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An Empirical Study of the Backward-Bending Labor Supply Curve of Older Workers in Taiwan: Long-Term Data Analysis from 1978 to 2023

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Abstract

This study investigates the existence of a backward-bending labor supply curve among older workers in Taiwan, utilizing an extensive longitudinal dataset spanning 46 years (1978–2023). Employing weekly working hours of individuals aged 65 and above as the primary metric, we construct a quadratic empirical model to capture nonlinear wage effects while controlling for demographic characteristics, household structure, and regional fixed effects. Our primary findings indicate that while a nonlinear relationship is statistically present, the criteria for a theoretically consistent "backward-bending" phenomenon are not met in the main model across the observed period. However, robustness checks utilizing the logarithm of wages reveal a significant backward-bending trend in 43 out of 46 years, suggesting that model specification and wage distribution play a pivotal role in empirical outcomes. These results imply that the labor supply behavior of older workers is highly sensitive to functional forms, highlighting the shifting balance between substitution and income effects in an aging economy.

JEL classification numbers: J14, J22, J31, C21.
Keywords: Older workers, Backward-bending labor supply, Taiwan, Long-term data analysis, Wage elasticity.

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1. Introduction

In recent years, population aging has become an important issue facing the global economy and labor markets. As life expectancy increases and fertility declines, many countries are rapidly entering aged or even super-aged societies. Against this background, the labor force participation rate and labor supply behavior of older workers have gradually attracted the attention of both scholars and policymakers. On the one hand, the continued participation of older workers in the labor market helps alleviate labor shortages and the pressure that population aging places on economic growth. On the other hand, changes in the labor supply of older workers are also closely related to retirement systems, social security systems, and family support structures. Therefore, understanding the labor supply decisions of older workers under different wage conditions is of important significance for the formulation of relevant labor and social policies.

In traditional labor supply theory, changes in wages simultaneously generate the substitution effect and the income effect. When wages rise, the substitution effect makes work relatively more attractive than leisure, thereby increasing labor supply. However, a wage increase also raises an individual's disposable income, which may lead the individual to choose more leisure and reduce labor time. Therefore, when the income effect exceeds the substitution effect, the labor supply curve may bend backward, forming the so-called backward-bending labor supply curve. For older workers, because they have usually accumulated a certain amount of wealth, pensions, or family support, the income effect may be more significant, causing them to reduce their working hours at higher wage levels. Whether a backward-bending labor supply phenomenon exists among older workers, and how its turning wage changes over time, deserves long-term and systematic empirical study.

This study takes Taiwan as the research object and uses cross-sectional data from the Manpower Utilization Survey conducted by the Directorate-General of Budget, Accounting and Statistics from 1978 to 2023 to explore the relationship between labor supply and wages among older workers. The research sample focuses on the population aged 65 and above, and weekly working hours are used as the measure of labor supply. To test the backward-bending labor supply hypothesis, this paper adopts a quadratic functional form of wages in the empirical model, that is, wage and its squared term are included in the regression model, while individual characteristics such as gender and education, family structure such as marital status, and regional and job characteristics are also controlled for. In addition, this study also uses year-by-year regression analysis to estimate the turning wage for different years, and further examines whether the labor supply structure of older workers has changed over time.

The rest of this paper is organized as follows. Section 2 reviews the literature and introduces labor supply theory and empirical studies on the labor supply of older workers. Section 3 presents the research method and empirical model, and explains the data sources, variable definitions, and empirical model. Section 4 reports the empirical results, including the main regression model, year-by-year regressions,

and turning wage estimation, and further analyzes long-term trends and robustness checks. Section 5 concludes by summarizing the findings of this study, discussing their policy implications, and explaining the research limitations and directions for future research.

2. Literature Review

2.1 Labor supply theory

Labor supply theory is an important foundation of labor economics, and its core lies in examining how individuals make choices between work and leisure. Early studies were mostly based on the time allocation model. Mincer (1962) pointed out that under a fixed time constraint, individuals must allocate time between labor and leisure, and wages are an important factor influencing labor supply decisions. When wages increase, individuals must decide whether to increase working hours to earn more income or to increase leisure time to improve quality of life.

In traditional microeconomic theory, changes in wages simultaneously generate the substitution effect and the income effect. The substitution effect means that an increase in wages raises the relative return to work, leading individuals to increase working hours and reduce leisure. The income effect means that an increase in wages raises an individual's disposable income, enabling them to purchase more leisure and potentially reduce working hours. Killingsworth (1983) pointed out that the relative magnitude of the substitution effect and the income effect determines the direction of labor supply responses to wage changes.

Hausman (1981) used nonlinear models to estimate labor supply responses to wages and taxation, and pointed out that labor supply behavior may exhibit significant nonlinear characteristics. Blundell and MaCurdy (1999) further summarized labor supply theory and empirical research, and pointed out that labor supply decisions are influenced by multiple factors such as individual characteristics, family structure, and life-cycle stages.

Some studies further develop labor supply theory from the perspectives of life-cycle and heterogeneity. Erosa, Fuster, and Kambourov (2016) used a dynamic life-cycle model and pointed out that individuals' labor supply responses to wage changes may differ across different ages and wealth conditions. Especially near retirement age, because individuals have accumulated certain wealth and retirement income sources, the income effect may become more significant, making older workers more likely to reduce working hours at higher wage levels. Therefore, in the later stages of life, the labor supply curve is more likely to exhibit a backward-bending shape.

2.2 Empirical studies on labor supply

In empirical research, scholars have long been concerned with the impact of wage changes on labor supply. Early studies mostly used cross-sectional data to estimate labor supply elasticity. Heckman (1974) pointed out that when estimating labor supply functions, the sample selection problem must be considered, because some

individuals may not participate in the labor market, and ignoring this problem may lead to biased estimation results.

Hausman (1981) used structural models to study labor supply behavior in the United States and found that wage changes have significant effects on labor supply, but overall labor supply elasticity is usually small. Blundell and MaCurdy (1999) summarized a large number of empirical studies on labor supply and pointed out that labor supply elasticity is usually between 0 and 1, but significant differences may exist across different groups. For example, women and married individuals usually have higher labor supply elasticity, while high-income groups are more likely to exhibit income effects.

With improvements in econometric methods and data quality, recent studies have increasingly emphasized heterogeneity and institutional backgrounds in labor supply. For example, Chetty et al. (2011) pointed out that labor supply elasticity differs significantly across income groups and institutional environments. Some studies also pointed out that labor supply responses are not only determined by wage changes, but are also influenced by policy systems, adjustment costs, and family conditions.

In terms of model specification, many studies include the squared term of wages or the squared term of ln wage in the labor supply function to test for nonlinear relationships. If the coefficient of the linear wage term is positive and the coefficient of the squared term is negative, this indicates a concave labor supply curve and the possible existence of a backward-bending labor supply phenomenon. This model specification has become an important method for testing nonlinear labor supply relationships.

2.3 Labor supply of older workers

As population aging becomes increasingly severe, the labor supply of older workers has gradually become an important topic in labor economics. Early studies emphasized the effects of retirement systems, health conditions, and social security on labor participation of older workers. For example, French (2005) pointed out that health, wealth, and wages jointly affect retirement and labor supply behavior. Maestas (2010) pointed out that health shocks may increase the probability of older workers exiting the labor market.

Recent studies place more emphasis on institutional reforms and cross-country comparisons. Manoli and Weber (2016) used quasi-experimental evidence from Austrian pension reform and found that raising the retirement age significantly affects retirement decisions and employment status of older workers. Börsch-Supan and Coile (2018) summarized experiences of pension reforms in multiple countries and pointed out that retirement incentives are an important factor affecting labor supply of older workers. Coile, Milligan, and Wise (2017) pointed out that in most countries, older workers still possess considerable working capacity, but retirement systems and labor market institutions may limit their participation.

On the other hand, OECD (2019, 2023) studies indicate that in most OECD countries, labor participation rates of older workers are increasing, but their work

patterns are usually more flexible, such as part-time work or self-employment. These work patterns may affect how older workers respond to wage changes, leading to different shapes of labor supply curves.

In the context of Taiwan, studies on backward-bending labor supply are still relatively limited. Wu (2012) used Taiwanese labor market data to analyze the relationship between economic development and labor supply curves, and found that as income increases, the labor supply curve may gradually become backward-bending. Wu (2024) re-examined the backward-bending labor supply phenomenon in Taiwan and analyzed differences across groups, pointing out that the shape of the labor supply curve may vary by gender, education level, and labor market conditions.

2.4 Research gap

Based on the above literature, it can be found that although a large body of research has been accumulated in labor supply theory and empirical studies, several research gaps still exist. First, most labor supply studies focus on the overall labor market or specific groups, such as female labor supply or household labor supply, while studies specifically focusing on older workers are relatively limited. Although some studies point out that retirement systems, health conditions, and social security systems affect labor participation of older workers, empirical studies on whether the labor supply curve of older workers exhibits a backward-bending shape are still limited.

Second, in terms of data, most existing studies use single-year or short-term data for analysis, and fewer studies use long-term data to examine structural changes in labor supply behavior. However, labor supply behavior is often influenced by economic development, demographic structure, and institutional changes, so long-term data are important for understanding dynamic changes in labor supply. Through long-term data, it is possible to observe whether the labor supply curve changes over time and analyze the variation of turning wages across different periods.

Third, in terms of research regions, most studies on older workers' labor supply focus on Western countries such as the United States and Europe. However, in the Asian context, the labor market structure and retirement systems for older workers may have different characteristics. For example, family structures and intergenerational support systems are often more prominent in Asian countries, which may affect labor supply decisions of older workers. However, research on labor supply of older workers in Asian countries is still relatively limited.

3. Research Method and Empirical Model

3.1 Data source

This study uses data from the Manpower Utilization Survey of the Directorate-General of Budget, Accounting and Statistics, covering 46 years of cross-sectional data from 1978 to 2023.

Table 1: Sample size and employment rate of older workers by year

Year	Total Sample Size	Older Sample Size	Older Employed Sample Size	Employment Rate of Older Workers
1978	47336	3068	265	8.64%
1979	49683	3173	263	8.29%
1980	50915	3379	267	7.90%
1981	53159	3702	275	7.43%
1982	51327	3647	274	7.51%
1983	55603	3945	292	7.40%
1984	57382	4274	338	7.91%
1985	56982	4324	363	8.40%
1986	57339	4579	403	8.80%
1987	59666	5020	431	8.59%
1988	60078	5071	427	8.42%
1989	58033	4996	442	8.85%
1990	56894	5131	427	8.32%
1991	54409	5129	462	9.01%
1992	55425	5499	432	7.86%
1993	59563	6235	543	8.71%
1994	60944	6717	564	8.40%
1995	61091	6962	612	8.79%
1996	60371	7186	587	8.17%
1997	60044	7386	592	8.02%
1998	61142	7667	601	7.84%
1999	60619	7939	586	7.38%
2000	69857	8394	599	7.14%
2001	60151	8187	582	7.11%
2002	62607	8263	569	6.89%
2003	60657	8447	603	7.14%
2004	60219	8991	576	6.41%
2005	59298	9170	589	6.42%
2006	58942	9084	623	6.86%
2007	59445	9199	620	6.74%
2008	58208	9484	678	7.15%
2009	57743	9698	693	7.15%
2010	57770	9608	774	8.06%
2011	57363	9437	608	6.44%
2012	58033	9936	688	6.92%
2013	57235	10892	743	6.82%
2014	56267	11324	864	7.63%
2015	56831	11741	926	7.89%
2016	57203	12323	1022	8.29%
2017	56328	12754	1156	9.06%
2018	55954	13193	1244	9.43%
2019	55754	13221	1262	9.55%
2020	55292	13535	1246	9.21%
2021	55141	13856	1298	9.37%
2022	53507	14184	1385	9.76%
2023	54462	15036	1430	9.51%
Total	2642272	374986	30224	8.06%

From Table 1, we can observe that the sample size and employment rate of older workers in each year both show a stable proportion and are also close to the overall employment average.

3.2 Theoretical model of the labor supply of older workers

This study aims to examine whether the phenomenon of a "backward-bending labor supply curve" exists in the labor supply of older workers in Taiwan. Because older workers usually have already accumulated a certain amount of wealth or can maintain their living through sources such as pensions and support from children, when wages reach a certain threshold, older workers may choose to reduce working hours in order to increase leisure time. Therefore, this phenomenon may be more pronounced in the labor market for older workers.

Empirically, backward-bending labor supply is usually tested through the quadratic functional form of wages:

$$H_i = \alpha + \beta_1 w_i + \beta_2 w_i^2 + X_i'\gamma + \varepsilon_i \quad (1)$$

Where:

H_i : labor supply (working hours)

w_i : wage rate

$X_i'\gamma$: the linear combination of control variables

ε_i : the error term

If $\beta_1 > 0$ and $\beta_2 < 0$, this indicates the existence of backward-bending labor supply.

3.3 Empirical model specification

The dependent variable is working hours. It comes from the survey question: "Weekly working hours last week." This study uses actual weekly working hours in the previous week as the measure of labor supply for older workers.

The independent variable is wage. It comes from the survey question: "What is your monthly income from your main job?" Because the labor supply model should theoretically use the wage rate rather than total income, this study first converts monthly income into hourly wage:

$$W_i = \frac{Monthly\ Income_i}{4.35 \times H_i} \quad (2)$$

Where

$Monthly\ Income_i$: monthly income

H_i : weekly working hours

4.35: average number of weeks per month

w_i : wage rate

And the following variables are constructed:

$$w_i$$

$$w_i^2$$

These are used to test the nonlinear relationship between wages and labor supply.
Control Variables:
In order to control for the effects of the demographic characteristics and family structure of older workers on labor supply, this study includes the following control variables:
1. Gender: a nominal scale variable, $Male_i$ (coded as male = 1, female = 2). This variable is used to reflect gender differences in the labor market.
2. Education level: an ordinal scale variable, $Education_i$ (coded as no education = 0, elementary school = 1, junior high school = 2, senior high school/vocational high school = 3, junior college = 4, university and above = 5). This variable is used to reflect the level of educational attainment of older workers.
3. Spouse status: a nominal scale variable, $Spouse_i$ (coded as having a spouse or cohabiting partner = 1, others = 0). This variable is used to reflect whether older workers have a family support system.
Fixed Effects:
1. City fixed effects: dummy variables, μ_c, with Taipei City as the reference group.
2. Job-type fixed effects: dummy variables, v_j, with privately employed workers as the reference group.
In order to control for individuals' demographic characteristics, multiple control variables are included in the regression model, including gender, education level, and marital status. These variables help control for heterogeneity in the labor supply behavior of the older workers. In addition, the model also includes job-type fixed effects and regional fixed effects to control for structural differences in employment arrangements and local labor market conditions. These fixed effects can capture unobserved factors that may affect working hours across different employment types and geographic areas.
The regression model of this study is as follows:

$$H_i = \alpha + \beta_1 w_i + \beta_2 w_i^2 + \beta_3 Male_i + \beta_4 Education_i + \beta_5 Spouse_i + \mu_c + v_j + \varepsilon_i \quad (3)$$

ε_i : the error term
If $\beta_1 > 0$ and $\beta_2 < 0$, this indicates the existence of backward-bending labor supply.
Turning wage calculation:

$$w^* = -\frac{\beta_1}{(2\,\beta_2)} \quad (4)$$

3.4 Robustness checks

In order to avoid the empirical result of "backward-bending labor supply" being caused only by model specification or data processing methods, this paper designs two types of robustness checks:

3.4.1 Using the logarithm of hourly wage

In order to correct the wage distribution problem, the first robustness check uses the logarithm of hourly wage and the square of the logarithm of hourly wage:

$$\ln w_i$$

$$(\ln w_i)^2$$

At this time, the robustness check model is:

$$H_i = \alpha + \beta_1 ln\, w_i + \beta_2\, (ln\, w_i)^2 + \beta_3 Male_i + \beta_4 Education_i + \beta_5 Spouse_i + \mu_{\,c} + v_j + \varepsilon_{\,i} \quad (5)$$

Turning wage calculation:

$$\ln w^* = -\frac{\beta_1}{(2\,\beta_2)} \quad (6)$$

$$w_i^* = exp\left(-\frac{\beta_1}{2\,\beta_2}\right) \quad (7)$$

3.4.1 Pooling the sample size of all years

In order to control for the fixed effects of years, the second robustness check pools the samples of all years and then runs the main regression model. At this time, the robustness check model 2 is:

$$H_i = \alpha + \beta_1\, w_i + \beta_2 w_i^2 + \beta_3 Male_i + \beta_4 Education_i + \beta_5 Spouse_i + \mu_{\,c} + v_j + \delta_t + \varepsilon_{\,i} \quad (8)$$

Where
δ_t: year fixed effects

4. Empirical Results

4.1 Descriptive statistics

The total number of individuals aged 65 and above in the 1978-2023 samples is 374,986. Among them, the number of non-working observations is 344,762. The number of working observations is 30,224. The average employment rate is 8.21%. This shows that the labor force participation rate of the older population is stable, but relatively low.

Table 2: Annual averages for employed older workers

Year	Sample Size	Average Hourly Wage	Average Weekly Working Hours
1978	265	33.26	41.93
1979	263	32.94	44.24
1980	267	38.25	45.84
1981	275	77.08	43.64
1982	274	55.42	45.21
1983	292	61.11	43.53
1984	338	57.86	43.77
1985	363	54.51	44.83
1986	403	58.32	43.61
1987	431	68.70	44.19
1988	427	70.17	43.78
1989	442	86.56	43.96
1990	427	100.57	42.85
1991	462	85.14	43.26
1992	432	104.23	43.21
1993	543	91.11	43.64
1994	564	95.51	41.88
1995	612	115.97	40.09
1996	587	131.17	40.80
1997	592	126.05	42.26
1998	601	147.09	42.27
1999	586	129.69	42.05
2000	599	136.45	42.54
2001	582	138.57	41.33
2002	569	120.52	41.20
2003	603	125.45	40.17
2004	576	137.86	42.67
2005	589	132.94	44.00
2006	623	132.07	43.03
2007	620	126.94	41.95
2008	678	147.35	42.12
2009	693	142.65	40.79
2010	774	149.08	41.32
2011	608	162.35	41.67
2012	688	150.43	40.83
2013	743	155.64	40.84
2014	864	178.88	40.88
2015	926	178.29	41.28
2016	1022	194.00	40.75
2017	1156	189.94	39.81
2018	1244	209.36	40.16
2019	1262	218.92	40.30
2020	1246	217.35	40.24
2021	1298	286.40	36.03
2022	1385	228.35	38.57
2023	1430	260.90	39.03
Total	30224		

From Table 2, we can observe that the average hourly wage shows a gradual upward trend over time. This is consistent with the year-by-year increase in the minimum wage, implying that the wages of older workers are similar to those in the general labor market and are neither excessively high nor excessively low.
In most years, the average weekly working hours fall between 39 and 44 hours. This is also consistent with the legal standard for weekly working hours under the Labor Standards Act, but it also implies that the working hours of older workers are close to those of full-time workers.

4.2 Main regression model results

4.2.1 Estimation results of the labor supply model for older workers

Table 3: Estimation results of the main regression model

Year	β_1	β_2	β_2 P-value	Turning Wage	Turning Wage Within Sample Range	Meets Backward-Bending Criteria
1978	-0.217893079	0.000346585	0.009778***	314.3429899	Yes	No
1979	-0.163546126	0.000128966	0.329502	634.0671267	No	No
1980	-0.079780768	2.30981E-05	0.839955	1727.001974	No	No
1981	-0.110426914	2.61264E-05	0.000000***	2113.324281	Yes	No
1982	-0.108642648	5.27622E-05	0.055315*	1029.550254	Yes	No
1983	-0.090196258	2.78397E-05	0.379029	1619.923663	No	No
1984	-0.086929846	3.685E-05	0.231582	1179.509283	No	No
1985	-0.0311878	4.76419E-06	0.949053	3273.148533	No	No
1986	-0.004809296	-9.15156E-05	0.306278	-26.27583752	No	No
1987	-0.040051818	9.73115E-06	0.108504	2057.918643	Yes	No
1988	-0.016949292	-5.24488E-05	0.164802	-161.579471	No	No
1989	-0.033761073	9.76161E-06	0.408153	1729.27731	No	No
1990	-0.024979089	-5.14249E-06	0.663381	-2428.696782	No	No
1991	-0.013939797	1.19044E-05	0.317302	585.4895897	Yes	No
1992	-0.040061062	9.00241E-06	0.019922**	2225.018242	Yes	No
1993	-0.029546007	1.26703E-05	0.134561	1165.956136	Yes	No
1994	-0.007473194	-8.13784E-06	0.450711	-459.1632941	No	No
1995	-0.017333695	-3.16711E-06	0.689891	-2736.519819	No	No
1996	-0.009750306	-2.15288E-06	0.454428	-2264.474543	No	No
1997	-0.018810953	-5.92598E-06	0.327366	-1587.159384	No	No

1998	-0.015771452	2.2127E-06	0.006737***	3563.854136	Yes	No
1999	-0.01661417	4.70816E-06	0.133603	1764.402329	Yes	No
2000	-0.021420121	3.18996E-06	0.035019**	3357.425402	Yes	No
2001	-0.023916609	4.42177E-06	0.012963**	2704.417088	Yes	No
2002	-0.010222561	-1.18132E-05	0.420999	-432.6760015	No	No
2003	0.004273017	-1.71418E-05	0.157522	124.6376163	Yes	No
2004	-0.016526979	9.12818E-07	0.618069	9052.728441	No	No
2005	-0.020992197	8.10667E-09	0.999290	1294747.885	No	No
2006	-0.012442516	1.079E-06	0.123162	5765.782404	Yes	No
2007	-0.012416114	-8.29659E-07	0.900920	-7482.660339	No	No
2008	-0.020305434	1.59476E-06	0.379359	6366.305887	No	No
2009	-0.033948569	8.41882E-06	0.000098***	2016.232036	Yes	No
2010	-0.034676105	1.13905E-05	0.036514**	1522.149603	Yes	No
2011	-0.018239927	5.47952E-06	0.002833***	1664.37296	Yes	No
2012	-0.028399395	1.03634E-05	0.005295***	1370.183328	Yes	No
2013	-0.021746472	5.42192E-06	0.028397**	2005.420499	Yes	No
2014	-0.017381081	3.70835E-06	0.013474**	2343.504865	Yes	No
2015	-0.015254839	1.82343E-06	0.562914	4182.99865	No	No
2016	-0.025217425	5.00385E-06	0.006618***	2519.800212	Yes	No
2017	-0.013794903	2.64293E-06	0.360455	2609.770498	No	No
2018	-0.021104837	5.06544E-06	0.002983***	2083.219595	Yes	No
2019	-0.026434694	7.07187E-06	0.000065***	1869.003404	Yes	No
2020	-0.021068404	2.97679E-06	0.007092***	3538.783569	Yes	No
2021	-0.013424184	1.25062E-06	0.000000***	5367.030551	Yes	No
2022	-0.013832651	-4.05956E-06	0.071108*	-1703.712773	No	No
2023	-0.007096959	5.44783E-07	0.485471	6513.560196	No	No

In addition to $\beta_1 > 0$ (substitution effect) and $\beta_2 < 0$ (income effect), the turning wage must fall within the sample wage range in order to have economic meaning. Otherwise, within the observed wage range, labor supply is still increasing in only one direction. Therefore, this study further adds four judgment criteria: β_1, β_2, whether the turning wage falls within the sample wage range, and whether the p-value of β_2 is less than 0.1. The empirical results in Table 3 show that, among the 46 years, no year satisfies the criteria for a backward-bending labor supply curve.

In terms of control variables, the gender variable shows that male older workers

generally work longer hours than female workers, reflecting differences in labor market participation and the household division of labor. Education level also shows a certain degree of influence. Those with higher education may exhibit different labor supply patterns because they have more employment opportunities or different types of jobs. Marital status may affect labor supply decisions through family responsibilities and economic needs.

To control for differences in working-time structures caused by different employment types, this study also includes job-status fixed effects. Different employment statuses differ significantly in work-time arrangements and labor supply flexibility. For example, self-employed workers usually have greater flexibility in working hours and may work longer hours. In contrast, workers employed by the government or private enterprises may be constrained by institutional arrangements for working hours. Therefore, including job-status fixed effects can effectively control for the influence of different employment types on labor supply. In addition, this study also includes city fixed effects in order to control for differences in labor market structure and economic conditions across regions. For example, urban and non-urban areas differ clearly in employment opportunities, industrial structure, and living costs, and all of these factors may affect the working-hour decisions of older workers.

4.2.2 Shape and stability of the labor supply curve of older workers

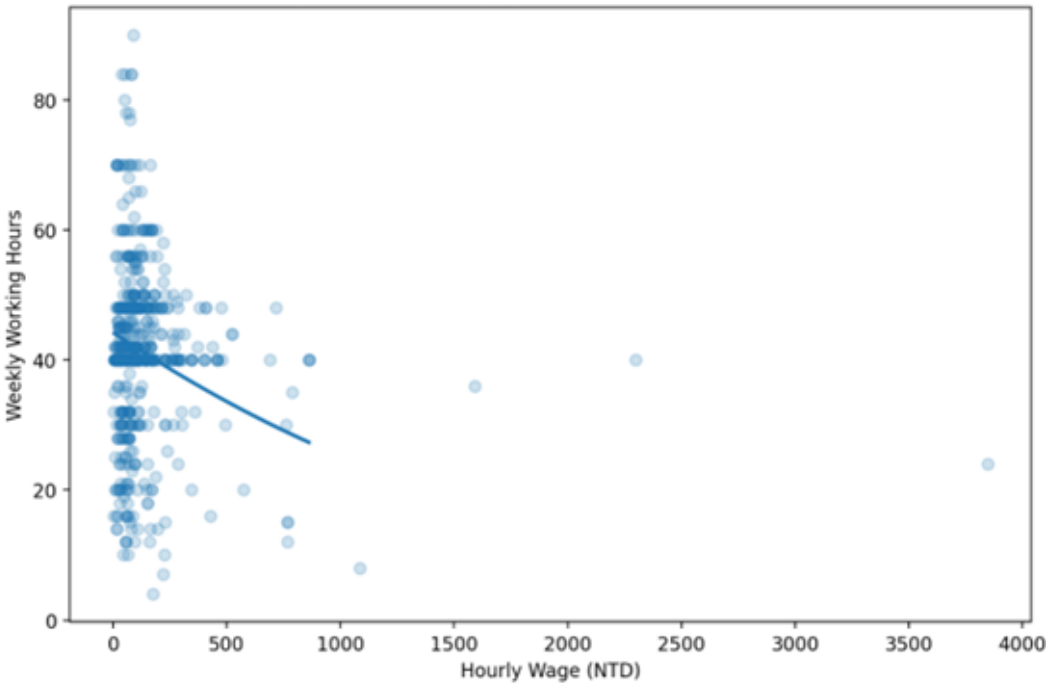

Figure 1: Labor supply curve (main model), 2001

Using the sample for the year 2001 as an example, the x-axis in Figure 1 is hourly wage, and the y-axis is weekly working hours. The figure shows that wages and weekly working hours are negatively related, and labor supply declines as wages increase. The regression curve does not show a typical inverted-U structure, and the turning wage falls outside the observed sample range, which means that backward-bending labor supply does not hold within the observed interval. This result shows that, in that year, the labor supply decision of older workers was mainly dominated by the income effect, and when wages increased, they tended to reduce working hours. In addition, the scatter distribution is highly dispersed, indicating substantial heterogeneity across individuals. Factors such as job type, health condition, and family factors may also influence labor supply behavior.

From the perspective of economic meaning, this result implies that, in Taiwan's older labor market in 2001, the traditional labor-supply mechanism in which the substitution effect and the income effect alternate in dominance is not obvious. In other words, the wage increase did not trigger a clear income effect causing workers to reduce working hours and increase leisure. Instead, the labor supply of older workers may have been affected more by institutional and structural factors, such as the availability of jobs, occupational constraints, and health conditions, so that even at relatively high wage levels, they still needed to maintain a certain number of working hours. Therefore, what this figure reflects is not a typical backward-bending labor supply curve, but rather that the labor supply of older workers responds relatively rigidly to changes in wages, supporting the empirical observation that the backward-bending labor supply phenomenon is not widespread among older workers in Taiwan.

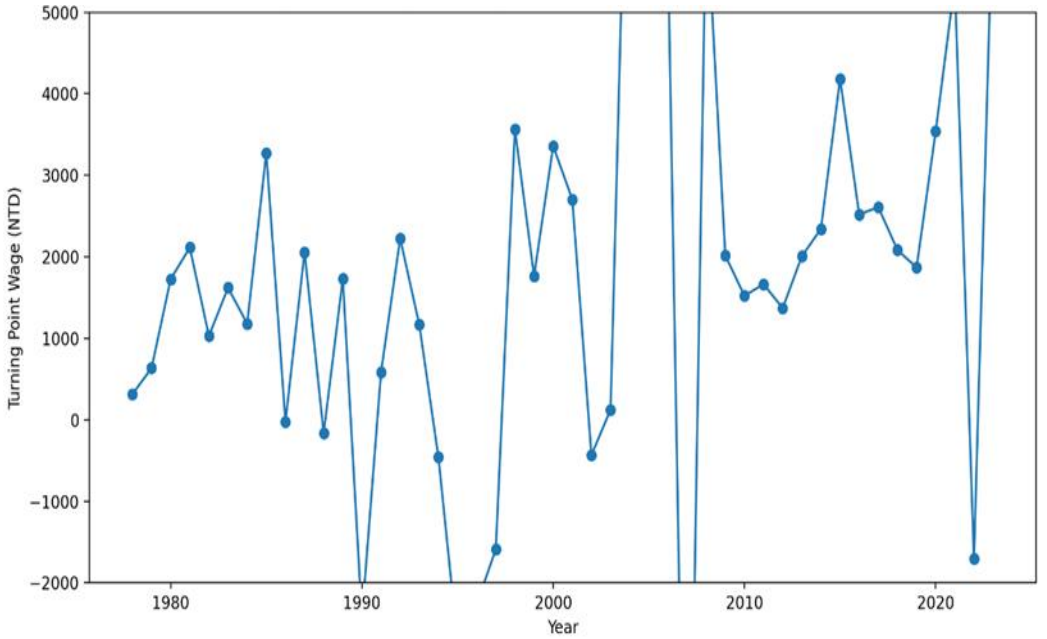

Figure 2: Turning wage (main model) (clipped -2000 to 5000)

Looking at the time trend of the annual turning wage values, clipped between -2000 and 5000, Figure 2 shows that in most years the turning wage fluctuates between -2,000 and 5,000. This indicates several implications:

First, large fluctuations in the turning wage reflect high heterogeneity in the effect of wages on labor supply across years, which may be affected by changes in labor market structure, employment opportunities, health conditions, and the institutional environment.

Second, turning wages above an hourly wage of 5,000 do not mean that wages are actually that high. Rather, they indicate that the model is almost not curved at all. When the turning wage is extremely large, it means that within the observed range the labor supply curve is almost monotonically increasing. This is because β_2 is very close to zero. Since $w^* = -\frac{\beta_1}{2\beta_2}$, a very small denominator causes w^* to become extremely large. This means that there is no substantive backward bend; there is only a mathematical turning wage in a technical sense.

Third, wages cannot be negative in the real world. If the model produces a negative turning wage, this follows from $w^* = -\frac{\beta_1}{2\beta_2}$. Therefore, when $\beta_1 < 0$ and $\beta_2 < 0$, it leads to $w^* < 0$. In economic terms, this means that the labor supply curve is downward-sloping from the very beginning, with no upward-sloping segment at all. As wages increase, working hours instead decrease, so the entire curve has a negative slope, implying that the main model is not stable.

In most years, the turning wage falls outside a reasonable range, showing that the estimated results are not economically meaningful. In addition, in some years the turning wage is negative, which also does not fit the actual wage range. Only in a small number of years does the turning wage fall within a reasonable interval, showing that backward-bending labor supply is not common.

From the perspective of economic meaning, this result shows that the labor-supply behavior of older workers does not exhibit a stable backward-bending characteristic; that is, wage increases do not systematically lead working hours to first increase and then decrease in the typical pattern.

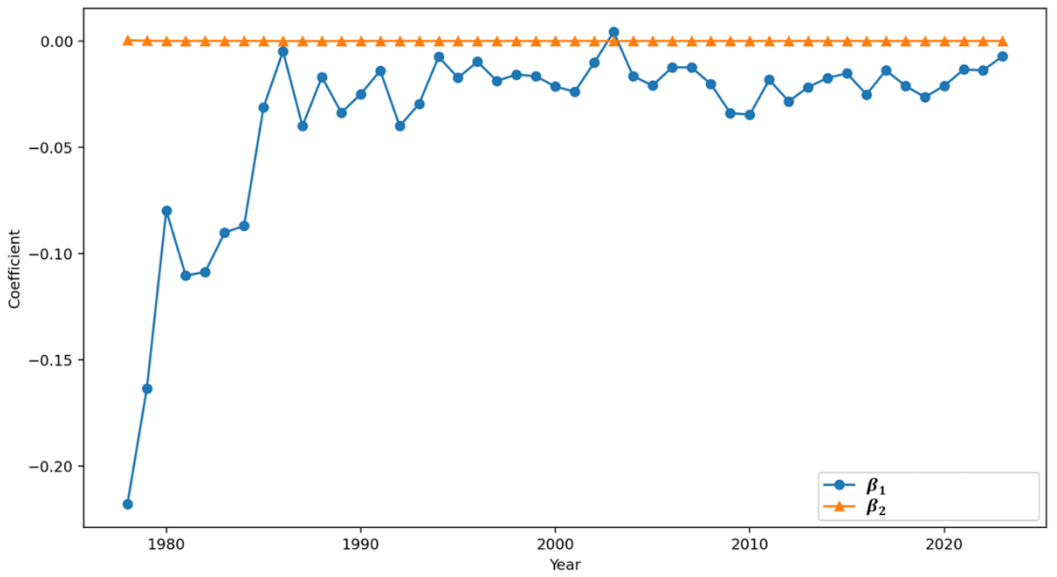

Figure 3: β_1 and β_2 coefficients of the main model

The x-axis of Figure 3 is Year, and the y-axis is Coefficient. Two shapes are used to distinguish the two coefficients: the dotted circle line represents β_1(wage), and the triangle line represents β_2(wage squared). The figure arranges the linear wage coefficient and the squared wage coefficient from the main model for each calendar year into a time-series line chart. Judging from the figure itself, in most years the linear wage coefficient(β_1) is below zero, and its absolute value generally tends to shrink over time. The squared wage coefficient(β_2) is close to zero in most years, usually with a small positive value, and turns negative only in a very small number of years. This indicates that, in most years, the combination of the linear wage term and the squared wage term does not stably present the theoretically expected pattern for backward-bending labor supply, namely a positive linear term and a negative squared term. In other words, judging only from coefficient signs, the labor-supply response of older workers in Taiwan in most years does not support a typical inverted-U labor supply curve.

In terms of economic meaning, this figure reflects that the response of older workers' labor supply to wage changes does not present a consistent and stable backward-bending structure over the long-term time series. In theory, if clear backward-bending labor supply existed, the substitution effect should dominate in the low-wage range so that wage increases raise working hours, while the income effect should dominate in the high-wage range so that working hours begin to decline. This would usually correspond to a positive linear coefficient and a negative squared coefficient. But this figure shows that this is not the case in most years, implying that the choice of working hours by older workers may not be driven mainly by wage levels, but may instead be more deeply affected by health conditions, job characteristics, employment opportunities, family arrangements,

and the institutional environment. Therefore, what Figure 3 presents is not only annual fluctuations in the coefficients, but also a further explanation that in Taiwan's older labor market, backward-bending labor supply may appear only in a few specific years rather than as a long-term universal phenomenon.

4.3 Robustness check model 1: ln wage regression model

4.3.1 Estimation results of robustness check model 1 for the labor supply of older workers

Table 4: Estimation results of robustness check regression model 1

Year	β_1	β_2	β_2 P-value	Turning Wage	Turning Wage Within Sample Range	Meets Backward-Bending Criteria
1978	12.75748999	-2.706241106	0.000927***	10.55975182	Yes	Yes
1979	10.85346389	-2.559308299	0.002321***	8.334387977	Yes	Yes
1980	8.009221722	-1.761645661	0.031604**	9.71063367	Yes	Yes
1981	9.126266128	-1.878671004	0.000000***	11.3465697	Yes	Yes
1982	15.69137533	-2.803834369	0.000283***	16.41506329	Yes	Yes
1983	16.74464420	-2.899266667	0.000132***	17.95265209	Yes	Yes
1984	10.47455942	-2.097741172	0.001470***	12.14148587	Yes	Yes
1985	7.310452398	-1.245836194	0.020480**	18.80182786	Yes	Yes
1986	10.38782154	-1.598348687	0.022443**	25.77868518	Yes	Yes
1987	4.407048706	-1.026736799	0.020483**	8.551813594	Yes	Yes
1988	17.55900606	-2.519091956	0.000000***	32.62848263	Yes	Yes
1989	14.31104769	-2.000147283	0.000020***	35.78391427	Yes	Yes
1990	18.15182108	-2.511225720	0.000004***	37.11925015	Yes	Yes
1991	5.819744728	-0.694349433	0.226079	66.07494119	Yes	No
1992	15.03791271	-2.220109110	0.000006***	29.56971872	Yes	Yes
1993	8.809993291	-1.372355880	0.005285***	24.77428874	Yes	Yes
1994	21.24313630	-2.510427598	0.000000***	68.78458589	Yes	Yes
1995	15.54224678	-2.021407801	0.000001***	46.73117480	Yes	Yes
1996	15.11808601	-1.818534273	0.000054***	63.8583841	Yes	Yes
1997	26.68092953	-3.210672336	0.000000***	63.7543714	Yes	Yes
1998	8.717773597	-1.153970953	0.002944***	43.69760704	Yes	Yes
1999	16.43248773	-1.930686473	0.000004***	70.49963377	Yes	Yes

2000	15.32717694	-1.949273872	0.000002***	50.98387255	Yes	Yes
2001	14.40776053	-1.856875708	0.000000***	48.40342252	Yes	Yes
2002	11.51791138	-1.485657873	0.003674***	48.2486265	Yes	Yes
2003	9.099710937	-1.092784778	0.020167**	64.29887507	Yes	Yes
2004	14.75073025	-1.899457351	0.000000***	48.56388216	Yes	Yes
2005	12.74822751	-1.658880083	0.000012***	46.63819527	Yes	Yes
2006	14.05019483	-1.624513856	0.000060***	75.52249739	Yes	Yes
2007	5.084673801	-0.780983279	0.110153	25.92745904	Yes	No
2008	18.86121578	-2.30857817	0.000002***	59.44363888	Yes	Yes
2009	11.50526618	-1.663846144	0.000148***	31.73534076	Yes	Yes
2010	32.53362876	-3.757547804	0.000000***	75.87625383	Yes	Yes
2011	-3.178991530	0.016215593	0.965959	3.72139E+42	No	No
2012	14.90369759	-1.931263766	0.000045***	47.39586450	Yes	Yes
2013	19.06310545	-2.220036005	0.000005***	73.21663042	Yes	Yes
2014	12.07003698	-1.448044009	0.000049***	64.56702171	Yes	Yes
2015	23.53100000	-2.562419246	0.000000***	98.64813554	Yes	Yes
2016	15.72645852	-2.00839739	0.000000***	50.15789858	Yes	Yes
2017	17.77682864	-1.973499506	0.000000***	90.36750503	Yes	Yes
2018	15.35056025	-1.850699813	0.000000***	63.25861111	Yes	Yes
2019	19.59011627	-2.32056775	0.000000***	68.0998397	Yes	Yes
2020	16.59980351	-2.073144983	0.000000***	54.79131773	Yes	Yes
2021	10.79411077	-1.44067106	0.000000***	42.3602043	Yes	Yes
2022	28.41938528	-3.098659538	0.000000***	98.07718135	Yes	Yes
2023	14.85269812	-1.56091221	0.000000***	116.4774979	Yes	Yes

Using the four judgment criteria - β_1 (substitution effect), β_2 (income effect), whether the turning wage falls within the sample wage range, and whether the p-value of β_2 is less than 0.1 - the empirical results in Table 4 show that, among the 46 years, 43 years satisfy the criteria for a backward-bending labor supply curve.

More years satisfy the backward-bending criteria under the log-wage robustness regression model, and possible reasons include the following:

First, the wage data are highly right-skewed. Because the squared term magnifies the influence of high-wage observations, a small number of high wages can make the estimation of the squared term unstable.

Second, the robustness check model 1 captures nonlinearity more easily. The effect of a wage increase is usually a proportional effect. For example, the incentive effect

of a wage increase from 100 to 110 is larger than that of an increase from 500 to 510. People usually respond to proportional changes in wages, so ln wage is closer to actual behavior.

Third, the robustness check model 1 also reduces heteroskedasticity. In the basic assumptions of OLS regression, the variance of the error term is fixed, but in much economic data the variance changes with a variable and usually increases with the wage level, making the variance of high-wage groups larger. Therefore, using logarithms can reduce heteroskedasticity.

The robustness check model 1 provides stronger evidence that the labor supply curve exhibits a backward bend. This result may be due to the highly right-skewed wage data and the existence of heteroskedasticity. Log transformation reduces the influence of extreme hourly wages and thereby identifies the nonlinear relationship between hourly wage and labor supply more clearly. In addition, labor supply decisions are usually affected by proportional rather than absolute changes in wages, which gives ln wage economic meaning.

In addition, in the empirical data of the robustness check model 1, most turning wages are below NTD 50 per hour. This may reflect a dominant income effect: older workers may already have pensions, savings, or support from children, so when wages rise they do not need to work more. It may also be because the labor-supply motivation of older workers is not to maximize earnings, but to pass time or maintain social interaction, so they do not give up leisure merely to raise income. It may also be related to labor market structure, as older workers are concentrated in low-wage jobs, informal sectors, and flexible working hours.

4.3.2 Shape and stability of the labor supply curve of older workers

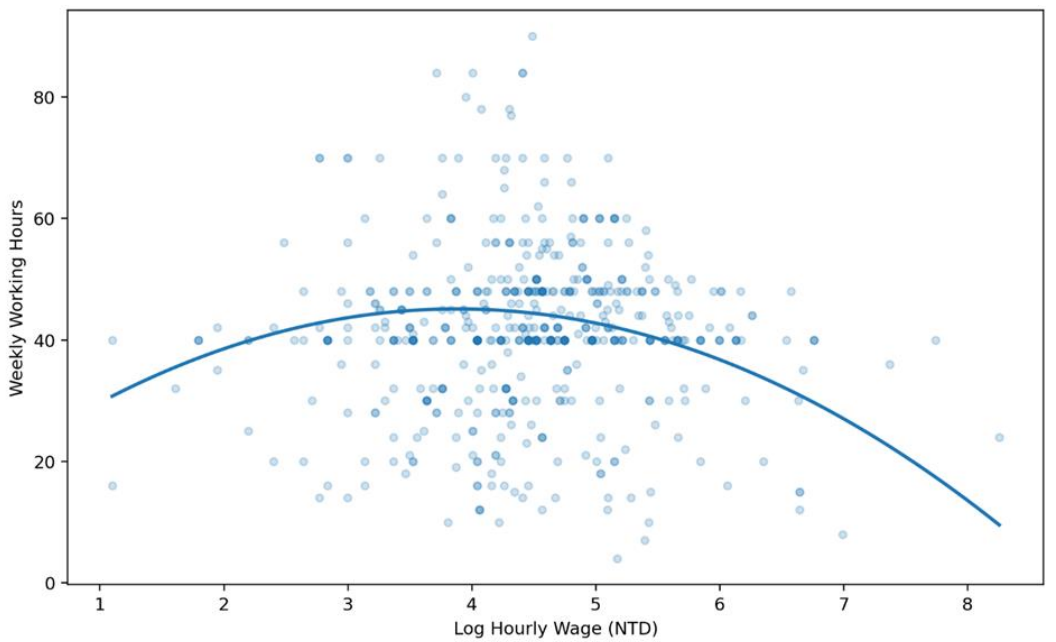

Figure 4: Labor supply curve (robustness check model 1), 2001

Figure 4 presents the relationship between ln hourly wage and weekly working hours in 2001 under robustness check model 1. The x-axis is ln hourly wage, and the y-axis is weekly working hours. The scatter plot reflects the distribution of individuals' labor supply at different wage levels, and the quadratic fitted line depicts the overall trend. It can be observed from the figure that the fitted curve presents an inverted-U structure, indicating that as wages increase, working hours first increase and then decrease, which is consistent with the theoretical prediction of backward-bending labor supply.

From the perspective of economic meaning, this result shows that under the log-wage specification, the labor-supply behavior of older workers exhibits nonlinear characteristics more clearly. In the low-wage stage, the substitution effect dominates, so wage increases strengthen work incentives and increase working hours. In the high-wage stage, the income effect gradually exceeds the substitution effect, causing workers to reduce working hours and increase leisure. Compared with the less obvious curve shape in the main model, this figure shows that log transformation can effectively reduce the influence of extreme values and strengthen the behavioral signal in the middle range, making the characteristics of backward-bending labor supply easier to identify.

Therefore, this result supports the existence of backward-bending labor supply under a specific model specification, but it also shows that the result is highly sensitive to variable transformation, reflecting the dependence of empirical findings on model specification.

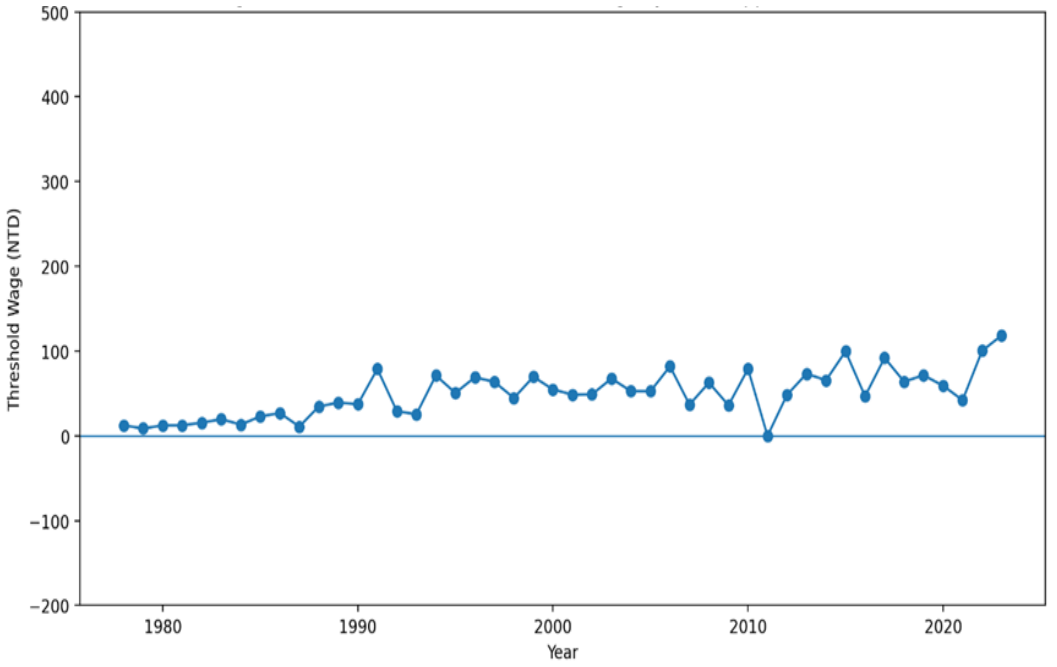

Figure 5: Robustness check model 1: turning wage by year (clipped -200 to 500)

For each year, Figure 5 first calculates the turning wage under robustness check model 1, then converts the turning wage back into NTD and plots it as a yearly sequence. Figure 5 shows the annual turning wages of backward-bending labor supply estimated by robustness check model 1 from 1978 to 2023. Overall, the turning wage in most years falls within a reasonable and observable sample range, and 43 out of the 46 years satisfy the criteria for backward-bending labor supply, indicating that the nonlinear response of older workers' labor supply to wages is highly robust. Compared with the main model, robustness check model 1 presents a more consistent and stable backward-bending labor supply phenomenon.

From the perspective of economic meaning, this figure shows that under Robustness Check Model 1, which uses ln wage, the turning wage of older workers' labor supply has a relatively stable and economically meaningful distribution. In most years, the turning wage is concentrated at about NTD 40 to NTD 100, indicating that around this wage interval, labor supply shifts from being dominated by the substitution effect to being dominated by the income effect; that is, workers begin to reduce working hours and increase leisure at this level. Such a result is consistent with the prediction of the inverted-U curve in standard labor-supply theory and shows that, when facing wage changes, older workers do indeed experience the interaction of the substitution effect and the income effect. In addition, the turning wage shows a slow upward trend over time, which also reflects changes in the overall labor market environment, such as the rise in real wage levels, changes in living costs, and changes in the labor-participation motivation of older workers. As time progresses, workers require a higher wage level before shifting from work toward leisure, and this may be related to improvements in health, the trend toward later retirement, and changes in employment patterns. Therefore, this figure not only reflects the labor-supply characteristics of a single year, but also reveals structural change in the older labor market over the long run.

Finally, this figure also has important methodological implications. The results show that if the original wage variable is used directly, extreme values and distributional skewness may make the estimated turning wage unstable and even strip it of economic meaning. By contrast, log transformation can effectively compress the influence of high-wage observations, making the estimated results more concentrated in the main range of the sample and thereby improving the explanatory power and stability of the model. Therefore, the findings of this study emphasize that, when analyzing the labor supply of older workers, model specification and variable transformation are not merely technical choices, but choices that substantially affect judgments and conclusions about economic behavior.

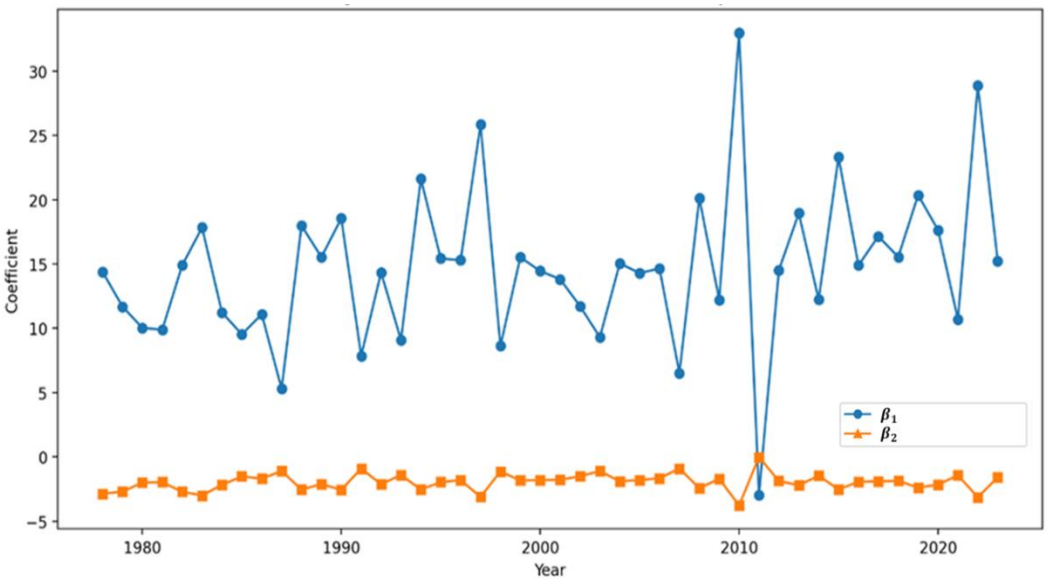

Figure 6: Robustness check model 1 coefficients by year

Figure 6 presents the estimated coefficients of ln wage and its squared term in each year under Robustness Check Model 1. The x-axis is year, and the y-axis is the coefficient value, with zero used as the benchmark line for judging whether the coefficients are positive or negative. Two shapes are used to distinguish the two coefficients: the dotted circle line represents ln wage, and the triangle line represents ln wage squared. It can be observed from the figure that the coefficient of ln wage is positive in most years, while the coefficient of its squared term is negative in most years. Although the two sets of coefficients fluctuate across years, the overall trend is relatively stable. This means that the labor supply of older workers and wages generally exhibit a nonlinear relationship, which is consistent with the theoretical expectation of backward-bending labor supply.

In terms of economic meaning, this figure reflects that the response of older workers' labor supply to wage changes presents a relatively stable and consistent nonlinear relationship in the log-wage model. A persistently positive coefficient on ln wage means that in the lower wage range, wage increases raise labor supply, showing that the substitution effect dominates. A persistently negative coefficient on ln wage squared means that when wages rise further, the income effect gradually strengthens and workers begin to reduce their working hours, forming backward-bending labor supply. More importantly, this relationship still exists after using ln wage, indicating that the backward-bending phenomenon is not caused by extreme wage values but has strong robustness. In other words, the nonlinear response of older workers' labor supply to wage changes has a structural characteristic rather than being the result of the sample distribution. Therefore, Figure 6 provides stronger evidence than the main model in support of the existence of backward-bending labor supply to some extent in the sample of older workers in Taiwan, and this existence is relatively stable over the long-term annual data.

4.4 Robustness check model 2: pooled sample regression model

4.4.1 Estimation results of robustness check model 2 for the labor supply of older workers

Table 5: Estimation results of robustness check model 2

Year	β_1	β_2	β_2 P-value	Turning Wage	Turning Wage Within Sample Range	Meets Backward-Bending Criteria
1978-2023	0.0004	-9.830E-10	0.0006***	189770.7995	Yes	Yes

The pooled-year robustness regression model also satisfies the criteria for backward-bending; however, the value of β_2 is very small, and the implied turning wage is as high as 189,790, which lies far outside a plausible economic range. This indicates that the backward-bending relationship is not a stable average effect across years, but rather has year-specific heterogeneity. In other words, the backward-bending phenomenon appears in some years, rather than existing on average in all years. Possible reasons are the year-specific heterogeneity of labor supply:

1. Business cycles.
2. Policy institutions, such as changes in labor insurance, retirement systems, pension reform, and the minimum wage.
3. Labor market structure, such as changes in employment opportunities for older workers, the part-time market, and the share of self-employment; these structural changes alter the labor-supply response.

4.4.2 Shape and stability of the labor supply curve of older workers

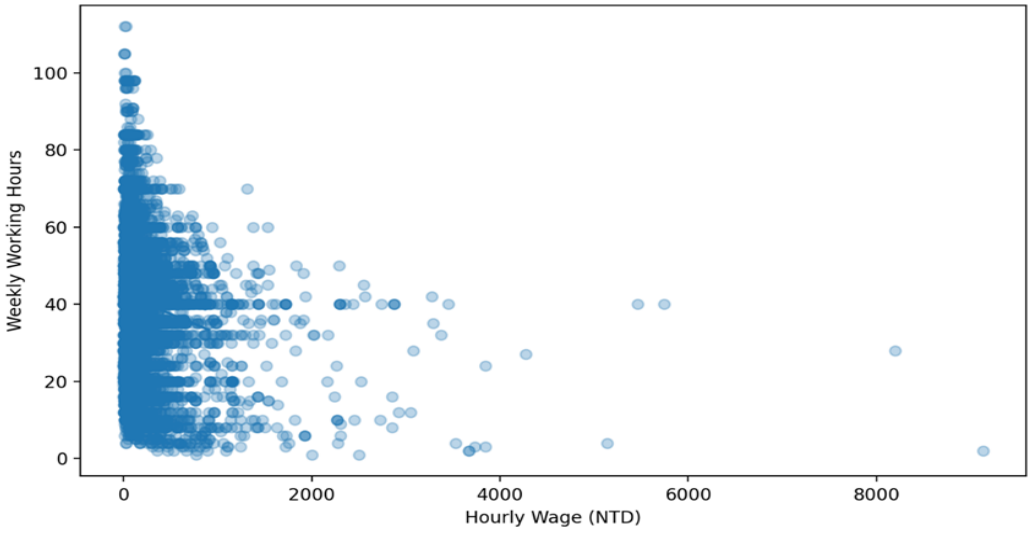

Figure 7: Labor supply curve (robustness check model 2, pooled data)

Under robustness check model 2, Figure 7 shows that within the main wage distribution range, the relationship between weekly working hours and hourly wage is generally flat or slightly downward sloping, and no clear inverted-U structure is observed. This visual result is consistent with the graph from the main model, showing that after controlling for individual characteristics and structural factors, the response of labor supply to wage changes does not show a significant nonlinear turning point. However, it should be emphasized that relying only on graphical interpretation may underestimate or blur potential nonlinear effects. Therefore, this study does not use the graph itself as the basis for determining backward-bending labor supply, but instead combines the signs and significance of the regression coefficients with conditions such as whether the turning wage falls within the sample range. Overall, robustness check model 2 does not show a clear backward-bending pattern in the graph, but its empirical conclusion still needs to be evaluated comprehensively on the basis of statistical inference results.

5. Conclusion

5.1 Main findings

This study uses long-term cross-sectional data from Taiwan from 1978 to 2023 to examine whether the labor supply of older workers exhibits a backward-bending labor supply curve. The empirical analysis is conducted using a main model and two robustness check models to ensure the stability and reliability of the results. Overall, the results show that although a nonlinear relationship exists between labor supply and wages, whether a backward-bending labor supply curve exists depends heavily on model specification and measurement methods.

In the main model, although the inclusion of wage and its squared term captures some nonlinear effects, most years do not simultaneously satisfy the criteria for a backward-bending labor supply curve. This means that the coefficients do not consistently exhibit the expected positive and negative pattern, or the turning wage does not fall within the observable sample range. This indicates that after controlling for individual characteristics and structural factors, the response of older workers' labor supply to wage changes is limited. The backward-bending phenomenon is not commonly observed.

In contrast, the robustness check model 1 using ln wage shows that in most years, the linear wage term is positive and the squared term is negative, and the turning wage falls within the sample range. This indicates that the backward-bending labor supply is consistently observed across years under this specification. This suggests that the backward-bending characteristic is not a short-term or random phenomenon, but a pattern that appears persistently in long-term data.

On the other hand, the second robustness check model produces results that lie between the main model and the ln wage model. Although some years satisfy the backward-bending condition, the graphical results do not clearly show an inverted U-shape. In addition, the turning wage is sensitive to extreme values and fluctuates significantly across years. This suggests that the robustness check model 2 is

sensitive to data distribution and may require cautious interpretation. Overall, this study finds that although labor supply and wages have a nonlinear relationship, the existence of a backward-bending labor supply curve is highly dependent on model specification.

Based on the results of the three models, this study finds that a nonlinear relationship indeed exists between labor supply and wages among older workers. However, whether the backward-bending labor supply holds is highly dependent on model specification. The main model shows that the backward-bending phenomenon is not prevalent. In contrast, robustness check model 1 provides stronger and more consistent support. robustness check model 2 shows partial support but exhibits lower stability. This finding indicates that the backward-bending labor supply is not a single and stable structural characteristic in the labor market of older workers in Taiwan. Instead, it may be influenced by factors such as functional form, data scaling, and sample distribution.

5.2 Contributions

This study makes several important contributions to the literature on labor supply of older workers.

First, this study uses long-term data covering multiple decades, allowing observation of changes in labor supply behavior over time. Compared to studies using only single-year data, this provides a more comprehensive understanding of long-term trends.

Second, this study conducts year-by-year regression analysis and estimates turning wages for each year. This allows a more detailed examination of the nonlinear relationship between wages and labor supply.

Third, this study incorporates both statistical significance and economic meaning when evaluating backward-bending labor supply. It also examines whether the turning wage falls within the sample range. This improves the credibility of the conclusions.

5.3 Policy implications

The empirical results of this study show that a certain degree of nonlinear relationship indeed exists between labor supply and wages among older workers. However, the backward-bending labor supply curve is not universally present across all years. In most cases, the labor supply of older workers still exhibits a positive relationship. That is, an increase in wages is usually accompanied by an increase in working hours. This result implies that, under the current labor market environment in Taiwan, most older workers still have incentives to continue participating in the labor market. Wages remain an important factor influencing their labor supply.

Second, the results show that increases in wages generally lead to an increase in working hours among older workers. This indicates that the substitution effect remains dominant. This implies that if the government aims to increase labor force participation among older workers, wage incentives or related subsidy policies may

still be effective. For example, increasing wage levels for older workers, providing employment subsidies, or offering tax incentives may encourage older workers to extend their participation in the labor market. This result also supports the rationale of government policies that promote delayed retirement and encourage employment among older workers.

Third, this study finds that the backward-bending labor supply phenomenon appears only in some years. In some cases, the turning wage falls outside the sample wage range. This indicates that most older workers have not yet reached the stage at which increases in income would lead to a substantial reduction in working hours. This implies that, for most older workers, economic needs remain an important motivation for labor supply. From a policy perspective, this may reflect that retirement protection for older workers is still insufficient. Alternatively, their income replacement rate after retirement has not yet reached a level that would allow them to fully exit the labor market. Therefore, improving the retirement protection system and strengthening economic security in old age remain important policy directions.

Fourth, the results of the control variables show that different demographic characteristics and family structures also affect the labor supply of older workers. For example, gender differences reflect differences in labor market participation patterns between men and women. When older workers receive more financial support from children or family, their labor supply may decrease. This indicates that the family support system still plays an important role in labor supply decisions among older workers. Therefore, when formulating employment policies for older workers, factors such as family structure and intergenerational support should also be taken into consideration.

Fifth, after incorporating job status and regional fixed effects, the results show that different employment types and regional labor market conditions also have significant effects on the labor supply of older workers. For example, self-employed individuals usually have greater flexibility in working hours. Differences in industrial structure and employment opportunities across regions may also affect labor participation among older workers.

Therefore, when promoting employment policies for older workers, differences in regional labor market conditions and employment types should also be considered. Policymakers should avoid adopting overly uniform policy measures.

Overall, the results of this study show that the labor supply of older workers does not generally exhibit a backward-bending pattern. Wage incentives remain an important factor influencing labor participation among older workers.

However, as population aging accelerates and retirement systems continue to evolve, labor supply behavior among older workers may undergo further changes in the future. Therefore, when formulating relevant policies, the government should not only provide wage and employment incentives, but also continue to improve the retirement protection system and the employment environment for older workers. This would help promote stable participation of the older population in the labor market.

5.4 Limitations and future research

This study still has several limitations in its empirical analysis. First, the wage variable is derived from individual income and working hours. This may give rise to endogeneity problems. For example, working hours themselves are also influenced by labor supply decisions. As a result, they may be correlated with the error term and affect the accuracy of the estimation results. Second, the data used in this study are cross-sectional data. They can only reflect the status of different individuals in each year. They are unable to track changes in the labor supply behavior of the same individual over time. They also make it difficult to capture dynamic adjustment processes and individual heterogeneity. In addition, the data lack direct observations of individual wealth and pension status. This makes the measurement of the income effect potentially incomplete. It may further affect the interpretation of the backward-bending labor supply mechanism. Based on the above limitations, future research may further incorporate panel data. This would allow observation of changes in individual labor supply across different stages of the life cycle. At the same time, it is recommended to include wealth survey data and information related to pension systems. This would help to more comprehensively capture the effects of individual assets and institutional incentives on labor supply decisions. It would thereby enable more precise and in-depth analysis of labor supply behavior among older workers.

References

[1] Blundell, R., & MaCurdy, T. (1999). Labor supply: A review of alternative approaches. In O. Ashenfelter & D. Card (Eds.), Handbook of Labor Economics (Vol. 3A, pp. 1559-1695). Amsterdam: Elsevier.

[2] Börsch-Supan, A. H., & Coile, C. (2018). Social Security Programs and Retirement Around the World: Reforms and Retirement Incentives-Introduction and Summary (NBER Working Paper No. 25280). National Bureau of Economic Research.

[3] Chetty, R., Guren, A., Manoli, D., & Weber, A. (2011). Are micro and macro labor supply elasticities consistent? A review of evidence on the intensive and extensive margins. American Economic Review Papers & Proceedings, 101(3), 471-475.

[4] Coile, C., Milligan, K., & Wise, D. A. (2017). Introduction to Social Security Programs and Retirement around the World: The Capacity to Work at Older Ages. In D. A. Wise (Ed.), Social Security Programs and Retirement around the World: The Capacity to Work at Older Ages (pp. 1–33). University of Chicago Press.

[5] Erosa, A., Fuster, L., & Kambourov, G. (2016). Towards a micro-founded theory of aggregate labour supply. Review of Economic Studies, 83(3), 1001-1039.

[6] French, E. (2005). The effects of health, wealth, and wages on labour supply and retirement behavior. Review of Economic Studies, 72(2), 395-427.

[7] Hausman, J. A. (1981). Labor supply. In H. J. Aaron & J. A. Pechman (Eds.), How taxes affect economic behavior (pp. 27–72). Washington, DC: Brookings Institution.
[8] Heckman, J. J. (1974). Shadow prices, market wages, and labor supply. Econometrica, 42(4), 679-694.
[9] Killingsworth, M. R. (1983). Labor Supply. Cambridge: Cambridge University Press.
[10] Maestas, N. (2010). Back to work: Expectations and realizations of work after retirement. Journal of Human Resources, 45(3), 718-748.
[11] Manoli, D. S., & Weber, A. (2016). The effects of the early retirement age on retirement decisions. NBER Working Paper No. 22561. Cambridge, MA: National Bureau of Economic Research.
[12] Mincer, J. (1962). Labor force participation of married women: A study of labor supply. In H. G. Lewis (Ed.), Aspects of Labor Economics (pp. 63-105). Princeton, NJ: Princeton University Press.
[13] OECD. (2019). Working better with age. Paris: OECD Publishing.
[14] OECD. (2023). OECD Employment Outlook 2023: Artificial Intelligence and the Labour Market. Paris: OECD Publishing.
[15] Wu, M.-Y. (2012). Houwan laodong gongji quxian yu jingji fazhan: Yi Taiwan laodong shichang wei li [後彎勞動供給曲線與經濟發展 - 以台灣勞動市場為例] [The backward-bending labor supply curve and economic development: Evidence from Taiwan's labor market] (Master's thesis). National Central University.
[16] Wu, W.-C. (2024). Taiwan de houwan laodong gongji quxian: Shizheng, chayi yu jieshi [臺灣的後彎勞動供給曲線: 實證、差異與解釋] [The backward-bending labor supply curve in Taiwan: Empirical evidence, heterogeneity, and explanations] (Master's thesis). Tamkang University.
[17] Directorate-General of Budget, Accounting and Statistics, Executive Yuan. (1978–2023). Renli yunyong diaocha [人力運用調查] [Manpower utilization survey] [Data set]. Republic of China (Taiwan).