (columns 3 and 5) adds the interesting insight with respect to the total employment effect of the reform. Even though the before-tax wage for low-earning workers falls as a consequence of the introduction of in-work benefits, the net wage remains above the no-policy level. There is then a positive effect on the employment rate.

To sum up, these exercises provide valuable insights with respect to the labor demand side responses when in-work benefits are introduced and expanded. In particular, they show how production and employment reallocate across firms as a consequence of the policy. Wages are depressed for the low-earning segment, without changes for high-earning workers.[41]

8 Conclusions

This paper analyzes firm responses to an expansion of in-work benefits in the form of lower taxes for low-earning workers. Unlike the existing literature, which has focused mainly on *labor supply* responses to such interventions, I provide an analysis of the *labor demand* responses. The paper shows that in-work benefits do not only affect employment of targeted low-earning workers, but also generate *spillovers* on the employment of higher-earning workers who are not directly targeted by the policy. The empirical analysis focuses on the German Mini-Job reform of 2003, which had a dramatic impact on the German labor market. After the reform, about 20% of all private sector workers hold "marginal" jobs that qualify for the tax benefits.

The existing literature has documented that employers share part of the tax benefits provided to workers, which results in a change in labor costs when in-work benefits are expanded. In this paper, I show that firm responses are affected both by the implied decrease in total labor costs (and thus a "scale effect"), and the change in the relative costs of tax-advantaged versus non-tax-advantaged

---

[41]Interpretation of aggregate employment levels, income and total output in this version of the model are affected by the parsimonious modelling of the extensive margin decision of the labor supply.

workers (and thus a "substitution effect"). To motivate my empirical analysis, I first present a simple theoretical framework that relates the strength of the scale and substitution effects of a particular firm to its pre-reform intensity in low-earning workers. The theoretical analysis suggests that the scale effect is stronger in firms which are more intensive in low-earning workers, whereas the substitution effect dominates in firms with a relatively low intensity in low-earning workers.

I then test these predictions using a panel of establishments matched to administrative data of workers. The identification strategy relies on a differences-in-differences approach that exploits the expansion of in-work benefits after the Mini-Job Reform and the pre-reform intensity in low-earning workers across establishments. I document that establishments with a high intensity of low-earning workers prior to the reform expand relative to low-intensity establishments. Interestingly, this relative expansion of initially high-intensity establishments is concentrated in high-earning, non-tax advantaged workers. On the other hand, initially low-intensity establishments seem to substitute employment towards low-earning workers without expanding total employment at the same pace. These changes in firms' workforce are the result of changes within firms in the relative importance of part-time and full-time employment, in the skill level of the workforce, and in the type of tasks that workers perform.

While the relative responses of initially high-intensity and initially low-intensity firms provide evidence on the presence of both the scale and the substation effects, the differences-in-differences approach does not allow to analyze employment levels in each type of firms. To provide some sense of the macroeconomic implications of the empirical findings, I extend the initial theoretical framework, which focuses on labor demand, to a general equilibrium model by adding the labor supply-side. The results presented here suggest that the equilibrium wages of low-earning workers decline, whereas the wages of high-earning workers remain constant. In this framework, the differential responses in terms of employment across firms that are observed in the data are driven by an increase in employment in the low-earning segment across all firms, and by a reallocation of high-earning workers from firms in which they are more abundant to firms in which high-earning workers are scarcer. There is also reallocation of production from low-intensity (in low-earning workers) firms to high-intensity firms, even though the data seems to suggest that high-intensity firms are less productive.

The theoretical mechanism presented in this paper relies on two key premises. The first premise is that an increase in in-work benefits for low-earning workers augments the labor supply of these workers. The second premise is that low-earning and high-earning workers are imperfect substitutes in the production of goods and services. I provide several pieces of descriptive evidence to support these assumptions, such as an analysis of changes in the distribution of earnings and worker flows, and several pieces ample anecdotal evidence.

The effects documented in this paper are inherently important for the design of in-work benefits, and more broadly, for any type of labor market intervention that targets workers that are imperfect substitutes to the rest of the workforce. My findings suggest that labor supply incentives targeting low-earning workers can have non-trivial labor demand effects and can create spillovers to employment not targeted by the policy. Finally, the results help to shed light on the ongoing debate regarding the pervasive effects of the German Mini-Job Reform, which is often cited as a major cause of the observed increase in precarious employment in Germany, and which is considered as a potential role model by several other countries that are seeking to implement labor market reforms.

References

Acemoglu, D. and D. Autor (2011). Skills, tasks and technologies: Implications for Employment and Earnings. In O. Ashenfelter and D. Card (Eds.), *Handbook of Labor Economics, Vol. 4*. Elsevier.

Angrist, J. and J. Pischke (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press.

Arellano, M. and O. Bover (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics 68*.

Autor, D. (2003). Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing. *Journal of Labor Economics 21*(1), 2–42.

Azmat, G. (2014). Incidence, salience and spillovers: The direct and indirect effects of tax credits on wages. *R&R Quantitative Economics*.

Bargain, O., M. Caliendo, P. Haan, and K. Orsini (2010). "Making work pay" in a rationed labor market. *Journal of Population Economics 23*, 323–351.

Bayer, C. and M. Kuhn (2016). Which ladder to climb? Evidence on wages of workers, jobs, and plants. Technical report, CESifo.

Beaudry, P., D. Green, and B. Sand (2014). In search of labor demand. Working Paper 20568, National Bureau of Economic Research (NBER).

Blundell, R. (2000). Work incentives and 'in-work' benefit reforms: A review. *Oxford Review of Economic Policy 18*, 27–44.

Blundell, R. (2006). Earned income tax credit policies: Impact and optimality. The Adam Smith Lecture, 2005. *Labour Economics 13*, 423–443.

Blundell, R. and S. Bond (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics 87*.

Blundell, R., A. Bozio, and G. Laroque (2011). Extensive and intensive margins of labor supply: Working hours in the US, UK and France. *IZA Discussion Paper* (6051).

Blundell, R., M. Costa Dias, C. Meghir, and J. Shaw (2016). Female labour supply, human capital and welfare reform. *Econometrica 84*(5), 1705–1753.

Blundell, R., A. Duncan, J. McCrae, and C. Meghir (2000). The labour market impact of the Working Families' Tax Credit. *Fiscal Studies 21*(1), 75–104.

Blundell, R. and H. Hoynes (2004). Has in-work benefit reform helped the labor market? Seeking a Premier Economy: The Economic Effects of British Economic Reforms, 1980-2000, pp. 411–459. NBER.

Blundell, R., C. Meghir, M. Costa Dias, and J. Van Reenen (2004). Evaluating the employment impact of a mandatory job search program. *Journal of the European Economic Association 2*(4), 569–606.

Blundell, R. and A. Shephard (2011). Employment, hours of work and the optimal taxation of low income families. *The Review of Economic Studies 01*, 1–31.

Bradley, J. and A. Kuegler (2017). Labor market reforms: An evaluation of the Hartz policies in Germany. Technical report, Working Paper.

Cahuc, P., S. Carcillo, and T. Le Barbanchon (2018). The effectiveness of hiring credits. *Review of Economic Studies (forthcoming)*.

Caliendo, M. and K. Wrohlich (2010). Evaluating the German "Mini-Job" reform using a natural experiment. *Applied Economics 42*, 2475–2489.

Carrillo-Tudela, C., A. Launov, and J. Robin (2015). Marginal employment: Evidence from Germany. *Unpublished*.

Chetty, R., J. Friedman, T. Olsen, and L. Pistaferri (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records. *Quarterly Journal of Economics 126*, 749–804.

Chetty, R., J. Friedman, and E. Saez (2013). Using differences in knowledge across neighborhoods to uncover the impacts of the EITC on earnings. *American Economic Review 103*(7), 2683–2721.

Crepon, B., E. Duflo, M. Gurgand, R. Rathelot, and P. Zamora (2013). Do labor market policies have displacement effects? Evidence from a clustered randomized experiment. *The Quarterly Journal of Economics 128*(2), 531–580.

Draca, M., S. Machin, and J. Van Reenen (2011). Minimum wages and firm profitability. *American Economic Journal: Applied Economics 3*(1), 129–151.

Eichhorst, W. and V. Tobsch (2013). Has atypical work become typical in Germany? Country case study on labour market segmentation. Employment Working Paper 145, International Labour Office (ILO).

Eichhorst, W. and V. Tobsch (2014). Not so standard anymore? Employment duality in Germany. Working Paper 8155, IZA.

Eissa, N. and H. Hoynes (2004). Taxes and the labor market participation of married couples: the earned income tax credit. *Journal of Public Economics 88*(9-10), 1931 – 1958.

Eissa, N. and J. Liebman (1996). Labor Supply Response to the Earned Income Tax Credit. *The Quarterly Journal of Economics 111*(2), 605–37.

Eissa, N. and A. Nichols (2005). Tax-transfer policy and labor-market outcomes. *AEA Papers and Proceedings 95*(2), 89–93.

Engbom, N., E. Detragiache, and F. Raei (2015). The German labor market reforms and post-unemployment earnings. Working Paper IMF WP/15/162, International Monetary Fund.

Ferracci, M., G. Jolivet, and G. van den Berg (2010). Treatment Evaluation in the case of inter-actions within markets. *IZA Discussion Papers 4700*.

Fertig, V. and J. Kluve (2006). Alternative beschaftigungsformen in Deutchland: Effekte der neuregelung von zeitarbeit, Minijobs und Midijobs. *Vierteljahrshefte zur Wirtschafts-forschung 75*(3), 97–117.

Fisher, P. and E. Ciani (2014). Dif-in-dif estimators of multiplicative treatment effects. Working Paper 2014-14, Institute for Social and Economic Research.

Freier, R. and V. Steiner (2008). "Marginal employment": Stepping stone or dead end? Evaluating the German experience. *ZAF 2-3*, 223–243.

Galassi, G. (2016). The German Mini-Job Reform: Intended and unintended consequences. *Unpublished, European University Institute*.

Garcia Perez, I. and Y. Rebollo Sanz (2009). The use of permanent contracts across Spanish regions: Do regional wage subsidies work? *Investigaciones Economicas XXXIII*(1), 97–130.

Gautier, P., P. Muller, B. van der Klaauw, M. Rosholm, and M. Svarer (2015). Estimating equilibrium effects of job search assistance. *CESifo Working Papers 5476*.

Goldin, C. and L. Katz (2016). A most egalitarian profession: pharmacy and the evolution of a family-friendly occupation. *Journal of Labor Economics 34*(3), 705–746.

Guardiancich, I. (2010). Germany: Current pension system. First assessment of reform outcomes and output. Country report, European Social Observatory.

Gudgeon, M. and S. Trenkle (2017). Earnings responses, adjustment costs, and the role of firm labor demand. *Unpublished*.

Hamermesh, D. (1982). Minimum wages and the demand for labor. *Economic Inquiry 20*(3), 365–380.

Hamermesh, D. (1986). The demand for labor in the long run. *Handbook of Labor Economics 1*.

Hamermesh, D. and J. Grant (1979). Econometric studies of labor-labor substitution and their implications for policy. *The Journal of Human Resources 14*(4), 518–542.

Harasztosi, P. and A. Lindner (2017). Who pays for the minimum wage? *Unpublished*.

Haywood, L. and M. Neumann (2017). The role of aggregate preferences for labour supply: evidence from marginal employment. DIW Discussion Paper 1652, Deutsches Institut für Wirtschaftsforschung.

Hoynes, H. and A. Patel (2015). Effective policy for reducing inequality: The Earned Income Tax Credit and the distribution of income. Working Paper 21340, National Bureau of Economic Research (NBER).

Immervoll, H. and M. Pearson (2009). A good time for making work pay? Taking stock of in-work benefits and related measures across the OECD. Social, Employment and Migration Working Papers 81, OECD.

Jacobi, L. and S. Schaffner (2008). Does marginal employment substitute regular employment? A heterogeneous dynamic labor demand approach for Germany. *Ruhr Economic Papers 56*.

Keller, B. and H. Seifert (2012, July). Atypical employment in Germany. Forms, development, patterns. In *16th ILERA World Congress*.

Kolm, A. and M. Tonin (2011). In-work benefits and unemployment. *International Tax and Public Finance 18*.

Kunn-Nelen, A., A. de Grip, and D. Fourage (2013). Is part-time employment beneficial for firm productivity? *ILR Review 66*(5), 1172–1191.

Leigh, A. (2010). Who benefits from the Earned Income Tax Credit? Incidence among recipients, coworkers and firms. *The B.E. Journal of Economic Analysis and Policy. Advances 10*(1).

Machin, S., A. Manning, and L. Rahman (2003). Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector. *Journal of the European Economic Association 1*(1), 154–180.

Mayneris, F., S. Poncet, and T. Zhang (2017). Improving or disappearing: firm-level adjustments to minimum wages in China. *Unpublished*.

Meyer, B. and D. Rosenbaum (2001). Welfare, the Earned Income Tax Credit, and the Labor Supply of Single Mothers. *Quarterly Journal of Economics 116*(3), 1063–1114.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica 49*(6), 1417–1426.

Pallais, A. (2014). Inefficient hiring in entry-level labor markets. *American Economic Review 104*(11), 3565–3599.

Raval, D. (2011). Estimation of a CES production function with factor augmenting technology. Discussion Paper CES 11-05, Center for Economic Studies, U.S. Census Bureau.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal 9*(1), 86–136.

Rothstein, J. (2010). Is the EITC as good as an NIT? Conditional cash transfers and tax incidence. *American Economic Journal: Economic Policy*.

Saez, E. (2002). Optimal income transfer programs: Intensive versus extensive labor supply response. *Quarterly Journal of Economics 95*(11-12), 1485–1500.

Saez, E. (2010). Do taxpayers bunch at kink points? *American Economic Journal: Economic Policy 2*(August 2010), 180–212.

Schiller, C. (2016). *The politics of welfare state transformation in Germany: Still a semi-sovereign state?* Routledge.

Shephard, A. (2016). Equilibrium search and tax credit reform. *Unpublished, University of Pennsylvania*.

Steiner, V. and K. Wrohlich (2005). Work incentives and labor supply effects of the mini-job reform in Germany. *Empirica 32*, 91–116.

Tazhitdinova, A. (2017). Adjust me if I can't: The effect of firm incentives on labor supply responses to taxes. *Unpublished*.

Tazhitdinova, A. (2018). Does the magnitude of incentives matter? Labor supply and demand responses to an unusually large tax break. *Unpublished*.

Appendix

See Online Appendix.