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DISCUSSION PAPER SERIES

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ABSTRACT

Labor Market Institutions and the Incidence of Payroll Taxation*

Despite unambiguous predictions of the canonical model of a competitive labor market, empirical studies on the labor market effects of payroll taxation provide conflicting evidence. Our meta-analysis shows that varying degrees of labor market competitiveness across places and time could be one explanation for the mixed results. We then estimate the labor market impacts of payroll taxation in Singapore, the country with most competitive and flexible labor market among the countries investigated in the literature. By exploiting the sharp reduction in payroll tax rate when workers turn 60, we find that the payroll tax cut in Singapore has a large effect on wages without changes in employment. We provide novel evidence corroborating the canonical model prediction that the welfare costs of social insurance programs financed by payroll taxes can be minimized in a competitive labor market.

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1. Introduction

Most social insurance programs such as old-age pension and health, disability, and unemployment insurance are financed by payroll taxes (or social security contributions). These payroll taxes often account for more than 30% of workers' labor income and about a quarter of the total tax revenue of the OECD member countries (Saez et al., 2019). Although social insurance programs play an important role in improving social welfare, the payroll taxes levied to finance those programs can distort the labor market.

In the canonical competitive labor market model, workers have an incentive to increase (decrease) their labor supply depending on how they value their social insurance benefits when the payroll tax rate increases (decreases). Thus, the employers' additional labor costs due to higher payroll taxes can be shifted to workers through reduced wage payments. If workers value their social insurance benefits equal to the payroll taxes borne by their employers, the incidence of payroll taxes will fall solely on the workers' wages, leaving the employment or work hours unchanged and thus minimizing the deadweight loss in labor market (Summers, 1989).

Several empirical studies have tested Summers' (1989) insights on the labor market impacts of payroll taxes across various countries and time periods to document mixed results. Table 1 presents the results of 22 studies on the wage effects of payroll taxation. The pass-through rate, defined as the percentage change in wages upon a 1 percentage point change in payroll tax rate, ranges from below 10% (Elias, 2015; Adam et al. 2019) to above 80% (Gruber, 1994, 1997; Anderson and Meyer, 2000; Komamura and Yamada, 2004; Baicker and Chandra, 2006; Kim and Koh, 2021). However, few studies have tried to explain this discrepancy.

The canonical payroll tax incidence model assumes a perfectly competitive labor market. However, the competitiveness in an actual labor market varies across countries, demographic groups, and time periods. From our meta-analysis results shown in Tables 2 and 3, countries with a more flexible and competitive labor market exhibit a roughly 3.5 times higher pass-through rate of payroll taxation (see Section 2 for details). These results imply that heterogeneity in labor market competitiveness might be one reason for the inconsistent findings on the labor market consequence of payroll taxes.

To test the implications of our meta-analysis findings, we estimate the labor market impact of a payroll tax rate cut in Singapore, which has a more competitive and flexible labor

market than the other countries investigated in the literature.[1] According to the World Economic Forum's Global Competitiveness Report 2019 (Schwab, 2019), Singapore was ranked first among 141 countries in labor market flexibility. Wage bargaining takes place predominantly at the firm level in Singapore, where the rate of collective bargaining coverage was only 19% in 2015. This is significantly lower than that in European countries such as Finland (91% as of 2016), France (94% as of 2015), and Sweden (90% as of 2015). If our meta-analysis finding is valid, then we are likely to find a high pass-through rate of payroll taxation in Singapore.

For the identification of the labor market effects of payroll taxes, we exploit the sharp reduction in the payroll tax rate in Singapore when a worker turns 60. We apply a regression discontinuity design (RDD) by comparing the labor market outcomes of workers immediately before and after their 60th birthday. We find a discontinuous 3.3% increase in monthly labor income, but not much discontinuity in labor inputs such as employment and full-time work status at the cutoff age. These results indicate that almost all the labor costs saved through the payroll tax cut are shifted to workers' monthly wages. Thus, the welfare costs of a social insurance program financed by payroll taxation would be minimal when the labor market is highly competitive.

This study is closely related to the literature estimating the labor market consequences of payroll taxes. Several recent studies examining the labor market impacts of payroll taxation mainly considered the European countries having high collective bargaining coverage rates. For example, Saez et al. (2019) provide evidence of null wage impacts of a payroll tax cut in Sweden, where the collective bargaining coverage rate was 90%, that is, higher than in most other countries (ILO, 2020). They suggest that union bargaining might have prevented the transfer of saved labor costs to the beneficiaries (i.e., young workers). Our study contributes to the literature by providing novel evidence of labor market impacts of payroll taxation in the contrasting context of highly competitive and flexible labor market.

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[1] The majority of studies on labor market impacts of changes in payroll tax rates focused on European countries such as Sweden (Bohm and Lind, 1993; Bennmarker, Mellander, and Ockert, 2009; Egebark and Kaunitz, 2013 and 2017; Bennmarker et al., 2013; Skedinger, 2017; Saez et al, 2019), France (Kramarz and Philippon, 2001; Bozio, Breda, and Grenet, 2019; Cahuc, Carcillo and Le Barbanchon, 2019), Norway (Johansen and Klette, 1997; Gavrilova et al., 2015), Finland (Korkeamäki and Uusitalo, 2009; Huttunen al., 2013), Spain (Elias, 2015), Greece (Saez, Matsaganis, Tsakloglou, 2012), and Germany (Müller and Neumann, 2017). Some studies have investigated the labor market impacts of payroll taxations in Argentina (Cruces et al., 2010), Chile (Gruber, 1997), Columbia (Adriana and Kugler, 2009), and the United States (Anderson and Meyer, 2000).

Bozio et al. (2020) is the closest study to our work; it investigates the role of tax-benefit linkage to explain variations in the pass-through rate of payroll taxes. This study is a rare exception in that it attempts to explain the observed variations in estimated labor market impacts of payroll taxation. The authors document that increased payroll taxes are fully shifted to workers' wages when a strong and salient relationship existed between social security contribution and workers' expected benefits. We complement their study by shedding lights on the role of market competitiveness, another important institutional assumption used by canonical competitive labor market models.

The remainder of this paper is structured as follows. Section 2 discusses the meta-analysis of existing studies considering the labor market impact of payroll taxation. Section 3 discusses the institutional background in Singapore. Section 4 presents the conceptual framework we use to rationalize our empirical findings. Sections 5 and 6 describe the data and empirical strategy, respectively. Section 7 reports the empirical results. Finally, Section 8 concludes the paper.

2. Meta-Analysis

Table 1 reports the estimated pass-through rates of payroll taxes to wages from 22 published studies or working papers covering different countries and time periods. The pass-through rate is equal to 1 when an increase in payroll tax on employers is completely shifted to workers, and 0 when workers do not bear the burden of the increased payroll tax levied on the employer at all.

We first constructed this sample of studies using 16 papers surveyed in Bozio et al. (2020) and reviewed all the papers referenced in each of these papers. We then carried out a Google Scholar search to identify additional studies citing Bozio et al. (2020), the 16 papers, and the papers referenced in them. Thus, we obtained 34 papers in total empirically studying the incidence of payroll taxation. We then excluded 12 papers from the sample because we could find no estimate of pass-through rate for them. Three papers in the sample reported more than one pass-through rate estimate. Thus, we obtained 26 estimates in total.

The pass-through rates varied widely across countries and time periods. For example, Gruber and Krueger (1991), Gruber (1994), Gruber (1997), Anderson and Meyer (2000), and Komamura and Yamada (2004) report a pass-through rate larger than 0.8. In contrast, relatively recent studies such as Lehmann et al. (2013), Skedinger (2014), Elias (2015), Egebark and Kaunitz (2018), Adam et al. (2019), and Saez et al. (2019) find the pass-through rate below 0.2.

In particular, Bozio et al. (2020) show that the pass-through rates can range from 0.1 to 1.1 depending on the salience of tax-benefit linkage even within the same country, using three distinct payroll tax reforms in France.

The last three columns of Table 1 report the degree of labor market flexibility in the wage determination process of the corresponding country of each study. We obtained this information from the Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts (ICTWSS) database (Visser, 2019). The variable in the fifth column pertains to the predominant level at which wage bargaining takes place in a country each year. It distinguishes five tiers, from 1 (wage bargaining takes place predominantly at the local or company level) to 5 (bargaining takes place predominantly at the central or cross-industry level).[2] We presume a more competitive labor market when wage bargaining takes place at the firm level, because the wage determination process is then more likely to be flexible.[3] The variable in the sixth column indicates whether the country has a sectoral organization for employment relations. The value 0 stands for weak or no institutions, 1 for intermediate cases (only one side, with no joint institutions), and 2 for strong institutions (both employers and unions, with some joint institutions). The variable in the last column is the collective bargaining coverage rate; this is the population share of employees covered by valid collective wage bargaining agreements. Wage determination can be more flexible if no strong sectoral organization exists or fewer workers are covered under collective bargaining agreements. The values reported in the last three columns of Table 1 give the average of these variables over the years covered by the data considered in the respective studies.

To formally test whether institutional characteristics of the labor market affect the degree of payroll tax change transferred to wages, we conduct a subgroup meta-analysis on the equality of the pass-through rates between the cases with more and less competitive labor markets based on the three aforementioned measures in Table 1 (Card et al., 2018; Bozio et al., 2020). Our subgroup meta-analysis excludes Gruber (1994) and Kugler and Kugler (2009) because the former does not report the standard error of the estimated pass-through rate and

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[2] See the variable description in Table 1 for the description of the five levels.

[3] Three elevating levels are considered in this variable: (i) local or company level, (ii) sector or industry level, and (iii) central or cross-industry level. A level is "predominant" if it accounts for at least two-thirds of the total bargaining coverage rate in a given year. If it accounts for less than two-thirds but more than one-third of the coverage rate, a mixed or intermediate situation exists between levels (i) and (ii) or (ii) and (iii). A mixed situation also occurs when the bargaining levels alternate and/or one cannot assess which of the two levels contributes more to the actual coverage of agreements.

the latter has the missing labor market flexibility information for Colombia over the study period from the ICTWSS database. Thus, we consider 24 estimates.

Panel A of Table 2 reports the weighted average of the pass-through rate from the 24 estimates, with more precise estimates having larger weights. We use the random-effects meta-analysis model to calculate the weights.[4] The average pass-through rate is significantly positive (0.406), and its 95% confidence interval is strictly above zero.

Panel B shows the pass-through rate estimates by wage bargaining levels. The weighted average pass-through rate is 0.838 for studies conducted in countries where wage bargaining predominantly takes place at the local or firm level (8 observations), and 0.234 for studies conducted in countries where wage bargaining generally takes place at a more aggregate level (16 observations). The group mean difference is statistically significant, with the p-value less than 0.001. This implies that the employer's burden of payroll taxes is easily shifted to workers when the wage is determined at a more flexible level, as predicted by the canonical competitive labor market model.[5] We find a similar finding in Panel C, where we report the average pass-through rates for groups by sectoral organization. The payroll tax burden is more easily shifted to workers when there is no or only weak institution of employment relations than when there is a medium or strong sectoral organization.

Since the collective bargaining coverage rate is a continuous variable, we employ the meta-analysis regression method with random effects, which is a linear regression of the estimated pass-through rates on study-level covariates (or moderators). Column (1) of Table 3 shows the regression result with collective bargaining coverage rate as a single moderator. We find that the pass-through rate is significantly smaller with a higher coverage rate, and the incidence of payroll taxes is therefore less likely to fall on workers' wages in a country determining wages in a more collective manner. This is in line with our earlier finding that the employer's burden of payroll taxes is easily shifted to workers when the labor market is more flexible.

The specification in column (2) additionally controls for the average GDP growth and unemployment rate to capture the fluctuations in macroeconomic conditions over the study years (Card et al., 2018). We also add controls for the observation units in the study (workers,

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[4] A random-effects meta-analysis model assumes that variations in the pass-through rate across studies result from both the between-study and sampling variability. In this model, the weight is inverse of the sum of the two variance estimates.

[5] A graphical presentation of this subgroup meta-analysis, also known as forest plot, is shown in Appendix Figure A1.

firms, regions). None of these moderators show statistically significant association with the pass-through rate, whereas the collective bargaining coverage rate shows robust effects.

Our meta-analysis indicates that institutional characteristics of the labor market can play a significant role in explaining the heterogeneity in tax incidence. Wages are more likely to respond to payroll taxation when the labor market is more competitive and flexible.

In the following sections, we test the implication of our meta-analysis by estimating the labor market impact of payroll taxation in Singapore, where the labor market is highly competitive.

3. Institutional Background

Singapore was ranked first in labor market flexibility out of 141 countries surveyed in the Global Competitiveness Report 2019 (Schwab, 2019). The ICTWSS database indicates that wage bargaining in Singapore was predominantly at the firm level during our sample period (2015–2020). The database also reports that the collective bargaining coverage rate was only 19% in Singapore as of 2015; this is significantly lower than the rate of most countries considered in the literature, such as Argentina (63% as of 2013), Greece (24%, 2015), Finland (91%, 2016), France (94%, 2015), Norway (70%, 2016), Spain (70%, 2015), Sweden (90%, 2015), and the United Kingdom (28%, 2015). This implies that Singapore is a good setting to examine whether the estimated pass-through rate is consistent with the prediction of the canonical payroll tax incidence model in a competitive labor market.

Singapore collects payroll taxes from employers and employees to fund its social security savings program, called the Central Provident Fund (CPF). The CPF is a compulsory savings program for local residents. It has features similar to a 401(k) retirement plan in the United States. The CPF balance is used to finance four individual savings accounts with distinct purposes: Medisave, Ordinary Account (OA), Special Account (SA), and Retirement Account (RA). Medisave is a savings account for hospitalization and approved health insurance plans. OA is a savings account whose balance can be withdrawn before age 55 to buy a house or pay for children's tuition fees. SA is a savings account for investment in government-approved financial products. RA is opened on the account holder's 55th birthday. The savings in OA and SA are transferred to RA to form a retirement fund; this can be withdrawn through monthly payouts after the official claiming age (currently 65).[6] Both employers and workers contribute

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[6] The payroll taxes collected for a worker's CPF are allocated across Medisave, OA, and SA at predetermined shares, which vary with his/her age. In general, more savings are allotted to Medisave when the worker is old, and

to the CPF, but self-employed individuals are only required to contribute to the Medisave component. Appendix Table A1 shows the detailed CPF allocation schedule by age.

Appendix Table A2 summarizes how the payroll tax rate (i.e., the CPF contribution rate) varies with the workers' age. The tax rate is 26% of the monthly wages of workers aged 55 and above but below 60 (13% on employers and 13% on employees). For those aged 60 and above but below 65, the payroll tax rate is 16.5% of monthly wages (9% on employers and 7.5% on employees).[7] Monthly income up to S$ 6,000 is taxable for payroll tax purposes in Singapore. Our main analysis exploits the discontinuous change in payroll tax rate upon turning 60 in order to identify the labor market incidence of payroll taxation in Singapore.

Table A2 shows that the payroll tax rates sharply reduce at age 55 and 65. However, there are simultaneous policy changes at these two age cutoffs. Singaporeans become eligible to withdraw their CPF balances upon turning 55 and can claim their pension benefits upon turning 65. Since these institutional settings deter us from cleanly identifying the causal effects of payroll taxation, our main analysis does not investigate the labor market impacts at these age cutoffs.[8]

4. Simple Theoretical Framework

In this section, we present a simple model that can predict the labor market impacts of payroll taxation, accounting for the institutional characteristics of Singapore's labor market and age-specific payroll tax rate schedule. We build the model on the standard labor market framework studying the effects of payroll taxes and mandated benefits (Summers, 1989).

Let t_a denote the payroll tax rate levied on employers hiring workers aged a, and τ_a denote the payroll tax rate levied on employees aged a. For example, $t_{59} = .13$, $t_{60} = .09$, $\tau_{59} = .13$, and $\tau_{60} = .075$ in Singapore during our sample period.

Consider the labor market for workers aged 59 years. The market equilibrium for these workers is point A in Figure 1, where the labor demand and supply curves are denoted by D_{59} and S_{59}, respectively.

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to SA when the worker is young. For workers aged between 60 and 65 years, 63.6%, 21.2%, and 15.2% of their total payroll taxes are allocated to the Medisave account, OA, and SA, respectively. For workers aged 35 and below, 22%, 16%, and 62% of their payroll tax payments are allocated to the Medisave account, OA, and SA, respectively.

[7] The government has increased the payroll tax rates several times over the past decades to ensure enough retirement savings, but no change was made during our study period, 2015–2020.

[8] For more discussions on the theoretical predictions of CPF contribution rate changes upon turning 55 and 65 and corresponding empirical evidence, see Appendix B.

If workers aged 59 and 60 are homogenous, the demand curve for 60-year-old workers (D_{60}) will be located above D_{59}, where the gap between the two demand curves is $(t_{59} - t_{60})w$; w denotes the wages paid to homogeneous workers. The gap occurs because firms incur extra costs for hiring 59-year-old workers who come with a higher payroll tax rate.

As the payroll taxes levied on employers go to the workers' individual CPF savings accounts, the supply curve for workers aged 60 (S_{60}) will be located above S_{59}. If workers consider the reduction in employers' CPF contribution as a loss in compensation (which we call condition I), the gap between the two supply curves will be $(t_{59} - t_{60})w$.

Another change occurring at age 60 pertains to the reduced contributions of workers to their own CPF accounts; the reduction amounts to $(\tau_{59} - \tau_{60})w$. If a worker matches this reduction with an increase in private saving by $(\tau_{59} - \tau_{60})w$ and thus leaves the total savings intact (condition II), the payroll tax cut for employee contribution at age 60 will not shift the labor supply curve from that at age 59.

In sum, both the demand and supply curves for workers aged 60 will shift by the same proportion from the curves for workers aged 59 if conditions I and II are met. The market equilibrium for workers aged 60 will then be at point B of Figure 1. The wage rate for 60-year-old workers will be higher than that for 59-year-old workers, but the employment for both age groups will be identical. These predictions are tested in our empirical analysis.

5. Data

For our empirical analysis, we use data from the Singapore Life Panel (SLP), a nationally representative longitudinal survey of local residents in Singapore aged between 50 and 70 in 2015, when it was launched. The SLP surveys about 7,000–9,000 individuals each month, mainly through the Internet, collecting rich individual- and household-level information on, for example, labor market outcomes, health, and demographic characteristics. We consider 61 monthly waves of the SLP from July 2015 through July 2020.

Our primary dependent variables are the binary indicators of employment and full-time work status, and net monthly labor income. The SLP does not ask respondents their specific work hours. Instead, it surveys whether the respondents work 35 hours a week or longer or less, or whether their work hours vary. We consider an individual working for more than 35 hours as a full-time worker. Net monthly labor income is defined as the monthly income before taxes and other deductions conditional on employment and after employer payroll tax contribution.

Singapore's payroll tax rate schedule depends on the individual's age. For an age-based RDD, we consider age in months.[9] As control variables, we include years of schooling, with the dummy variables indicating ethnicity (Chinese, Indian, or Malay), marital status, and gender.

Our baseline analysis sample is restricted to Singaporeans with paid jobs, because only they are subject to payroll taxation. As the SLP also collects information on labor market outcomes from self-employed workers and foreigners who are not subject to payroll taxation, we use these individuals to estimate the discontinuities in labor market outcomes at age 60 as a falsification check.

Table A3 provides the summary statistics of labor market outcomes and demographics of individuals aged 59 or 60, excluding foreign or self-employed workers.[10] Workers aged 59 years earn higher monthly wages, are more likely to be employed, and are more likely to be full-time workers than those aged 60, although their demographic characteristics measured by years of education, gender, ethnicity, and marital status are generally similar.

6. Empirical Strategy

To identify the labor market impacts of payroll taxation in Singapore, we exploit the sharp reduction in payroll tax rate of a worker turning 60. We compare the labor market outcomes of workers just before and just after they turn 60 by applying an RDD. To estimate the discontinuity in labor market outcomes at the age cutoff (i.e., the 60th birthday month), we use the following regression specification:

$$Y_{ia} = \alpha + \beta \cdot 1[age_{ia} > 0] + f(age_{ia}) + \varepsilon_{ia}, \tag{1}$$

where Y_{ia} is a labor market outcome variable such as monthly wage and its logarithm value and binary indicators of employment and full-time status (conditional on being employed) for individual i at age in month a; age_{ia} denotes a worker's age in months normalized to zero at the month individual i turns 60; $1[age_{ia} > 0]$ is equal to 1 if individual i is 60 years of age or older and 0 otherwise;[11] $f(\cdot)$ is a smooth function of individual i's age in months, controlling for the age profiles of labor market outcomes; and ε_{ia} is an error term. The parameter of

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[9] We can also use age in days, but this could create too noisy patterns of outcome variables. Therefore, as the running variable, we use age in months instead of days.

[10] We restrict the age of sample respondents to 59 and 60 for consistency with the sample used for empirical analysis.

[11] We do not include the observations in the month of the 60th birthday because some respondents surveyed in that month may not be eligible for the tax rate cut yet.

interest is β, representing the discontinuous changes in labor market outcomes at the cutoff age. For statistical inference, we calculate the standard errors clustered at the age-in-month level and corrected for heteroskedasticity.

The key identification assumption for interpreting the estimated discontinuities in labor market outcomes as the causal effects of payroll tax cuts is that all factors except payroll tax rate change continuously. As an indirect test of this assumption, we examine whether the observable characteristics of workers change smoothly at the cutoff age. Appendix Table A4 shows that the estimated discontinuities are small in magnitude and statistically insignificant, except for the share of Chinese ethnicity, which is estimated at 0.005, but statistically significant at the 5 % level. However, we argue that this discontinuity will not cause a serious bias in our estimation. First, the estimate is small compared to the average share of Chinese ethnicity in our sample, which is 86% (see Table A3). Second, some birth cohorts will always be younger or older than 60 years during the sample period, and their ethnic group compositions may be different from those of other birth cohorts.[12] As a robustness check, we estimate equation (1) after controlling for these individual characteristics and examine whether the statistically significant discontinuous change in share of ethnic Chinese is orthogonal to the discontinuities in labor market outcomes.[13]

To minimize the bias in estimating βs, given the bandwidth, we need to choose a correct parametric approximation of unknown labor market age profiles, $f(\cdot)$. We restrict the age of the sample respondents in the baseline specification to 59 and 60 (i.e., 12-month bandwidth before and after the 60th birthday month). By assuming a reasonably narrow bandwidth, we approximate the labor market age profiles with a linear function of age in months and the slope differing on each side of the cutoff. As this baseline bandwidth is chosen arbitrarily, we alternatively consider the data-driven optimal bandwidths computed for each dependent variable adopting the method of Calonico et al. (2014). As an additional robustness check, we use a more flexible parametric approximation of $f(\cdot)$ by adding quadratic terms of age in months and its interaction with *1[age$_{ia}$ > 0]*.

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[12] To test this conjecture, we restrict the sample to those born between 1956 and 1959 so that our sample constitutes individuals observed both before and after the cutoff age. Consistent with our conjecture, the estimated discontinuity of the Chinese ethnicity share becomes smaller in magnitude and statistically insignificant.

[13] Another identification assumption is that individuals cannot manipulate the running variable. This assumption must hold in our case because a biological age is impossible to change by nature.

7. Results

Baseline analysis: Labor market impacts of payroll tax rate cut at age 60

Figure 2 shows the age profiles of labor market outcomes of individuals aged between 59 and 60; each dot represents the average value of each age in months along the lines, fitting those dots on each side of the cutoff age. All labor market outcomes decrease with age, reflecting the fact that our sample individuals have already passed their peak working age. Panels A and B show discontinuous increases in monthly wage and its logarithm values upon turning 60. However, Panels C and D do not demonstrate discontinuous changes in the probability of employment and full-time work status (conditional on employment) in the month of the 60th birthday. These results provide graphical evidence that the reduction in payroll tax rate increased the older individuals' wages without changes in their labor inputs.

Table 4 reports the estimated discontinuities of labor market outcomes in the month of the 60th birthday, using equation (1). Columns (1) and (2) show the estimated discontinuities in monthly wage and its logarithm values at the cutoff age as S\$ 130.9 (or US \$97.3) and 3.3%, respectively. [14] These estimates are statistically significant at the 1% and 5% levels, respectively. The 3.3% increase in monthly wages is equivalent to an 82.5% reduction in employer contribution upon the worker turning 60 (reduction from 13% to 9% in monthly earnings). Columns (3) and (4) provide little evidence on discontinuous changes in probability of employment and full-time work status. The estimates are small in magnitude and statistically insignificant.

In sum, the incidence of payroll taxes largely falls on workers' wages, leaving their employment intact. Several recent studies considering the labor market impacts of payroll taxation mainly focused on the European countries having high collective bargaining coverage rates. For example, Saez et al. (2019) document the null wage impacts of a payroll tax cut in Sweden, where the collective bargaining coverage rate is higher than in most other countries (ILO, 2020). The findings of these studies, which are consistent with our meta-analysis findings, imply that the efficiency loss of payroll taxation can be small in highly competitive labor markets.

Robustness checks

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[14] The exchange rate of S\$ 1 is US\$ 0.74 as of March 25, 2021.

We report our robustness check results in Table 5. First, some birth cohorts can always be below or above 60 years of age in our sample period. Different cohorts might have experienced different life-cycle profiles of labor market outcomes. If some of our sample individuals have not crossed the cutoff age of 60, the difference in sample composition in terms of birth years can lead to a bias in fitting the age profiles of labor market outcomes. To address this issue, we restrict the sample to individuals born between 1956 and 1959 so that our sample includes individuals observed both before and after the cutoff age. The estimated discontinuities shown in Panel A are similar to the baseline estimates in Table 4. The estimates for monthly wage and its logarithm values are statistically significant at the 1% and 5% levels, respectively.

Second, if the estimated discontinuities reported in Table 4 are due to the payroll tax rate cut, they would be insensitive to the inclusion of control variables. Consistent with the findings reported in Appendix Table A4, the estimates in Panel A of Table 5 remain robust when we include covariates such as years of education, gender, ethnicity, marital status, and an interaction term between gender and marital status.[15]

Third, we examine the baseline estimates' sensitivity to the choice of age bandwidth. Instead of the 12-month bandwidth used in baseline analysis, we consider the data-driven optimal bandwidth computed using Calonico et al.'s (2014) methodology, assuming that our running variable, age in months, is continuous. Panel C of Table 5 reports that the alternative bandwidths are wider than our baseline 12-month bandwidth, but the estimated discontinuities remain similar to those in Table 4.

Finally, we investigate whether the estimated labor market outcome discontinuities at age 60 remain robust when we approximate $f(\cdot)$ with higher-order polynomials of age in months. We use the quadratic function of age in months and its interaction with $I[\text{age}_i > 0]$ to fit the age profiles of labor market outcomes. As the optimal bandwidth choice can be affected by the functional form of $f(\cdot)$, we re-calculate the data-driven bandwidths following Calonico et al.'s (2014) method. The results shown in Panel D of Table 5 indicate that the estimated discontinuities, with the higher-order polynomials of age in months, are similar to those of the baseline specification in Table 4.

Falsification checks

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[15] From Table A4, the change in Chinese ethnicity share at the age cutoff is statistically significant at the 5% level, whereas its magnitude (0.005) is small. To further examine whether this leads to bias in estimates, we include only the dummy variable for Chinese ethnicity and re-estimate equation (1). The results remain robust.

In our baseline analysis, we excluded foreigners and self-employed Singaporeans because social security contribution is mandated only for the local residents engaged in paid work.[16] If the estimated discontinuities in labor market outcomes at age 60 are due to payroll tax cut, we do not expect such discontinuities for foreigners or self-employed Singaporeans. Table 6 shows that the estimated discontinuities of labor market outcomes at age 60 are statistically insignificant.

For an additional falsification check of the estimated discontinuities at a hypothetical age cutoff range, we assign each of the 48 months before and after the actual cutoff (the month of the 60th birthday) as a placebo age cutoff. We then estimate the discontinuity of labor market outcomes at each of those 96 cutoffs with a 12-bandwidth. Figure 3 plots the distribution of the 96 estimates, with the baseline estimates in Table 4 shown as the vertical lines. The probabilities of the placebo estimates being larger in magnitude than the baseline estimate for monthly wages and log monthly wages are 8.3% and 3.1%, respectively, while the corresponding probabilities for employment status and full-time work status are both 19.8%. These results imply that the estimated discontinuities at placebo age cutoffs are less likely to replicate the baseline estimates.

8. Conclusion

Despite clear predictions under the canonical model of a competitive labor market, existing empirical studies have provided mixed evidence on how much a payroll tax change is shifted to workers' wages. One possible explanation for this discrepancy is the heterogeneity in labor market flexibility across countries and time. For example, Saez et al. (2019) argues that union bargaining might have prevented the increased labor costs from being shifted to the beneficiaries. For a better understanding of the role of market flexibility or competitiveness, we investigate the labor market impact of payroll taxation in Singapore, where the labor market is more competitive and flexible than in any other country investigated in the literature. We document that a payroll tax cut largely shifts to the workers' wages. The estimated pass-through rate in Singapore is 82.5%; this is similar to the weighted average pass-through rate of the studied countries, where wage bargaining predominantly takes place at the local or firm level, as in Singapore. These findings indicate that labor market institutions such as market

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[16] Self-employed individuals are required to contribute only to the individual medical savings account called Medisave. Their Medisave contribution rates (5.25% to 10% depending on income) do not change once they reach 50.

competitiveness play a significant role in determining the labor market impacts of payroll taxation. A policy implication is that the labor market distortions due to payroll taxation would be minimal when the labor markets are competitive.

Finally, a few caveats are in order. First, due to the data limitation, we cannot distinguish whether the estimated wages increase on turning 60 is achieved when employees change jobs or by a salary adjustment within the same employment. An increase in wages at age 60 may come from job mobility. However, from our informal communication with an HR personnel staff of a multinational company operating in Singapore, the salaries of workers are adjusted upward when they turn 60. Second, as we rely on survey data, we do not have enough statistical power to conduct heterogeneity analysis across industries or between public and private companies to further investigate the role of labor market competitiveness.[17] We leave these unanswered questions to future work.

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[17] We estimate the labor market impacts of payroll tax cuts at age 60 for workers in the public sector, where the labor markets can be less competitive than in other sectors. We find little evidence of discontinuous increases in monthly wages or their logarithm value at the age cutoff. However, the number of observations used for this analysis is only 577. The results should therefore be interpreted with caution.

References

Adam, S., Phillips, D. and Roantree, B., 2019. "35 years of reforms: A panel analysis of the incidence of, and employee and employer responses to, social security contributions in the UK." *Journal of Public Economics*, 171, pp.29-50.

Kugler, Adriana, and Maurice Kugler. 2009. "Labor market effects of payroll taxes in developing countries: Evidence from Colombia." *Economic development and cultural change,* 57 (2): 335-358.

Anderson, P.M. and Meyer, B.D., 2000. "The effects of the unemployment insurance payroll tax on wages, employment, claims and denials." *Journal of Public Economics, 78*(1-2), pp.81-106.

Baicker, K. and Chandra, A., 2006. The labor market effects of rising health insurance premiums. Journal of Labor Economics, 24(3), pp.609-634.

Bennmarker, H., Mellander, E. and Öckert, B., 2009. "Do regional payroll tax reductions boost employment?" *Labour Economics, 16*(5), pp.480-489.

Bohm, P. and Lind, H., 1993. "Policy evaluation quality: A quasi-experimental study of regional employment subsidies in Sweden." *Regional Science and Urban Economics, 23*(1), pp.51-65.

Bozio, A., Breda, T., and Grenet, J., 2019. Does Tax-Benefit Linkage Matter for the Incidence of Social Security Contributions? IZA Discussion Paper No. 12502.

Cahuc, P., Carcillo, S. and Le Barbanchon, T., 2019. "The effectiveness of hiring credits." *The Review of Economic Studies*, *86*(2), pp.593-626.

Calonico, S., Cattaneo, M.D., and Titiunik, R., 2014. "Robust nonparametric confidence intervals for regression-discontinuity designs." *Econometrica*, *82*(6), pp.2295–2326.

Card, David, Jochen Kluve, and Andrea Weber, 2018. "What works? A meta-analysis of recent active labor market program evaluations." *Journal of the European Economic Association*, *16* (3), pps. 894-931.

Cruces, Guillermo, Sebastian Galiani, and Susana Kidyba. 2010. "Payroll taxes, wages and employment: Identification through policy changes." Labour economics, 17(4): 743-749.

Elias, Ferran. 2015. "Labor demand elasticities over the life cycle: Evidence from Spain's payroll tax reforms." Working Paper.

Egebark, J. and Kaunitz, N., 2018. "Payroll taxes and youth labor demand." Labour economics, 55, pp.163-177.

Gavrilova, E., Zoutman, F., Hopland, A. O., & Møen, J. (2015, August). "Who pays for the payroll tax? quasi-experimental evidence on the incidence of the payroll tax." Working Paper.

Gruber, J., 1994. "The incidence of mandated maternity benefits." *The American economic review*, pp.622-641.

Gruber, Jonathan. 1997. "The incidence of payroll taxation: Evidence from Chile." *Journal of Labor Economics*, *15*(3), pp. 72-101, July.

Gruber, J. and Krueger, A.B., 1991. "The incidence of mandated employer-provided insurance: Lessons from workers' compensation insurance." *Tax policy and the economy*, *5*, pp.111-143.

Huttunen, Kristiina, Jukka Pirttila, and Roope Uusitalo. 2013. "The Employment Effects of Low-Wage Subsidies." *Journal of Public Economics*, 97, pp. 49-60

International Labour Organization (ILO) (2020). ILOSTAT database. Available from https://ilostat.ilo.org/topics/collective-bargaining/.

Johansen, F. and Klette, T.J., 1997. Wage and Employment Effects of Payroll Taxes and Investment Subsidies (No. 194). Discussion Papers.

Komamura, K. and Yamada, A., 2004. "Who bears the burden of social insurance? Evidence from Japanese health and long-term care insurance data." *Journal of the Japanese and International Economies*, 18(4), pp.565-581.

Kim, Seonghoon, and Kanghyock Koh. 2020. "Does early access to pension wealth improve health?" *Economic Inquiry*, *58*(4), pp. 1783-1794.

Kim, Seonghoon and Kanghyock Koh. 2021. The Effects of the Affordable Care Act Dependent Mandate on Parents' Labor Market Outcomes, Working Paper.

Korkeamäki, O. and Uusitalo, R., 2009. "Employment and wage effects of a payroll-tax cut—evidence from a regional experiment." *International Tax and Public Finance*, *16*(6), pp.753-772.

Kramarz, F. and Philippon, T., 2001. "The impact of differential payroll tax subsidies on minimum wage employment." *Journal of Public Economics*, *82*(1), pp.115-146.

Kugler, A. and Kugler, M., 2009. "Labor market effects of payroll taxes in developing countries: Evidence from Colombia." *Economic Development and Cultural Change*, *57*(2), pp.335-358.

Lehmann, E., Marical, F. and Rioux, L., 2013. "Labor income responds differently to income-tax and payroll-tax reforms." *Journal of Public Economics*, 99, pp.66-84.

Müller, K.U. and Neumann, M., 2017. "Who bears the burden of social security contributions in Germany? Evidence from 35 years of administrative data." *De Economist*, 165(2), pp.165-179.

Saez, E., M. Matsaganis, and P. Tsakloglou. 2012. "Earnings determination and taxes:

Evidence from a cohort-based payroll tax reform in Greece." *Quarterly Journal of Economics*, *127* (1), 493-533.

Saez, E., Schoefer, B. and Seim, D., 2019. "Payroll taxes, firm behavior, and rent sharing: Evidence from a young workers' tax cut in Sweden." *American Economic Review, 109*(5), pp.1717-1763.

Skedinger, P., 2014. "Effects of payroll tax cuts for young workers." Working Paper.

Summers, Lawrence H. 1989. "Some simple economics of mandated benefits." *The American Economic Review Papers and Proceedings*, *79*(2), pp. 177-183.

Schwab, K. 2019. Global Competitiveness Report 2019. World Economic Forum.

Visser, Jelle 2019. ICTWSS Database, version 6.1. Amsterdam Institute for Advanced Labour Studies AIAS.

Figures and Tables

Figure 1. Labor Market Equilibrium
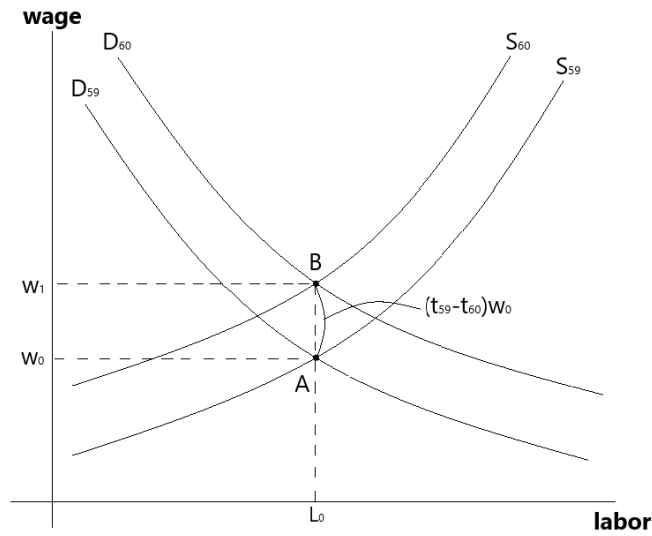
Figure 2. Age Profiles of Labor Market Outcomes

A. Monthly wages (S$)

B. Log(monthly wages)

C. Pr(employed)

D. Pr(weekly working hours>35)

Data source: The Singapore Life Panel.
Note: We exclude self-employed individuals and foreign citizens from the sample. Each dot represents the average value at each age in months.

Figure 3. Distributions of Discontinuities of Labor Market Outcomes at Placebo Age Cutoffs

A. Monthly wages

P(Fake estimate>Baseline estimate): 0.083

B. Log(monthly wages)

P(Fake estimate>Baseline estimate): 0.031

C. Pr(employed)

P(Fake estimate>Baseline estimate): 0.198

D. Pr(weekly working hours>35)

P(Fake estimate>Baseline estimate): 0.198
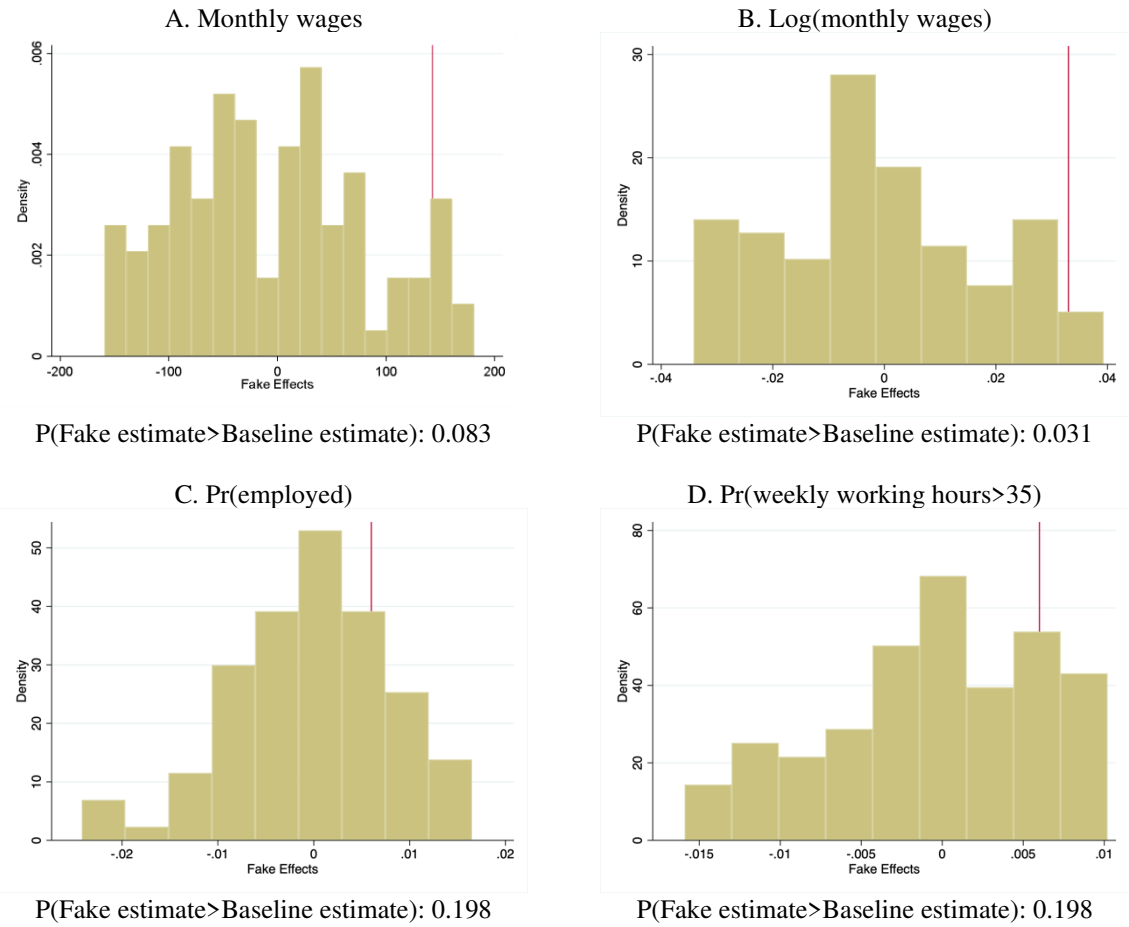
Data source: The Singapore Life Panel.
Note: The red vertical line indicates the baseline RDD estimate.

Table 1. Summary of Empirical Studies of Payroll Tax Incidence

Authors (pub. year)	Country of study	Years of study	Pass-through rate (std. err.)	Wage bargaining level	Sectoral organization	Collective bargaining coverage rate
Gruber and Krueger (1991)	U.S.	1979 – 81, 87, 88	0.865 (0.184) [Table 5, col. 7]	1	0	22.36
Gruber (1994)[1]	U.S.	1977, 78	1.56 [Table 5, col. (iii)]	1	0	25.45
Gruber (1997)	Chile	1984, 85	1.022 (0.180) [Table 3, col. 1]	1	0	10
Anderson and Meyer (1997)	U.S.	1978 – 84	0.715 (0.292) [Table 3, col. 1]	1	0	23.82
Johansen and Klette (1997)	Norway	1983 – 93	0.80 (0.15) [Table 6, col. 2]	4.55	2	75.00
Anderson and Meyer (2000)	U.S.	1985	1.427 (1.191) [Table 3, col. 1]	1	0	19.87
Komamura & Yamada (2004) (i) Health insurance	Japan	1995 – 2001	1.20 (0.2) [Table 1, FE model]	1	0	22.20
Komamura & Yamada (2004) (ii) Long-term care insurance	Japan	2000 – 01	0.20 (0.2) [Table 2, FE model]	1	0	21.10
Baicker and Chandra (2006)	U.S.	1996 – 2002	1.00 (0.20) [Table 4, col. 1]	1	0	14.65
Murphy (2007)	U.S.	1992 – 2002	0.23 (1.01) [Table 6, panel A, col. 3]	1	0	15.41
Kugler and Kugler (2009)[2]	Colombia	1994 – 1996	0.2346 (0.0883) [Table 3, col. 1]	.	.	.
Korkeamaki and Uusitalo (2009)	Finland	2003	0.49 (0.24) [Table 7, col. 2]	4	2	86.20
Benmarker et al. (2009)	Sweden	2002 – 04	0.23 (0.08) [Table 4, col. 3]	3	2	94.00
Cruces et al. (2010)	Argentina	1995 – 2001	0.501 (0.192) [Table 4, col. 2]	2	2	72.90
Saez et al. (2012)	Greece	2004 – 09	0.295 (0.182) [Table 5, col. 1]	4	0	100.00
Lehmann et al. (2013)	France	2003 – 06	0.134 (0.260) [Table 2, col. 3]	3	1	98.00
Skedinger (2014)	Sweden	2007, 08	0.036 (0.027) [Table 2, col. 5]	3	2	90.25
Gavrilova et al. (2015)	Norway	1996 – 2012	0.666 (0.154) [Table 2, col. 1]	3.47	2	73.80
Elias (2015)	Spain	1997, 98	0.0009 (0.0059) [Table 4, col. 6]	3	2	83.18
Egebark and Kaunitz (2018) (i) 2007 reform	Sweden	2007	0.012 (0.002) [Table 6, col. 2]	3	2	90.50
Egebark and Kaunitz (2018) (ii) 2009 reform	Sweden	2009	0.010 (0.003) [Table 6, col. 3]	3	2	90.00
Adam et al. (2019)	U.K.	1982 – 2015	-0.009 (0.109) [Table 3, col. 6]	1.5	0.05	38.90
Saez et al. (2019)	Sweden	2009 – 13	0.085 (0.046) [Table 1, panel A]	3	2	89.40
Bozio et al. (2020) Early 1980s	France	1988	0.209 (0.133) [Table 3, col. 4]	3	1	94.58
Bozio et al. (2020) Late 1980s	France	1996	0.100 (0.224) [Table 3, col. 3]	3	1	96.00
Bozio et al. (2020) Early 2000s	France	2007	1.077 (0.318) [Table 3, col. 2]	3	1	95.00

Notes: 1. Gruber (1994) does not report the standard error for the estimated pass-through rate. 2. The ICTWSS database does not provide information for Columbia over period 1994–96.

Variable description: (1) Wage bargaining level: predominant level at which wage bargaining takes place (in terms of coverage of employees). A level is "predominant" if it accounts for at least two-thirds of the total bargaining coverage rate in a given year. If it accounts for less, but for more than one-third of the coverage rate, a mixed or intermediate situation occurs between the two levels. A mixed situation also occurs when bargaining

levels alternate and/or one cannot assess which of the two contributes more to the actual coverage of agreements. There are five categories:

5 = bargaining predominantly takes place at the central or cross-industry level negotiated at lower levels

4 = intermediate or alternating between central and industry bargaining

3 = bargaining predominantly takes place at the sector or industry level

2 = intermediate or alternating between sector and company bargaining

1 = bargaining predominantly takes place at the local or company level

(2) Sectoral organization: sectoral organization of employment relations. There are 3 categories:

2 = strong institutions (both employers and unions, some joint institutions)

1 = medium (only one side, no joint institutions)

0 = weak, or none

(3) Collective bargaining coverage rate: employees covered by valid collective (wage) bargaining agreements as a proportion of all wage and salary earners in employment with the right to bargaining, expressed as a percentage (0–100), adjusted for the possibility that some sectors or occupations are excluded from the right to bargain.

Table 2. Meta-Analysis of Pass-through Rate by Groups of Wage Determination Flexibility

Group	Number of studies	Weighted Average	95% confidence interval	p-value for homogeneity
A. Overall	24	0.406	(0.239, 0.574)	0.000
B. By Wage bargaining levels Wage bargaining predominantly takes place beyond the company level (> 1)	16	0.234	(0.096, 0.372)	0.000
Wage bargaining predominantly takes place at the local or company level (= 1)	8	0.838	(0.560, 1.117)	0.030
[Test of group mean differences]	χ^2 (d.f.) = 14.54 (1), p-value < 0.001			
C. By Sectoral organization Medium or strong sectoral organization of employment relations (> 0)	15	0.234	(0.087, 0.380)	0.000
No or weak sectoral organization of employment relations (= 0)	9	0.757	(0.477, 1.037)	0.003
[Test of group mean differences]	χ^2 (d.f.) = 10.51 (1), p-value = 0.001			

Table 3. Meta-Analysis Regression

Dep. Var: Pass-through rate	Baseline (1)	Additional regressors (2)
Collective bargaining coverage rate	-.00762[***] (-3.49)	-.00591[***] (-2.59)
Cyclical environment GDP growth rate		.0294 (.820)
Unemployment rate		-.0145 (-.770)
Unit of observation (omitted = workers) Firm observations		.232 (1.48)
Regional observations		.405 (1.06)
Constant	.911[***] 5.51	.762[***] (2.99)
Obs.	24	24
R-sq	0.430	0.478

Notes: t-values are in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%. Data on annual GDP growth rates were extracted on Apr. 5, 2021, from the World Bank national accounts data and the OECD National Accounts data files. Data on unemployment rates were extracted on Apr. 5, 2021, from the OECD data, except for Chile, Colombia, Argentina, Norway, and the United Kingdom; the data of these countries are from the IMF.

Table 4. Discontinuity in Labor Market Outcomes Upon Turning 60

Dependent variables:	Monthly wages	Log(monthly wages)	Pr(employed)	Pr(Weekly working hours>35)
	(1)	(2)	(3)	(4)
1[Age>60th Birthday]	130.9***	0.033**	0.006	0.006
	(37.16)	(0.014)	(0.004)	(0.005)
Observations	31,108	30,974	48,415	48,415
R-squared	0.001	0.001	0.001	0.001

Data source: The Singapore Life Panel.
Notes: We exclude self-employed individuals and foreign citizens from the sample. We do not include any control variables. Standard errors in parentheses are clustered at the age level and corrected for heteroskedasticity. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5. Robustness Checks

Dependent variables:	Monthly wages	Log(monthly wages)	Pr(employed)	Pr(Weekly working hours>35)
	(1)	(2)	(3)	(4)
A. Restricting birth years				
1[Age>60th Birthday]	115.7***	0.028**	-0.002	-0.003
	(34.34)	(0.012)	(0.003)	(0.005)
Observations	24,012	23,909	37,100	37,100
R-squared	0.000	0.000	0.001	0.001
B. Adding covariates				
1[Age>60th Birthday]	113.625***	0.029**	0.005	0.005
	(37.811)	(0.013)	(0.004)	(0.005)
Observations	31,108	30,974	48,415	48,415
R-squared	0.205	0.286	0.052	0.070
C. Using data-driven optimal bandwidth (linear specification for age profile)				
1[Age>60th Birthday]	143.1***	0.033**	0.005*	0.002
	(40.75)	(0.012)	(0.003)	(0.004)
Observations	36,270	38,719	68,727	68,727
R-squared	0.001	0.001	0.002	0.001
Bandwidth	14	15	17	17
D. Adding quadratic specification				
1[Age>60th Birthday]	176.7***	0.034**	0.003	0.005
	(48.56)	(0.015)	(0.005)	(0.007)
Observations	62,406	62,147	60,583	68,727
R-squared	0.002	0.002	0.001	0.001
Bandwidth	24	24	15	17

Data source: The Singapore Life Panel.
Notes: We exclude self-employed individuals and foreign citizens from the sample. In Panel A, we include only individuals born between 1956 and 1959. We do not include any control variables. In Panel B, we include dummy variables of primary education, secondary education, gender, ethnicity (Chinese, Indian, and Malay), marital status, number of children, and the interaction term between gender and marital status. Standard errors in parentheses are clustered at the age level and corrected for heteroskedasticity. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 6. Discontinuity in Labor Market Outcomes among Foreigners or Self-employed Singaporeans

| Dependent variables:	Monthly wages	Log(monthly wages)	Pr(employed)	Pr(Weekly working hours>35)
	(1)	(2)	(3)	(4)
1[Age>60th Birthday]	144.5	0.028	-0.003	-0.002
	(116.6)	(0.018)	(0.003)	(0.002)
Observations	4,788	4,778	5,504	5,504
R-squared	0.000	0.000	0.000	0.000

Data source: The Singapore Life Panel.
Notes: We include self-employed individuals and foreign citizens from the sample. We do not include any control variables. Standard errors in parentheses are clustered at the age level and corrected for heteroskedasticity. *** p<0.01, ** p<0.05, * p<0.1.

Appendix

A. Appendix Figure and Table

Figure A1. Pass-through Rate by Wage Bargaining Levels

Study	
Wage bargaining level > 1	
Korkeamaki & Uusitalo (2009)	
Benmarker et al. (2009)	
Cruces et al. (2010)	
Saez et al. (2012)	
Lehmann et al. (2013)	
Adam et al. (2019)	
Saez et al. (2019)	
Johansen & Klette (1997)	
Skedinger (2014)	
Gavrilova et al. (2015)	
Elias (2015)	
Egebark & Kaunitz (2018) 2007 reform	
Egebark & Kaunitz (2018) 2009 reform	
Bozio et al. (2020) Early 80s	
Bozio et al. (2020) Late 80s	
Bozio et al. (2020) Early 00s	
Wage bargaining level = 1	
Gruber & Krueger (1991)	
Gruber (1997)	
Anderson & Meyer (1997)	
Anderson & Meyer (2000)	
Komamura & Yamada (2004) Health	
Komamura & Yamada (2004) Long-term	
Baicker & Chandra (2006)	
Murphy (2007)	

-.5   0   .5   1   1.5

Note: Vertical lines show the weighted average in each group.

Table A1. Allocation of CPF Contributions by Account and Age

| Employee's age (years) | Allocation Rates from Jan 1, 2016 (for monthly wages ≥ $750) | | | |
	Ordinary Account (% of wage)	Special Account (% of wage)	Medisave Account (% of wage)	Total
35 and below	23	6	8	37
Above 35 to 45	21	7	9	37
Above 45 to 50	19	8	10	37
Above 50 to 55	15	11.5	10.5	37
Above 55 to 60	12	3.5	10.5	26
Above 60 to 65	3.5	2.5	10.5	16.5
Above 65	1	1	10.5	12.5

Source: CPF Board (2016).

Table A2. CPF Contribution Rates by Age

| Employee's age (years) | Contribution Rates from Jan 1, 2016 (for monthly wages ≥ $750) | | |
	By Employer (% of wage)	By Employee (% of wage)	Total (% of wage)
55 and below	17	20	37
Above 55 to 60	13	13	26
Above 60 to 65	9	7.5	16.5
Above 65	7.5	5	12.5

Source: Singapore Central Provident Fund Board (2016).

Table A3. Summary Statistics

	Age 59	Age 60
Labor market outcomes		
Monthly wages (S$)	S$3982	S$3849
Pr(employed)	.65	.63
Pr(full-time)	.49	.47
Demographics		
Years of education	12.2	12.1
Share of male	.45	.45
Share of Chinese	.86	.86
Share of Indian	.05	.05
Share of Malay	.07	.07
Pr(married)	.81	.80

Data source: The Singapore Life Panel.

Table A4. Discontinuities in Demographic Characteristics Upon Turning 60

	Years of education	Male	Chinese	Indian	Malay	Married
	(1)	(2)	(3)	(4)	(5)	(6)
1[Age>60th Birthday]	0.036	0.003	0.005**	-0.002	-0.003	0.000
	(0.025)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Observations	48,415	48,415	48,415	48,415	48,415	48,415
R-squared	0.001	0.000	0.000	0.000	0.000	0.000

Data source: The Singapore Life Panel.
Notes: Standard errors in parentheses are clustered at the age level and corrected for heteroskedasticity. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A5. Discontinuity in Labor Market Outcomes at Other Age Cutoffs

Dependent variables:	Monthly wages	Log(monthly wages)	Pr(employed)	Pr(Weekly working hours>35)
	(1)	(2)	(3)	(4)
A. Upon turning 55				
1[Age>55th birthday]	-32.41	0.010	-0.005	0.005
	(43.50)	(0.006)	(0.004)	(0.004)
Observations	33,043	32,937	45,811	45,811
R-squared	0.000	0.000	0.000	0.000
B. Upon turning 65				
1[Age>65th birthday]	-7.97	-0.017	-0.020***	-0.015***
	(46.56)	(0.014)	(0.005)	(0.005)
Observations	17,624	17,515	37,084	37,084
R-squared	0.001	0.002	0.005	0.004

Data source: The Singapore Life Panel.
Notes: We exclude self-employed individuals and foreign citizens from the sample. We do not include any control variables. Standard errors in parentheses are clustered at the age level and corrected for heteroskedasticity. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

B. Changes of CPF Contribution Rates upon Turning 55 and 65 Years

Age-specific Payroll Tax Rates in Singapore

As Table A2 indicates, in the Singaporean payroll tax system, 60 is not the only age threshold when the payroll tax rate is reduced. The payroll tax rate (i.e., the CPF contribution rate) varies with workers' age. The tax rate is 37% of monthly wages of workers aged below 55 (17% levied on employers and 20% on employees), 26% of monthly wages of workers aged 55 and above and below 60 (13% charged on employers and 13% on employees). For those aged 60 and above and below 65, the payroll tax rate reduces to 16.5% of monthly wages (9% charged on employers and 7.5% on employees). For those aged above 65, it further decreases to 12.5% of monthly wages (7.5% charged on employers and 5% on employees).

However, a key difference exists between these age cutoffs and age 60. First, upon turning 55, Singaporeans can withdraw a portion of their CPF account balances (not less than S\$ 5,000 if there are sufficient balances deemed by the government). About 40–45% of individuals withdraw about S\$ 33,000–43,000 when they become eligible for withdrawal (Kim and Koh, 2020). Second, the tax cut at age 65 is accompanied by changes in retirement-related policies. Individuals reaching age 65 can claim public retirement pension benefits (called the CPF Life), which will relax their liquidity constraints at age 65. Individuals aged 65 and above are also eligible for the Silver Support Scheme, a means-tested cash transfer program for the bottom quintile earners.

Theoretical Analysis

We employ the theoretical framework in Section 4 to analyze the tax rate reductions at ages 55 and 65. Workers reaching age 55 with liquidity constraints will be willing to supply the same amount of labor with a wage increase smaller than $(t_{54} - t_{55})w$. Therefore, the labor supply curve will shift upward by less than $(t_{54} - t_{55})w$.[18]

The findings of Kim and Koh (2020) imply that many Singaporean workers aged 55 are liquidity constrained. For those under liquidity constraints, the payroll tax cut in employee contributions can affect their labor supply curve. Reduced contributions to the CPF account will relax the binding constraints of a 55-year-old worker under liquidity constraints, which would induce a 55-year-old worker to accept a wage lower than that of a 54-year-old worker.

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[18] The demand curve for workers aged 55 will shift up by $(t_{54}\text{-}t_{55})w$, as shown in Figure 1.

Therefore, the labor supply curve of workers aged 55 can shift downward compared with the supply curve of workers aged 54. This labor supply response to payroll tax cut in employee contributions would not exist for a worker with no liquidity constraints, because private savings will increase to compensate for the reduction in forced savings (i.e., lower CPF contributions), leaving his utility intact. Since the withdrawal from the CPF accounts is allowed after reaching 55 and workers aged 60 are not generally concerned with housing or educational expenditures, workers reaching 60 are less likely to be liquidity constrained, and hence we treat them as such in the theoretical analysis of Section 4.

Allowing withdrawals at age 55 will itself have an impact on the labor supply curve for those aged 55. It will have an additional income effect for workers aged 55; it will reduce their labor supply and shift the labor supply curve for workers aged 55 upward.

If the upward shift in labor supply curve at age 55 due to reduced employer contributions or allowing withdrawals is dominated by its downward shift due to the reduction in employee contributions, the net impact can lower the labor supply curve.[19] In this case, the wage rate for workers aged 55 will not be necessarily higher than that of workers aged 54, and employment will be more for workers aged 55. This implies that the effects of a payroll tax cut on labor market outcomes are ambiguous at age 55.

The tax cut at age 65 is accompanied by other changes in retirement-related policies such as allowance of pension benefits and Silver Support Scheme. As a result of these additional policy changes, we cannot have definite predictions on the wage and employment changes at the cutoff age of 65.

Labor Market Impacts of Payroll Tax Cuts at Age 55 and 65

We estimate the discontinuities in labor market outcomes at age 55 and 65 to understand how payroll tax cuts and other public policies jointly affect labor market outcomes. For our empirical analysis, we use the same specification as in the baseline analysis. We use the bandwidth of 12 months, and a linear function of age in month, which is normalized to zero at the month individual i turns 55 (or 65), and its interaction term with $I\{\text{age}_i > 0\}$, which is equal to 1 if individual i is 55 (or 65) or over, and 0 otherwise.

Panels A and B of Table A5 report the estimated discontinuities in labor market

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[19] This scenario is possible because the tax rate reduction for employers on employees aged 54 to 55 is 4 percentage points; this is smaller than the tax rate reduction of 7 percentage points for employees.

outcomes at the cutoff ages of 55 and 65, respectively. Panel A indicates that the estimated discontinuities in monthly wages, the logarithm value of monthly wages, and the probabilities of employment and full-time work status (conditional on being employed) are small in magnitude and statistically insignificant. Panel B shows that the estimated discontinuities in monthly wages and log monthly wages are small in magnitude and statistically insignificant. However, the estimated discontinuities in the probabilities of employment and full-time status (conditional on being employed) are -0.020 and -0.015, and statistically significant at the 1% level.

These results in general do not support the predicted labor market impacts of payroll taxes of the canonical model. However, this could be because the tax cuts at age 55 and 65 are accompanied by other simultaneous policy changes that make it difficult to isolate the tax cut effects. The significant drops in probability of employment and full-time status at age 65 may be due to the social norm in Singapore about retirement at that age.