Online Appendix – "The Impact of Heat Hazard on Gig Economy Workers: Evidence from an On-demand Food Delivery Platform"

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A1 Different Insurance Structures regarding Heat Injuries

In our cross-country comparison, we focus on four institutional dimensions that shape the extent to which heat-related health risks faced by platform couriers are internalized by workers, platform firms, or the public sector: the legal classification of couriers, whether heat-induced illnesses are recognized as occupational injuries, the allocation of medical and compensation costs, and the presence of national heat-risk regulatory frameworks. These dimensions jointly determine how extreme heat externalities are distributed across society and differ substantially across countries.

Several countries have already instituted legal and regulatory mechanisms to address heat exposure among couriers. In Spain, couriers are presumptively classified as employees, and heat-related conditions such as heatstroke are explicitly recognized as work accidents, with medical treatment and disability compensation financed through employer-funded social insurance (Real Decreto Legislativo 8/2015; Real Decreto-ley 9/2021). South Korea adopts a comparable structure by including delivery couriers within the category of "special-type workers" covered under the national Industrial Accident Compensation Insurance, which provides full reimbursement for heat-related occupational illnesses, with premiums jointly financed by platforms and workers (International Labour Organization, 2024). Singapore's Platform Workers Act establishes a quasi-employment framework under which heat-induced occupational injuries, once medically certified, are fully compensated, with all associated costs borne by platform operators (Government of Singapore, 2024).

In contrast, some jurisdictions offer much weaker protections. In California, couriers are classified as independent contractors under Proposition 22 and are therefore excluded from state workers' compensation systems; coverage is limited to platform-purchased occupational accident insurance that applies only when couriers are "online/on-trip" (State of California, 2020). The United Kingdom provides the least institutional support: couriers are treated as self-employed and thus ineligible for occupational injury benefits. Although the National Health Service (NHS) covers free medical treatment, income losses from heat-related illness receive no statutory protection (Department of Health & Social Care, 2023; UK Supreme Court, 2023). Table A2 provides a summary.

A2 Model-free Evidence

Figure A2 provides model-free evidence of the relationship between air temperature and courier performance. The X-axis represents the temperature, while the Y-axis in the eight panels represents the number of orders, working time, the probability of delays, and hourly income. The four panels in the left column show the situation in Shanghai, while the four panels in the right column show the situation in Hangzhou. Overall, the relationships between temperature and performance metrics are consistent across both cities. This suggests that the impact of heat on gig workers' performance is not city-specific but rather a broader trend that can be generalized across different urban environments with similar climate conditions.

A3 Semiparametric Selection-Correction Approach

To address concerns about reliance on the parametric structure of the conventional Heckman model, we conduct an additional robustness check using a semiparametric selection-correction approach, motivated by the literature on flexible control-function methods for sample selection (Das et al., 2003; Bazzi, 2017). The conventional Heckman estimator relies on the assumption that the error terms in the selection and outcome equations follow a joint normal distribution. In contrast, the semiparametric approach adopted here relaxes this distributional assumption and approximates the selection correction term using a flexible series expansion, thereby allowing for a more general functional form. Specifically, we estimate the following equations:

$$Work_{ict} = \alpha_0 + \alpha_1 HeatHazard_{ct} + \boldsymbol{\alpha X_{ict}} + \epsilon_{ict} \tag{A1}$$

$$Performance_{ict} = \beta_0 + \beta_1 HeatHazard_{ct} + \boldsymbol{\beta Z_{ict}} + \theta f(\widehat{Work_{ict}}) + \mu_{ict} \tag{A2}$$

Relative to the baseline parametric Heckman specification, this approach differs in two key respects. First, we do not impose joint normality of the disturbance terms. Second, the correction term $f(\widehat{Work_{ict}})$ is constructed using a flexible polynomial series in the fitted values from the first-stage regression.

In practice, we estimate the selection equation (Equation (A1)) using a linear probability model and use the resulting fitted values (i.e., $\widehat{Work_{ict}}$ in Equation (A2), reported as *Fitted work* in tables) to construct the control function. We approximate $f(\widehat{Work_{ict}})$ using the linear, quadratic, and cubic terms of *Fitted work*, and include these terms as additional controls in the outcome equation (Equation (A2)), which is estimated by OLS. The corresponding results are reported in Table A16. The results remain consistent with our baseline findings, suggesting that the main conclusions are not driven by the specific parametric assumptions of the standard Heckman procedure.

A4 Heterogeneity Analysis

A4.1 Peak versus Non-peak Hour

Panel A of Table A19 presents the result of the analysis on heterogeneous effects during peak versus non-peak hours. Peak hours are defined based on Panel (a) of Figure A1, specifically as 10:00–13:00 and 17:00–19:00 each day. We create a binary variable (referred to as "peak hour" in Panel A of Table A19) that takes the value of 1 for observations during these peak hours, and 0 for other time slots. We include the interaction term between this binary variable and *Heat Hazard* in Equation (2). Since we control for hour fixed effects, the peak hour variable itself is absorbed by these time fixed effects. The results in Panel A of Table A19 indicate that, compared to non-peak hours, hot weather conditions during peak hours lead to couriers accepting more orders, working longer time, having a higher likelihood of delays, and earning more money. It is easy to understand that couriers are more likely to be fully occupied when the food orders surge in a short time (i.e., peak hours), and it can lead to more delays due to the congestion of food orders exceeds the couriers' capacity.

A4.2 Experienced versus Inexperienced Couriers

Panel B of Table A19 presents the heterogeneous effects by courier experience. Because we do not observe the exact timing of a courier's entry onto the platform, we proxy for this information using

the first appearance in our data. Specifically, we treat couriers who appear within the first seven days of the sample as likely having joined before the sample period and exclude them from the analysis. We then focus on couriers who first appear after this initial window. For these couriers, we measure experience by the cumulative number of orders completed up to a given hour on a given day.[23] We then include an interaction term between this experience measure and *Heat Hazard* in Equation (2). The results in Panel B of Table A19 indicate that, compared to less experienced couriers, those with more experience are able to complete more number of orders and earn more amount of money in the same time and with a similar probability of delay under hot weather conditions. These findings support the conventional wisdom that experience enhances efficiency and helps workers perform better in challenging conditions (Lin et al., 2023).

A5 Back-of-the-Envelope Estimation

A5.1 Medical Expenditure based on Chinese Health Studies

Agarwal et al. (2021) utilize a random sample of inpatient visit claims from the Urban Resident Basic Medical Insurance (URBMI) and Urban Employee Basic Medical Insurance (UEBMI) programs, covering 47 cities across 28 provinces in China. The dataset spans three years (2008-2010) and includes detailed information such as hospitalization admission dates, patients' ages and genders, diagnoses for each visit, and billing details.[24] Specifically, they define an extremely hot day as one with a daily average temperature higher than 27°C. We list some medical expenditures for both insurers and patients in Appendix Table A18. Different from Agarwal et al. (2021), Li et al. (2023) focus on the impact of extreme temperature on the out-of-pocket medical expenditure. They use the data from China Family Panel Studies (CFPS) Survey which covers 162 counties or districts (counties thereafter) across 25 mainland provinces that represent 95% of the total population in China for the years 2014, 2016, and 2018. Their estimation shows that individuals have to pay at least 181.9 RMB for each extremely hot day (exceeding 32°C).

In Table 2, we use the estimates from Agarwal et al. (2021) to calculate the "Increased Total Bill" columns, and the number of hot days is that of days exceeding 27°C, which is 32 days in our data. We use the estimates from Li et al. (2023) to calculate the "Self-paid Expense" columns, and the number of hot days is that of days exceeding 32°C, which is 7 days in our data sample.

Specifically, Appendix Table A18 presents the increase of medical expenditure (¥/RMB) for an additional extremely hot day (exceeding 27°C) for the whole sample, the subsample of Male, and the subsample of diseases related with hot weather (i.e., Endocrine, nutritional, and metabolic diseases and immunity disorders) in Agarwal et al. (2021).[25] According to Table 1 in Agarwal et al. (2021), which provides summary statistics of hospital visits, 50.516% of the whole sample consists of male patients, and 5.112% of the whole sample has the diseases of endocrine, nutritional, and metabolic diseases and immunity disorders. This implies that the medical expenditure for the

[23] We standardize the experience variable to range between 0 and 1 and include it in Equation (2).

[24] These billing details encompass total charges, reimbursed amounts by insurance, copayments made by the insured, and expenses not covered by the insurance schemes, which are self-funded by the insured.

[25] The "whole sample" refers to a representative sample of 100,000 individuals in China. The "male" subsample refers to the male individuals within this sample (the number of male individuals is $100{,}000 \times 50.516\% = 50{,}516$), and the disease-specific subsample refers to individuals diagnosed with the corresponding conditions (the number of individuals with the disease is approximately $100{,}000 \times 5.112\% \approx 5{,}111$).

male subsample (120,561.6 RMB) and the diseases sample (32,084.81 RMB), as listed in Appendix Table A18, corresponds to approximately 50,516 male patients and 5,111 patients, respectively. Therefore, for benchmark ($\gamma = 1$), the average medical expenditure for a male patient (or a diseases patient) on a hot day is 2.4 RMB (or 6.3 RMB), which is higher than the overall average of 1.7 RMB per patient. For a group of 500 actively working male couriers, the total increase in medical costs due to heatwaves during the sample period would amount to approximately 38,185.3 RMB ($\approx 2.4 \times 32 \times 500$). The corresponding numbers for the "Diseases" row are similarly calculated. With numbers obtained for the benchmark case, the increased total bills for the cases of courier's exposed to heat ($\gamma = 8.8$) and courier's increased working time ($\gamma = 9.5$) can be easily calculated.

Note that Li et al. (2023) does not have the specific amount of expenses for the subsample of male, and it does not have a subsample of the same diseases specified by Agarwal et al. (2021). We then use the scale calculated from Agarwal et al. (2021) to estimate the self-fund expense for male and disease. Specifically, in Agarwal et al. (2021), the increased total bill of male is around 1.421 times the average level, while that of diseases is around 3.738 times. So we calculate, for example, the benchmark case for the self-fund expense made by male as ¥1,273.2 × 1.421 = ¥1,809.2. For the self-fund expenses of diseases documented by Agarwal et al. (2021), we simply calculate as ¥1,273.2 × 3.738 = ¥4,759.2, which should be the lower bound of the expense.

A5.2 Illustrative Examples of Social-Cost Calculations

To estimate long-run social costs, we adopt a three-step accounting framework.

Step 1: From heat exposure to health incidents. We map heat exposure into attributable health incidents using established exposure–response relationships from the epidemiological literature. These relationships quantify how each additional extreme-heat day affects mortality, emergency-department (ED) visits, and hospitalizations. Because couriers experience substantially higher outdoor exposure than the general population, we scale baseline incidence using an *exposure multiplier* (EM). We evaluate three scenarios: EM = 1 (general-population baseline), EM = 3 (moderate exposure), and EM = 9.5 (high exposure, based on our empirical estimates).

Step 2: Translating incidents into monetary burdens. We convert predicted incidents into monetary losses using (i) expected mortality, (ii) the value of a statistical life (VSL), and (iii) direct medical expenditures for heat-related ED visits and hospital admissions. Empirical inputs are drawn from Deschênes and Greenstone (2011), who estimate 0.936 excess deaths per 100,000 people per very-hot day, and Woolf et al. (2023), whose national extrapolation implies 291,000 treated heat-related cases over 80 hot days. The average medical cost per acute case is $3,479. All values are scaled to per-person, per-heat-day measures and then multiplied by the EM.

Step 3: Allocating social costs across stakeholders. Finally, we allocate total health-related costs across couriers, platforms, and public insurers under alternative insurance and regulatory regimes. These allocations are illustrative and follow the country-level mappings summarized in Table A2. We report scenarios where couriers bear 50%, 10% and 0% of total cost in Table 3.

We consider three populations: a small city (1,000 couriers), a medium city (5,000 couriers), and a large metropolitan area (100,000 couriers). Our calculations use the following assumptions.

- **Mortality incidence and reduced life-years.** Based on Deschênes and Greenstone (2011), the per-person mortality incidence for an additional very-hot day is $m_0 = 9.36 \times 10^{-6}$. Their estimate of 5.95 million lost life-years over 2010–2039 implies a per-person daily value of lost statistical life of $v_0 = 0.18112$ after normalizing by a 300-million population and assuming \$100,000 for the value of a statistical life.
- **Heat-day window.** We consider 30 extreme-heat days.
- **Medical-case incidence and cost.** Woolf et al. (2023) imply a per-person per-heat-day medical-case incidence of $med_0 = 1.215 \times 10^{-5}$, and a mean cost per treated case of \$3,479.
- **Exposure multiplier.** All incidence measures scale proportionally with EM.

For a courier population of size N, expected incidents and costs over 30 heat days are computed:

$$\text{ExpDeaths} = m_0 \times EM \times N \times 30, \qquad \text{ReducedVSL} = v_0 \times EM \times N \times 30,$$

$$\text{MedCases} = med_0 \times EM \times N \times 30, \qquad \text{MedCost} = \text{MedCases} \times 3{,}479.$$

Table A20 shows that (i) social costs rise sharply with exposure intensity, (ii) aggregate burdens scale linearly with the size of the courier workforce, (iii) mortality dominates the total social cost.

A6 Supplemental Figures and Tables

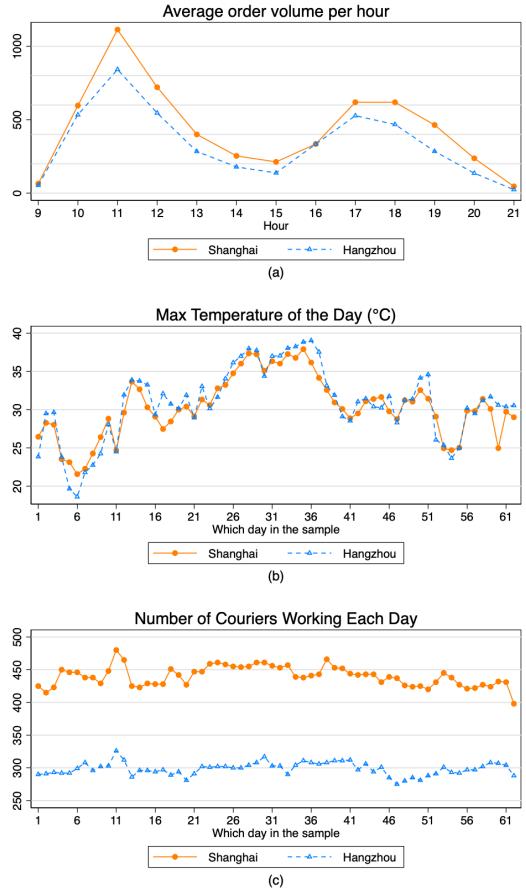


Figure A1. Pattern of Order Volume, Temperature, and Couriers

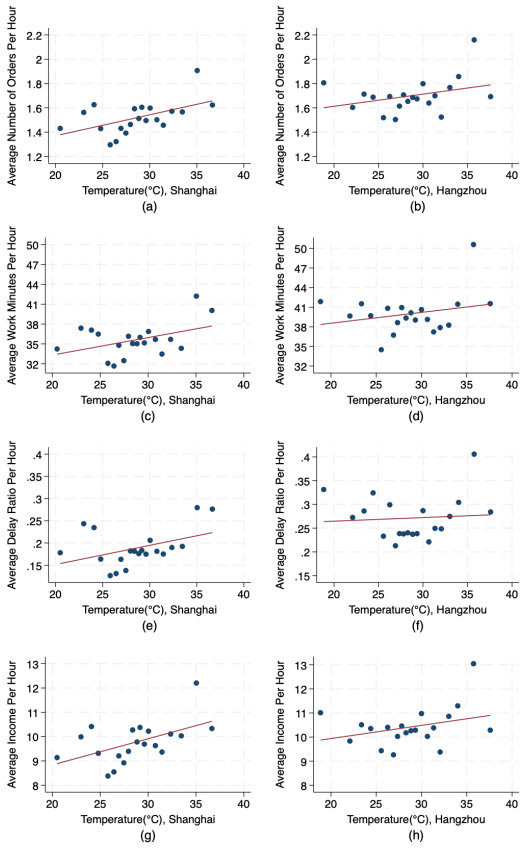


Figure A2. Relationship between Air Temperature and Courier Performance

Table A1. Summary of Different Heat Cost Estimation

Region / Country	Source	Period	Key Findings	Cost Type		
				Mortality	VSL	Hospital Cost
85 European Cities	Huang et al. (2023)	2015–2017	· VSL: Economic welfare loss of €192 per adult urban resident per year. · Mortality: Urban Heat Island increases summer mortality risk by +45%.	✓	✓	
UK (England)	Mehrhof and Bunn (2024)	2022 Summer	· Total deaths: Summer 2022 heatwaves caused 2,985 excess deaths in England.	✓		
USA (nationwide)	Deschênes and Greenstone (2011)	1968–2002	· Life-years reduced within 2010–2039: 5.95 million life-years. · Mortality: One additional day >32°C increases annual mortality rate by +0.11%.	✓	✓	
	Woolf et al. (2023)	2016–2020	· Total medical bill: Direct heat-related medical costs exceed $1 billion per summer. · Case volume: 235,000 ER visits + 56,000 hospitalizations annually.			✓
	Limaye et al. (2019)	2012	· Total health costs for 10 climate events ranged $2.7–$24.6 billion. · Impact: 917 deaths, 20,568 hospitalizations.	✓	✓	✓
Western Australia	Tong et al. (2021)	2006–2012	· Total medical bill: Baseline heat-attributable hospital costs estimated at AUD 79.5 million.			✓
Canada (BC)	Canadian Climate Institute (2023)	2021 Heat Dome	· Mortality welfare loss: 619 deaths valued at CAD 5.5 billion. · Direct healthcare cost: ER and hospital treatment costs totaled CAD 12 million.	✓	✓	✓
Spain (Nationwide)	Achebak et al. (2024)	2006–2019	· Hospital burden: Heat-illness +20–40%; Renal failure +10–15%; Metabolic +5–10%.			✓

Table A2. Summary of Different Insurance Structures regarding Heat Injuries across Countries

Country	Legal Status of couriers (with basis)	Heat Injury = Occupational Injury?	Who Pays?	Heat Exposure Protection Measures
Spain	Employee (Rider Law, Real Decreto-ley 9/2021).	— (LGSS framework: Real Decreto Legislativo 8/2015) Heatstroke cannot be treated as force majeure; therefore, is a work accident when occurring during work.	**Platform:** 100% work-injury insurance contributions (Real Decreto-ley 4/2023). **Government:** covers medical treatment. **Couriers:** 0%	**Royal Decree-Law 4/2023:** during AEMET orange/red alerts, employers must adapt working hours, reschedule tasks, or suspend outdoor work. Applies fully to couriers as employees (Real Decreto-ley 4/2023).
South Korea	Special-type worker / platform labour provider (International Labour Organization (2024)).	— (covered under IACI; includes heatstroke if job-related) IACI = Industrial Accident Compensation Insurance covering platform couriers.	**Platform:** 50% of IACI premium. **Couriers:** 50% of IACI premium. **Government:** 0%. **Medical costs:** 100% covered by IACI	**MOEL Press Release:** mandatory 20-minute rest every two hours in extreme heat; cool water; rest shelters; guidance for delivery companies; coordination with local governments (Ministry of Employment and Labor (2025)).
Singapore	Platform worker (statutory category) with protections (Platform Workers Act: Government of Singapore (2024)).	— (WICA-equivalent protection; compensable when medically certified) (Government of Singapore (2024)).	**Platform:** 100% work-injury insurance + medical compensation. **Government:** 0% **Couriers:** 0%	**MOM 2024 Heat Stress Framework:** mandatory acclimatization; water; rest breaks (≥10 min/hr. at WBGT ≥32°C); hourly WBGT monitoring; rescheduling; emergency plan (Ministry of Manpower (2024)).
United States (California)	Independent contractor (Proposition 22: State of California (2020)).	— (under Prop 22; couriers excluded from Workers' Compensation) (State of California (2020)). Couriers receive platform-funded occupational accident insurance while working.	**Platform:** 100% occupational accident insurance + health-care stipend (Prop 22) (State of California). **Government:** 0% **Couriers:** 0%	**Cal/OSHA §3395:** portable water; shade (> 80°F); cool-down rest; high-heat procedures (> 95°F); acclimatization; emergency procedures. Applies to employees; contractors excluded (California Division of Occupational Safety and Health (2020)).
United Kingdom	Self-employed independent contractor (Supreme Court on courier status: UK Supreme Court (2023)).	— (HSWA duties apply mainly to employees/workers; couriers treated as neither) (HSWA 1974: United Kingdom Parliament (1974)).	**Government (NHS):** provides clinically necessary treatment free at point of use (Department of Health & Social Care (2023)). **Platform:** 0% **Couriers:** 0%	**HSE Heat-Stress Guidance:** assess heat risk, provide water, rest breaks, shade/cooling, reschedule hours; does not legally apply to self-employed couriers (Health and Safety Executive (nd)).

Table A3. Summary Statistics

Variable	Definition	N	Mean	SD	Min	Max
Panel A: at courier-hour level						
Work	If a courier works during a specific hour = 1; otherwise = 0.	518,704	0.590	0.492	0.000	1.000
Number of orders	The number of orders a courier receives and accepts during a specific hour.	306,065	1.777	0.958	1.000	9.000
Work minutes	The number of minutes a courier works during a specific hour.	306,065	41.182	16.507	0.000	60.000
Delay ratio	The proportion of delayed orders among all orders received by a courier during a specific hour.	306,065	0.259	0.391	0.000	1.000
Income	The income earned by a courier during a specific hour.	306,065	11.157	6.006	5.000	59.000
Past 7-day hourly attendance rate	The share of days during the preceding seven days on which the courier was active in the same hour.	306,065	0.698	0.274	0.000	1.000
Hourly rate	The average earnings per courier in a given city and hour.	306,065	11.157	3.316	5.500	20.451
Panel B: at city-hour level						
Order volume	The total number of delivery orders in a city during a specific hour.	1,585	384.440	273.060	12.000	1,325.000
Throughput time	The average duration between consumer placing an order and consumer receiving the ordered meal per hour in a city.	1,585	33.978	6.465	23.777	60.917
Variability	$CV_a^2 + CV_p^2$	1,585	5.131	3.081	0.577	16.708
Delay ratio	The proportion of delayed orders among all orders in a city during a specific hour.	1,585	0.225	0.154	0.000	0.931
Total revenue	The platform's total revenue in a city during a specific hour.	1,585	23,235.531	18,827.727	296.000	102,514.102
Heat Hazard	Heat index falls within danger or extreme danger categories = 1; otherwise = 0.	1,585	0.108	0.310	0.000	1.000
Temperature	The temperature in a city at a specific hour.	1,585	28.611	4.247	17.543	39.050
Panel C: at order level						
Food expenditure	The food expenditure of this delivery order.	585,994	57.931	44.608	1.000	267.000
New customer	An indicator for whether an order is placed by a new customer, new=1, otherwise=0.	585,994	0.416	0.493	0.000	1.000
Food expenditure next 7 days	The food expenditure of this customer in the 7 days following this order.	538,156	127.897	228.733	0.000	4,587.200
Number of orders next 7 days	The total number of orders placed by this customer in the 7 days following this order.	538,156	2.624	5.292	0.000	127.000
Panel D: at consumer-day level						
Order dummy	Take the value 1 if the consumer placed at least one order on that day and 0 otherwise.	8,850,438	0.061	0.240	0.000	1.000
Number of orders	Measure how many orders a consumer placed on that day.	8,850,438	0.070	0.299	0.000	28.000

Table A4. Determinants of Delivery Fees

Variable	(1) Delivery fee	(2) Delivery fee	(3) Delivery fee	(4) Delivery fee	(5) Delivery fee
Distance	1.711***	1.710***	1.710***	1.710***	1.693***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Food expenditure			-0.000***	-0.000***	-0.000***
			(0.000)	(0.000)	(0.000)
Temperature			0.002***	0.001***	0.001***
			(0.000)	(0.000)	(0.000)
Rainfall			0.002***	0.001	0.001
			(0.001)	(0.001)	(0.001)
Observations	585,994	585,994	585,994	585,994	585,994
R-squared	0.714	0.714	0.714	0.714	0.721
City FE	NO	YES	YES	YES	YES
Hour FE	NO	YES	YES	YES	YES
Day of Week FE	NO	NO	NO	YES	YES
Month FE	NO	NO	NO	YES	YES
Courier FE	NO	NO	NO	NO	YES
Mean of dept. var.	6.267	6.267	6.267	6.267	6.267

Notes. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Table A5. Controlling for Hourly Order Volume

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.048***	0.175***	3.051***	0.062***	1.033***
	(0.012)	(0.023)	(0.352)	(0.011)	(0.137)
Past 7-day hourly attendance rate	1.728***				
	(0.012)				
Hourly rate	-0.008				
	(0.005)				
Hourly order volume	0.001***				
	(0.000)				
IMR		-0.546***	-8.457***	0.083***	-3.475***
		(0.045)	(0.695)	(0.019)	(0.274)
Constant	-1.929	2.670	145.696***	1.431	12.692
	(1.631)	(3.198)	(48.455)	(1.651)	(19.371)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.339	0.462	0.198	0.317
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.0808	0.0987	0.0741	0.239	0.0926

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A6. Controlling for Weather Forecast

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.066***	0.176***	3.052***	0.062***	1.034***
	(0.014)	(0.023)	(0.352)	(0.011)	(0.138)
Past 7-day hourly attendance rate	1.729***				
	(0.012)				
Hourly rate	0.055***				
	(0.005)				
Forecasted max temperature	-0.002				
	(0.003)				
Forecasted min temperature	0.006				
	(0.004)				
Forecasted rain dummy	-0.006				
	(0.011)				
Forecasted wind dummy	0.007				
	(0.014)				
IMR		-0.535***	-8.467***	0.072***	-3.406***
		(0.043)	(0.652)	(0.019)	(0.259)
Constant	0.242	2.678	145.838***	1.431	12.743
	(1.813)	(3.209)	(48.610)	(1.650)	(19.451)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.339	0.462	0.198	0.317
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.112	0.0989	0.0741	0.238	0.0927

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A7. Controlling for Traffic Congestion

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.072***	0.172***	3.002***	0.061***	1.014***
	(0.013)	(0.022)	(0.349)	(0.011)	(0.136)
Past 7-day hourly attendance rate	1.729***				
	(0.012)				
Hourly rate	0.056***				
	(0.005)				
Congestion index	0.003	-0.026***	-0.396***	-0.005**	-0.159***
	(0.005)	(0.008)	(0.144)	(0.004)	(0.049)
IMR		-0.531***	-8.371***	0.073***	-3.384***
		(0.043)	(0.649)	(0.019)	(0.258)
Constant	-0.187	3.417	156.950***	1.579	17.203
	(1.770)	(3.188)	(48.717)	(1.643)	(19.317)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.339	0.462	0.198	0.318
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.123	0.0970	0.0729	0.236	0.0909

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A8. Retain Couriers Who Continue to Work during Extreme Heat Conditions

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.218***	0.189***	3.222***	0.048***	1.083***
	(0.031)	(0.030)	(0.418)	(0.012)	(0.174)
Past 7-day hourly attendance rate	1.367***				
	(0.038)				
Hourly rate	0.046***				
	(0.010)				
IMR		-0.864***	-14.981***	-0.022	-5.735***
		(0.116)	(2.144)	(0.055)	(0.729)
Constant	5.476*	0.219	82.539	0.134	-13.458
	(2.961)	(3.821)	(52.598)	(1.812)	(21.915)
Observations	52,489	38,020	38,020	38,020	38,020
R-squared	-	0.377	0.476	0.183	0.361
Mean(y)	0.724	1.870	42.25	0.227	11.50
Coef(x) / Mean(y)	0.301	0.101	0.0763	0.210	0.0942

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A9. Analyze Instances of Extreme Weather Occurring during a Shift

Variable	(1) Number of orders	(2) Work minutes	(3) Delay ratio	(4) Income
Heat hazard	0.197***	3.742***	0.084***	1.173***
	(0.027)	(0.480)	(0.016)	(0.157)
Constant	0.871	92.342	1.036	3.000
	(2.659)	(57.847)	(2.045)	(15.692)
Observations	175,082	175,082	175,082	175,082
R-squared	0.206	0.388	0.180	0.182
Mean(y)	1.614	44.01	0.249	10.08
Coef(x) / Mean(y)	0.122	0.0850	0.338	0.116

Notes. The data used in this table are at the courier–hour level. All regressions include fixed effects for month, day of week, hour, and courier. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable and the last row reports the coefficient on Heat hazard scaled by the mean of the dependent variable. Standard errors in parentheses are conventional cluster-robust standard errors clustered at the city–hour level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A10. Timestamp of Order Completion as the Reference Time Point

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.050***	0.177***	3.312***	0.065***	1.027***
	(0.018)	(0.021)	(0.357)	(0.010)	(0.123)
Past 7-day hourly attendance rate	1.715***				
	(0.010)				
Hourly rate	0.073***				
	(0.006)				
IMR		-0.637***	-15.204***	-0.006	-4.038***
		(0.040)	(0.772)	(0.022)	(0.240)
Constant	-4.033*	2.992	144.820***	0.991	13.135
	(2.301)	(2.707)	(46.446)	(1.613)	(16.078)
Observations	557,388	311,932	311,932	311,932	311,932
R-squared	-	0.333	0.436	0.211	0.304
Mean(y)	0.560	1.745	41.54	0.265	10.95
Coef(x) / Mean(y)	0.0895	0.101	0.0797	0.245	0.0938

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A11. Robustness Checks with a Balanced Panel

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Panel A: Newly Registered Couriers					
Heat hazard	0.157***	0.091***	2.797***	0.075***	0.599***
	(0.022)	(0.021)	(0.426)	(0.012)	(0.135)
Past 7-day hourly attendance rate	2.316***				
	(0.017)				
Hourly rate	0.004				
	(0.006)				
IMR		-0.508***	-3.828***	0.089***	-3.028***
		(0.038)	(0.725)	(0.022)	(0.246)
Constant	8.387***	-0.882	147.990***	4.053**	-13.123
	(2.764)	(2.858)	(55.504)	(1.640)	(18.129)
Observations	142,909	44,261	44,261	44,261	44,261
R-squared	-	0.277	0.471	0.220	0.262
Mean(y)	0.310	1.655	41.62	0.349	10.33
Coef(x) / Mean(y)	0.507	0.0548	0.0672	0.216	0.0580
Panel B: Balanced Courier–hour Panel					
Heat hazard	0.073***	0.179***	3.110***	0.062***	1.056***
	(0.010)	(0.023)	(0.355)	(0.011)	(0.139)
Past 7-day hourly attendance rate	2.808***				
	(0.010)				
Hourly rate	0.024***				
	(0.003)				
IMR		-0.329***	-4.404***	0.075***	-2.069***
		(0.019)	(0.324)	(0.009)	(0.116)
Constant	1.397	2.593	144.569***	1.445	12.204
	(1.365)	(3.239)	(49.040)	(1.648)	(19.646)
Observations	892,384	306,065	306,065	306,065	306,065
R-squared	-	0.339	0.462	0.198	0.317
Mean(y)	0.343	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.213	0.101	0.0755	0.237	0.0946

Notes. Panel A reports results using a sample that retains all post-entry courier-hour observations for newly registered couriers. Panel B reports results using a fully balanced courier-hour panel. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A12. Alternative Estimation and Fixed-Effects Specifications

Variable	(1) Number of orders	(2) Work minutes	(3) Delay ratio	(4) Income	(5) Number of orders	(6) Work minutes	(7) Delay ratio	(8) Income
Panel A: OLS with baseline fixed effects					*Panel B: Heckman second stage with calendar-date fixed effects*			
Heat hazard	0.181***	3.137***	0.061***	1.068***	0.062***	1.462***	0.019	0.383**
	(0.023)	(0.356)	(0.011)	(0.140)	(0.029)	(0.463)	(0.014)	(0.175)
IMR					-0.430***	-7.080***	0.110***	-2.772***
					(0.039)	(0.588)	(0.017)	(0.234)
Constant	2.624	144.992***	1.438	12.402	-0.446	481.047***	5.204	0.784
	(3.259)	(49.179)	(1.645)	(19.766)	(9.373)	(118.248)	(5.072)	(56.352)
Observations	306,065	306,065	306,065	306,065	306,065	306,065	306,065	306,065
R-squared	0.338	0.461	0.198	0.316	0.345	0.469	0.206	0.323
Mean(y)	1.777	41.18	0.259	11.16	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.102	0.0762	0.236	0.0958	0.0346	0.0355	0.0737	0.0344

Notes. Panel A reports OLS estimates without selection correction and includes month, day-of-week, hour-of-day, and courier fixed effects. Panel B reports second-stage estimates from the Heckman two-step model with calendar-date, hour-of-day, and courier fixed effects. Its first-stage selection equation includes calendar-date, hour-of-day, and city fixed effects, as well as *Past 7-day hourly attendance rate* and *Hourly rate*. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. Standard errors in parentheses are clustered at the city–hour level. Significance in Panel A is based on conventional cluster-robust inference; significance in Panel B is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. In each panel, Mean(y) reports the mean of the dependent variable, and the final row reports the coefficient on Heat hazard relative to this mean. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A13. Focus on the Onset of a Heat-Hazard Episode

Variable	(1) Number of orders	(2) Work minutes	(3) Delay ratio	(4) Income
Heat hazard	0.048	4.366***	-0.027	0.525
	(0.102)	(0.637)	(0.024)	(0.562)
PM2.5	0.001	0.122***	0.000	-0.000
	(0.002)	(0.018)	(0.000)	(0.014)
Ozone	-0.005***	-0.051***	-0.001**	-0.028***
	(0.002)	(0.017)	(0.000)	(0.010)
Atmospheric pressure	0.074***	1.706***	0.043***	0.417***
	(0.026)	(0.180)	(0.005)	(0.148)
Wind speed	-0.027	0.265	-0.041***	-0.157
	(0.047)	(0.424)	(0.015)	(0.273)
Wind direction	0.001	0.021***	-0.001***	0.002
	(0.001)	(0.006)	(0.000)	(0.005)
Constant	-71.371***	-1,667.772***	-42.224***	-400.402**
	(26.130)	(180.261)	(5.206)	(148.355)
Observations	6,661	6,661	6,661	6,661
R-squared	0.453	0.734	0.408	0.453
Mean(y)	2.278	48.06	0.423	13.93
Coef(x) / Mean(y)	0.0213	0.0908	-0.0648	0.0377

Notes. The data used in this table are at the courier–hour level. All regressions include fixed effects for month, day of week, hour, and courier. The environmental control variable *Rainfall* is omitted because there is no raining occurrence in our selected data sample. The second-to-last row reports the mean of the dependent variable and the last row reports the coefficient on Heat hazard scaled by the mean of the dependent variable. Standard errors in parentheses are conventional cluster-robust standard errors clustered at the city–hour level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A14. Robustness Checks Using Alternative Measures of Heat

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Panel A: Temperature					
Temperature	0.012***	0.031***	0.534***	0.011***	0.180***
	(0.002)	(0.004)	(0.059)	(0.002)	(0.022)
Relative humidity	0.004***	0.006***	0.146***	0.003***	0.036***
	(0.001)	(0.001)	(0.017)	(0.001)	(0.006)
Past 7-day hourly attendance rate	1.728***				
	(0.012)				
Hourly rate	0.056***				
	(0.005)				
IMR		-0.526***	-8.242***	0.077***	-3.361***
		(0.043)	(0.652)	(0.019)	(0.261)
Constant	-2.469	-0.607	52.772	-0.570	-6.556
	(1.823)	(3.318)	(51.589)	(1.667)	(20.066)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.339	0.462	0.198	0.317
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.0209	0.0175	0.0130	0.0430	0.0161
Panel B: Heat index					
Heat index	0.001***	0.005***	0.053***	0.001***	0.029***
	(0.000)	(0.001)	(0.014)	(0.000)	(0.005)
Past 7-day hourly attendance rate	1.728***				
	(0.012)				
Hourly rate	0.059***				
	(0.005)				
IMR		-0.560***	-8.697***	0.064***	-3.565***
		(0.044)	(0.666)	(0.019)	(0.266)
Constant	-0.822	1.665	109.057**	0.663	6.546
	(1.756)	(3.197)	(49.746)	(1.617)	(19.301)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.338	0.460	0.196	0.316
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.00217	0.00277	0.00130	0.00400	0.00256

Notes. Panel A reports the results using temperature as the measure of heat, while Panel B reports the results using the heat index. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Temperature or Heat index relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A15. Remove *Hourly Rate* from the Heckman Two-step Estimation

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.120***	0.179***	3.096***	0.063***	1.057***
	(0.014)	(0.023)	(0.356)	(0.011)	(0.140)
Past 7-day hourly attendance rate	1.728***				
	(0.012)				
IMR		-0.170***	-4.160***	0.191***	-1.168***
		(0.033)	(0.568)	(0.015)	(0.203)
Constant	0.662	2.648	145.565***	1.412	12.564
	(1.914)	(3.258)	(49.186)	(1.646)	(19.761)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	-	0.338	0.461	0.198	0.317
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.203	0.101	0.0752	0.243	0.0947

Notes. Column (1) reports first-stage selection estimates from the Heckman two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full Heckman procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A16. Semiparametric Sample Selection Model

Variable	(1) Work	(2) Number of orders	(3) Work minutes	(4) Delay ratio	(5) Income
Heat hazard	0.032***	0.165***	3.011***	0.062***	0.970***
	(0.004)	(0.023)	(0.357)	(0.010)	(0.139)
Past 7-day hourly attendance rate	0.542***				
	(0.004)				
Linear term of fitted work		-0.094	-14.918***	-0.097*	-0.416
		(0.131)	(2.390)	(0.068)	(0.822)
Quadratic term of fitted work		-0.890***	19.512***	-0.135	-5.390***
		(0.262)	(4.241)	(0.124)	(1.608)
Cubic term of fitted work		1.078***	-5.330***	0.138**	6.459***
		(0.156)	(2.317)	(0.070)	(0.947)
Constant	0.598	2.286	143.864***	1.549	10.262
	(0.518)	(3.253)	(49.288)	(1.644)	(19.729)
Observations	518,704	306,065	306,065	306,065	306,065
R-squared	0.377	0.341	0.462	0.198	0.319
Mean(y)	0.590	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.0537	0.0928	0.0731	0.239	0.0869

Notes. The model has excluded *Hourly Rate* in the selection model. Column (1) reports first-stage selection estimates from the two-step procedure; Columns (2)–(5) report second-stage outcome estimates. The first stage includes month, day-of-week, hour, and city fixed effects, while the second stage includes month, day-of-week, hour, and courier fixed effects. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable, and the last row reports the coefficient on Heat hazard relative to this mean. Standard errors in parentheses are clustered at the city–hour level. Statistical significance in Columns (2)–(5) is based on a cluster bootstrap-t procedure with 1,000 replications that re-estimates the full semiparametric two-step procedure in each replication. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A17. Controlling for the Number of Working Couriers

Variable	(1) Number of orders	(2) Work minutes	(3) Delay ratio	(4) Income
Heat hazard	0.138***	2.530***	0.060***	0.773***
	(0.022)	(0.351)	(0.011)	(0.132)
Number of working couriers	0.002***	0.029***	0.000***	0.014***
	(0.000)	(0.004)	(0.000)	(0.002)
IMR	-0.462***	-7.436***	0.075***	-2.908***
	(0.040)	(0.617)	(0.018)	(0.240)
Constant	0.230	111.938**	1.333	-4.197
	(3.023)	(46.330)	(1.658)	(18.033)
Observations	306,065	306,065	306,065	306,065
R-squared	0.341	0.463	0.198	0.320
Mean(y)	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.0776	0.0614	0.233	0.0693

Notes. The data used in this table are at the courier–hour level. All regressions include fixed effects for month, day of week, hour, and courier. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. The second-to-last row reports the mean of the dependent variable and the last row reports the coefficient on Heat hazard scaled by the mean of the dependent variable. Standard errors in parentheses are conventional cluster-robust standard errors clustered at the city–hour level. Statistical significance is based on a cluster bootstrap-t procedure with 1,000 replications, where the full estimation procedure is re-estimated in each replication using city–hour–level resampling. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A18. Impact of Extremely Hot Temperature on Medical Bills Related to Inpatient Services

	Total bill (per 100k population)	Covered by insurers (per 100k population)	Covered by patients (per 100k population)
Whole sample	¥167,895.5	¥153,399.3	¥14,496.3
Males	¥120,561.6	¥118,853.9	¥1,707.7
Diseases	¥32,084.81	¥26,209.56	¥5,875.25

Notes. We only list the increase of medical expenditure (¥/RMB) for an additional extremely hot day (exceeding 27°C) for the whole sample, the subsample of male patients and the subsample of diseases related with hot weather (i.e., Endocrine, nutritional, and metabolic diseases and immunity disorders) in Agarwal et al. (2021).

Table A19. Heterogeneity Analyses

Variable	(1) Number of orders	(2) Work minutes	(3) Delay ratio	(4) Income
Panel A				
Heat hazard × Peak Hour	0.128***	0.945**	0.057***	0.757***
	(0.028)	(0.541)	(0.014)	(0.168)
Heat hazard	0.082***	2.358***	0.020***	0.478***
	(0.021)	(0.452)	(0.010)	(0.127)
IMR	-0.532***	-8.417***	0.073***	-3.393***
	(0.043)	(0.650)	(0.019)	(0.258)
Constant	2.825	146.929***	1.496	13.616
	(3.197)	(48.498)	(1.648)	(19.371)
Observations	306,065	306,065	306,065	306,065
R-squared	0.339	0.462	0.198	0.318
Mean(y)	1.777	41.18	0.259	11.16
Coef(x) / Mean(y)	0.072	0.0229	0.2201	0.0678
Panel B				
Heat hazard × Experience	0.337***	3.062**	0.027	2.072**
	(0.150)	(1.830)	(0.061)	(1.023)
Heat hazard	0.054***	2.466***	0.070***	0.348**
	(0.028)	(0.514)	(0.015)	(0.174)
Experience	0.092**	0.754	-0.013	0.405
	(0.060)	(1.066)	(0.034)	(0.367)
IMR	-0.668***	-6.399***	0.052**	-4.031***
	(0.062)	(1.143)	(0.034)	(0.389)
Constant	0.117	160.036***	4.045**	-8.592
	(2.902)	(58.020)	(1.755)	(18.582)
Observations	44,261	44,261	44,261	44,261
R-squared	0.278	0.471	0.220	0.262
Mean(y)	1.655	41.62	0.349	10.33
Coef(x) / Mean(y)	0.2036	0.0736	0.0774	0.2006

Notes. All regressions include fixed effects for month, day of week, hour, and courier. All specifications control for PM2.5, ozone, atmospheric pressure, wind speed, wind direction, and rainfall. In both panels, the second-to-last row reports the mean of the dependent variable and the last row reports the coefficient on Heat hazard × Peak Hour or Heat hazard × Experience scaled by the mean of the dependent variable. Standard errors in parentheses are conventional cluster-robust standard errors clustered at the city–hour level. Statistical significance is based on a cluster bootstrap-t procedure with 1,000 replications, where the full estimation procedure is re-estimated in each replication using city–hour–level resampling. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A20. Illustrative heat-related health impacts and social costs over a 30-day window

City (couriers)	Exposure measure	Expected deaths (30d)	Reduced value of statistical life years	Medical cases (30d)	Medical cost (USD)	Total cost (USD)
Small (1,000)	1	0.28	$5,434	0.36	$1,265	$6,699
Small (1,000)	3	0.84	$16,301	1.09	$3,796	$20,098
Small (1,000)	9.5	2.67	$51,621	3.46	$12,022	$63,643
Medium (5,000)	1	1.40	$27,169	1.82	$6,327	$33,496
Medium (5,000)	3	4.21	$81,507	5.46	$18,983	$100,489
Medium (5,000)	9.5	13.33	$258,105	17.28	$60,111	$318,216
Metro (100,000)	1	28.08	$543,379	36.38	$126,549	$669,928
Metro (100,000)	3	84.24	$1,630,137	109.13	$379,646	$2,009,783
Metro (100,000)	9.5	266.76	$5,162,101	345.56	$1,202,212	$6,364,312

Notes: Expected deaths and medical cases are estimated over a 30-day extreme-heat window. Exposure measure scales population-level heat–health incidence to reflect differential courier exposure. Reduced value of statistical life years monetizes mortality risk using benchmark valuation assumptions. Total cost is the sum of mortality-related welfare loss and direct medical expenditures.