初探台灣飲料市場需求體系

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Abstract

This paper investigates the long-term effects of job displacement on earnings and mental health using administrative health claims data from Taiwan. Focusing on job loss resulting from mass layoffs, our estimates suggest a displaced worker experienced a 40% decline in employment rates and a 67% earning loss in the year following a layoff. Even after ten years, employment and earnings do not fully recover. Displaced workers also experience a deterioration in mental health, particularly related to stress, with a 16% increase in outpatient visits for mental health issues and a 57% increase in medical costs for mental illness. The negative impact on mental health is more pronounced among workers with lower earnings, men, and older individuals.

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1 前言

1.1 研究背景

新型冠狀病毒 (COVID-19) 自 2019 年出現, 累計至 2023 年 1 月全球已約 6.7 億人確診, 造成 682 萬人死亡, 堪稱是本世紀最嚴重的傳染疾病。爲避免疫情擴散, 許多國家採取管制措施, 諸如禁止邊境進出、限制民衆外出、餐廳禁止內用及取消大型活動等, 這些措施嚴重衝擊國內外經濟, 以美國爲例, 2020 年第二季國內生產毛額 (GDP) 較 2019 年同季萎縮 9%, 失業率飆升至 14.8%。

1.2 研究目的

台灣在 2020 年 1 月 21 日發現首起本土確診病例, 且在 2 月 15 日出現首起死亡案例。雖然後續的防疫政策奏效, 疫情相較其他國家輕微, 但民衆因疫情肆虐恐慌減少正常活動, 再加上邊境管制,[1] 使國內經濟活力受到相當大的影響, 2020 年第 2 季經濟成長率僅 0.63%, 其中又以批發及零售業、餐飲業、運輸及倉儲業首當其衝。[2]

It is widely recognized that worker displacement can result in long-term earnings losses (**???**). Moreover, research has demonstrated that it is associated with heightened risk for health issues and increased mortality rates (**??????**). Despite significant research on the topic, the relationship between job loss and mental health remains somewhat ambiguous and poses challenges. On one hand, job loss can result in financial difficulties, loss of status, and social disconnection (**??**), which can contribute to feelings of anxiety and depression. On the other hand, job loss may alleviate some of the mental health problems that comes with working. Although numerous studies have explored the impact of job loss on mental health, there is no consensus on the extent of its effects (**?**), and some studies have even found no significant impact (**??**).

[1] 中央流行疫情指揮中心宣布從 3 月 19 日零時起, 非台灣籍人士一律限制入境。

[2] 依行政院主計總處公布之 2020 年第 2 季國內生產毛額連鎖實質成長率 (與去年同期相較), 服務業整體爲 -1.33%, 其中以運輸及倉儲業的 -26.19%, 其他 (含餐飲業) -4.04%, 與批發及零售業的 0.17% 表現最差。

2 文獻回顧

在探討台灣飲料市場的需求系統時，我們主要聚焦於消費者健康意識的增強，以及不同產品價格對於消費者偏好的影響。針對美國飲料市場，? 的研究運用「近似理想需求系統」（AIDS）模型分析了不同飲料的需求彈性，揭示了各類產品在奢侈性和必需性上的特徵。研究發現，非碳酸飲料的支出彈性較高，因此被視爲奢侈品，而咖啡和茶則顯示其作爲必需品的屬性。這表明，消費者在價格和支出上對不同飲料的需求具有顯著的敏感性差異。

? 在日本市場的研究中，運用了 LA/QUAIDS 模型，分析健康標籤和功能性成分對消費者偏好的影響。該研究指出，不同年齡層的消費者對飲料的偏好存在顯著差異：年輕人更傾向於選擇果汁和牛奶，而老年人則偏好茶飲。此外，溫度對飲料需求的影響也十分顯著，隨著氣溫上升，冷飲的需求增加，而熱飲需求則有所下降。這些結果展示了人口統計因素與季節性變化在需求系統中的重要性，對於理解台灣市場中不同飲料在不同氣候條件下的需求特徵具有參考價值。

? 的研究表明，飲料製造商正逐步響應消費者對健康產品需求的變化，通過減少產品中的糖、鈉及人工甜味劑，並引入「低糖」、「低鈉」等健康標籤來吸引消費者。與此同時，? 的文獻回顧聚焦於歐洲地區軟性飲料（soft drinks）的消費模式，結合各國代表性飲食調查數據，探討了健康意識增強、政策干預及人口結構對飲料需求的影響。這些研究爲健康政策的制定及市場需求的精準分析提供了實證支持。

此外，? 提出了一個全面的消費行爲模型，揭示了健康認知、社會影響和媒體資訊在驅動功能性飲料需求中的核心作用。該研究指出，消費者在面臨健康威脅時，對具有增強免疫力、抗氧化或促進整體健康功能的飲料表現出更高的需求彈性。

隨著消費者對含糖飲料（SSBs）健康風險的認知不斷加深，市場對低糖或無糖飲料的需求也呈現出顯著的增長趨勢，尤其在青少年和老年消費者群體中更爲明顯 (?)。隨著健康意識的普及，飲料行業逐步向生產更健康的產品轉型，我們希望通過需求系統模型驗證這一趨勢是否同樣適用於台灣市場，並進一步探索台灣消費者對無糖和低糖飲料需求的潛在增長，以評估健康意識增強對需求的具體影響。

3 資料蒐集與處理

3.1 資料蒐集

本研究使用的資料主要來自於「經濟部工業產銷存動態調查資料庫」，涵蓋 5 種飲料類別（果蔬汁飲料、碳酸飲料、運動飲料、咖啡飲料及茶類飲料）的銷售量與銷售值的月資料，詳細記錄了每種飲料的市場表現。此外，另一部分資料來自於「勞動部勞動統計查詢網」的國民所得月度統計資料，用以反映消費者的收入水準。所有資料的涵蓋期間爲 1982 年至 2024 年，共收集到 547 筆月統計資料，確保了樣本的時間跨度。這些數據不僅提供了每類飲料的銷售量和銷售值，也包含了與消費行爲密切相關的消費者所得，爲後續的 DSE（Demand System Estimation）分析提供了關鍵依據。

3.2 資料處理

在完成資料蒐集後，我們按步驟進行了資料處理，目的是提高數據的可靠性與一致性。首先，我們使用 R 統計軟體對資料進行清理，包括合併不同來源的數據、去除重複資料、以及處理遺漏值等工作。對於部分遺漏值，考量到補值可能帶來的偏誤，我們選擇將無法合理填補的觀察值移除。此外，由於不同飲料類別的統計起始時間不一致，我們將分析的起始時間進行統一，確保資料具有可比性。爲了進一步豐富研究變數，我們還根據銷售量與銷售值兩個變數計算並新增了每種飲料的單位價格，爲我們後續使用模型估計去衡量價格對消費者需求的影響提供了必要的解釋變數。

4 研究設計

本文分別採用 AIDS (Almost Ideal Demand System) 和 LA/AIDS (Linear Approximate AIDS) 兩種需求系統模型進行分析。兩種方法皆用於分析多個商品的需求及其需求彈性，主要差別在於價格指數的處理方式，。以下兩節將分別敍述 AIDS 及 LA/AIDS 的模型架構。

需求函數

模型中各商品的的需求函數爲：

$$w_i = \alpha_i + \sum_{j=1}^{5} \gamma_{ij} \ln(P_j) + \beta_i \ln\left(\frac{X}{P}\right), \tag{1}$$

其中，w_i 表示第 i 類飲料的支出比例，定義爲該類飲料的支出占總支出的比例，即：

$$w_i = \frac{P_i Q_i}{X}. \tag{2}$$

在這裡，P_i 是第 i 類飲料的價格，Q_i 是該類飲料的消費數量，而 $X = \sum_{i=1}^{5} P_i Q_i$ 是所有飲料的總支出，可能會隨月收入的變化而改變。此外，$\ln(P_j)$ 是第 j 類飲料價格的自然對數，用於反映價格變化對需求的影響。模型的待估參數包括 α_i、γ_{ij} 和 β_i，分別具有以下意義：

- α_i：基礎支出比例，表示在其他條件不變時，第 i 類飲料的消費佔比。
- γ_{ij}：描述第 j 類飲料價格對第 i 類飲料支出的影響。
- β_i：支出彈性，反映總支出變動對第 i 類飲料需求的影響。

價格指數

價格指數 P 用於調整總支出的影響。在 AIDS 模型中，其非線性表達式爲：

$$\ln(P) = \alpha_0 + \sum_{j=1}^{5} \alpha_j \ln(P_j) + \frac{1}{2} \sum_{j=1}^{5} \sum_{k=1}^{5} \gamma_{jk} \ln(P_j) \ln(P_k), \tag{3}$$

其中，α_0 是基準常數，用於表示價格指數的基本水平；α_j 是第 j 類飲料價格的影響係數；γ_{jk} 是第 j 和第 k 類飲料價格的交叉效應，用於衡量價格互動對需求的影響。由於價格指數 P 的非線性形式較難直接處理，在 LA/AIDS 模型中，通常會選擇線性近似方法來簡化價格指數的計算，例如使用 Stone 指數：

$$\ln(P) \approx \ln(P) = \sum_{j=1}^{5} w_j \ln(P_j). \tag{4}$$

彈性

AIDS 模型允許我們計算三種類型的需求彈性：

- **支出彈性** (η_i)：

$$\eta_i = 1 + \frac{\beta_i}{w_i}, \tag{5}$$

該彈性表示總支出變化對第 i 類飲料需求的影響。

- **自價格彈性** (ε_{ii})：

$$\varepsilon_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i \ln(X/P), \tag{6}$$

該彈性衡量第 i 類飲料價格變化對其自身需求的影響，通常爲負值。

- **交叉價格彈性** (ε_{ij})：

$$\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \ln(X/P), \tag{7}$$

該彈性衡量第 j 類飲料價格變化對第 i 類飲料需求的影響。若 $\varepsilon_{ij} > 0$，則說明兩者爲替代品；若 $\varepsilon_{ij} < 0$，則爲互補品。

總結來說，AIDS 模型的核心特徵在於其價格指數的非線性特性，使其能夠精確捕捉多商品之間的需求互動與價格影響。通過支出彈性、自價格彈性和交叉價格彈性的計算，該模型能夠有效分析商品之間的需求關係，並爲市場需求預測和政策評估提供有力的工具。

5 研究結果

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5.1 使用 AIDS 模型分析

Figures ?? and ?? show that the employment and annual earnings decline sharply in the year following displacement and recover limitedly ten years after displacement. Specifically, we note approximately a 30% decrease in the probability of employment and a 40% reduction

in the annual earnings, ten years after the year of displacement. Consistent with graphical evidence on labor market outcomes, Figure **??** suggests that compared to the control group, displaced workers had higher utilization of medical services due to mental illness. Importantly, prior to layoff, these outcomes of the displaced workers align closely with those of the non-displaced counterparts, suggesting that their post-displacement differences are not driven by differential pre-trends between treatment and control groups.

5.2 使用 LAAIDS 模型分析

Figure **??** presents our estimated dynamic effects of displacement on earnings and employment from model (**??**). Before the reference year (two years before displacement), earnings for workers who will be displaced and non-displaced workers follow a similar trend. In the year prior to displacement, there was a significant decline in earnings by roughly 2,000 NTD, economically small compared to previous years.[3] Annual earnings for displaced workers drop by around 270,000 NTD in the year of displacement and 340,000 NTD in the year following displacement (about 67%). While there is a small recovery in annual earnings two years after displacement, a substantial long-term effect is still visible ten years after a mass layoff. Similarly, Figure **??** (a) shows the probability of employment mirrors the earnings trend, with a sharp initial decline (about 40%) in the year after displacement and a partial recovery thereafter. After ten years, the employment probability remains nearly 30% lower than before the displacement.

5.3

We discuss a number of robustness checks for our main findings in Online Appendix **??**, including different matching techniques, different estimation methods, and different choices of samples. In general, our main results are robust to these changes. Moreover, we conduct a set of subgroup analyses and discuss these results in the Online Appendix **??**. To sum up,

[3] **?** and **?** also found a significant earning loss prior to displacement using data from the U.S. and Germany.

our analysis suggests that the negative effect of job displacement on mental health appears to be more pronounced among lower-income workers, men, and older individuals.

6 結論

地區的限制性 Using Taiwan's administrative data, we examined the effects of job displacement on employment, earnings, and mental health. Due to the mandatory and generous nature of Taiwan's NHI, our study are less likely to suffer from sample attrition and to be confounded with changes in health insurance enrollment. On the other hand, the comprehensive NHI data allows us to explore the impact of displacement on both outpatient and inpatient healthcare use.

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Tables

""	"FruitVegetableJuice$_{p}rice$"	"CarbonatedBeverage$_{p}rice$"	"SportsD
"q$_{F}ruitVegetableJuice_{s}hare$"	-0.452253075674546	-0.49825417032225	-0.041184
"q$_{C}arbonatedBeverage_{s}hare$"	-0.589251383804091	-1.55169604995971	-0.327518
"q$_{S}portsDrink_{s}hare$"	-0.274545471863382	-0.897977419890735	-1.56755
"q$_{C}offeeDrink_{s}hare$"	0.374305421210976	0.157563950767757	0.33920
"q$_{T}eaDrink_{s}hare$"	-0.0610395543591526	0.55568316955601	0.149669

Table 1: Summary Statistics

	Before Matching			After Matching	
Variable	Treatment	Comparison	Difference	Comparison	Difference
Individual Characteristics					
Female	0.564	0.460	0.104***	0.565	0.000
	(0.496)	(0.498)	[0.005]	(0.496)	[0.005]
Age at displacement	42.526	39.775	2.750***	42.512	0.014
	(9.092)	(7.556)	[0.078]	(9.093)	[0.094]
Live in urban area	0.790	0.737	0.053***	0.790	0.000
	(0.407)	(0.440)	[0.005]	(0.408)	[0.004]
Work in urban area	0.849	0.804	0.045***	0.849	0.000
	(0.358)	(0.397)	[0.004]	(0.358)	[0.004]
Firm Characteristics					
Number of employees	375.977	1,494.984	-1,119.007***	411.861	-35.884**
	(1,323.548)	(3,852.285)	[39.181]	(1,515.931)	[15.562]
Female Share	0.491	0.436	0.055***	0.492	0.000
	(0.212)	(0.224)	[0.002]	(0.212)	[0.002]
Average monthly wage ($1,000)	34.392	36.745	-2.353***	34.432	-0.040***
	(13.011)	(13.518)	[0.005]	(13.027)	[0.005]
Average age	37.530	36.971	0.559***	37.519	0.010
	(5.364)	(5.042)	[0.052]	(5.365)	[0.055]
Outcomes Variables in the Second Year Prior to the Displacement					
Real annual earnings ($1,000)	509.170	541.102	-31.932***	509.638	-0.468
	(262.076)	(257.066)	[2.649]	(262.303)	[2.702]
Cul. # of mental illness outpatient visits	0.554	0.450	0.104***	0.551	0.004
	(3.824)	(3.543)	[0.037]	(3.943)	[0.041]
Cul. medical expenses of mental illness	0.807	0.585	0.221**	0.708	0.098
($1,000)	(11.344)	(9.831)	[0.102]	(10.829)	[0.112]
Number of observations	9,700	332,720		332,720	

Notes: Standard deviations in parentheses, and standard errors in brackets. The treatment group comprises workers who underwent a mass layoff (firm reducing its employment by over 90%), and the comparison group comprises workers who were employed at a stable firm (no more than a 30% employment decrease) and had

continuous employment during the sample period. All dollars are adjusted with CPI and displayed in 2016 NT$ (1 NT$ 0.033 US$). The cumulative number of outpatient visits and cumulative medical expenses of mental illness are accumulated from the fifth to second years prior to the (pseudo) displacement. The statistics in the *After Matching* columns are weighted by entropy balancing (EB). The variables included in the matching process are all variables in the *Individual Characteristics* and *Firm Characteristics* panel.
*** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level.

Table 2: Long-term Impact of Job Displacement on Employment and Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Employment							
$Disp_i \times \mathbf{I}[t = c + 10]$	-0.324***	-0.326***	-0.326***	-0.326***	-0.326***	-0.326***	-0.326***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Control Baseline Mean				1.000			
Panel B: Annual Earnings (1,000 NT$)							
$Disp_i \times \mathbf{I}[t = c + 10]$	-302.582***	-305.924***	-305.922***	-305.438***	-305.417***	-305.953***	-305.988***
	(3.828)	(3.950)	(3.950)	(3.949)	(3.951)	(4.081)	(4.083)
Control Baseline Mean				509.637			
Observations				5,478,720			
Basic DID	✓	✓	✓	✓	✓	✓	✓
Year Fixed Effect		✓	✓	✓	✓	✓	✓
Age			✓	✓	✓	✓	✓
Individual Control				✓	✓		
Firm Control					✓		
Individual Fixed Effect						✓	✓
Unemployment Rate							✓

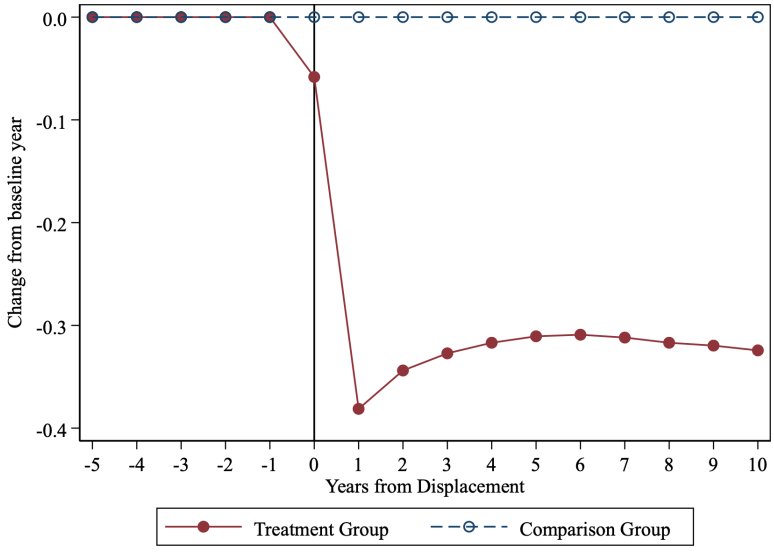
Notes: This table displays the estimated coefficients of δ_{10} from equation (**??**). The coefficient stands for the impact of a mass layoff in the tenth year after the displacement year (c). Standard errors clustered at the individual level are reported in parentheses. All regressions are weighted with EB weights. The control baseline mean is the EB-weighted mean for the comparison group in the baseline year ($t = -2$). Column (1) includes a dummy variable indicating whether an individual belongs to the treatment group (displaced worker) and the event time fixed effect. Column (2) further includes the calendar year fixed effect. Column (3) further includes the quadratic function of age. Column (4) further includes gender, birth month, wage, and county/municipality of residence in the pre-treatment period. Column (5) further includes firm characteristics (location, number of employees, average monthly wage, average age, proportion of females) in the pre-treatment period. Column (6) further includes individual fixed effects. Column (7) further includes county/municipality level unemployment rate.

*** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level.

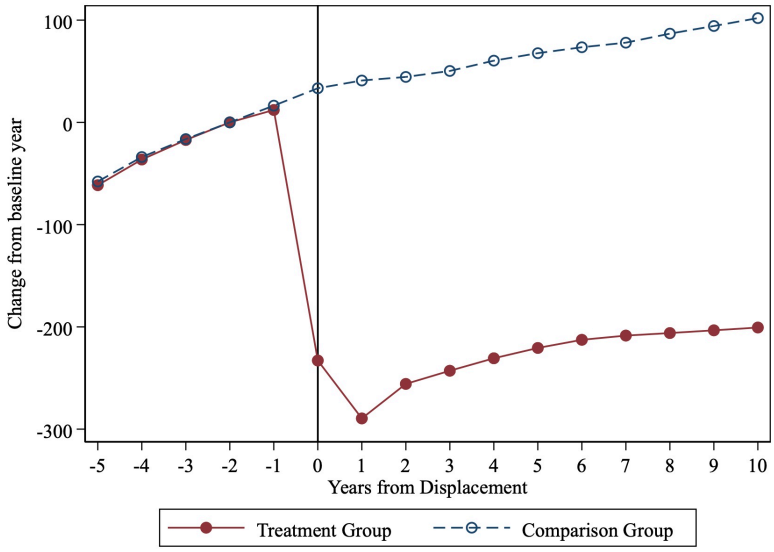
Figures

Figure 1: Trend in Employment and Annual Earnings

(a) Employment

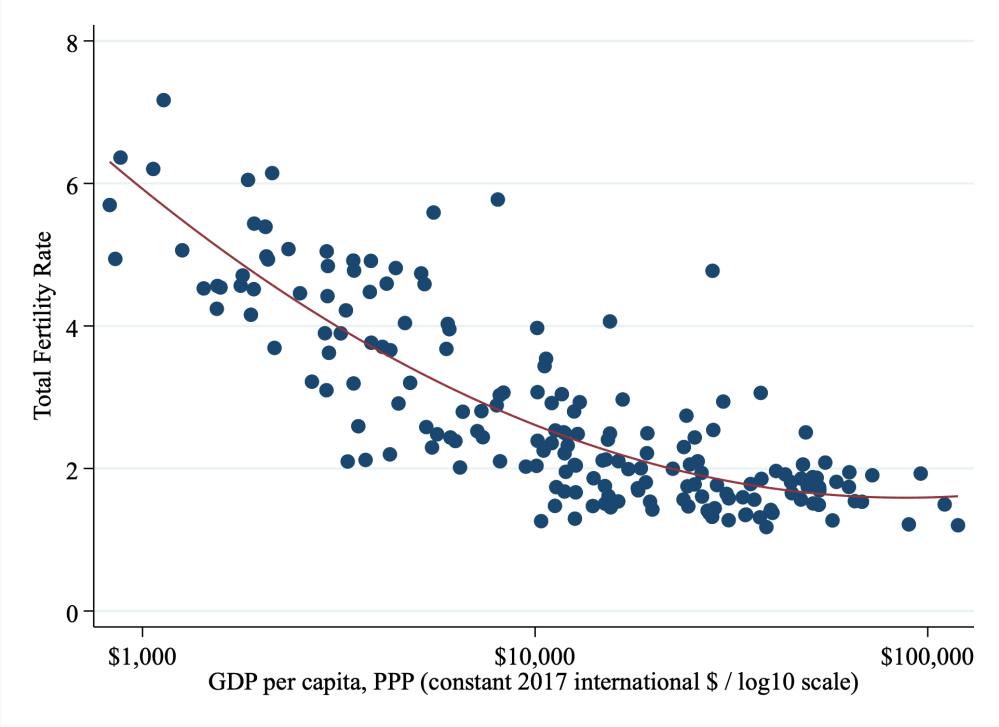


(b) Annual Earnings (1,000 NT$)



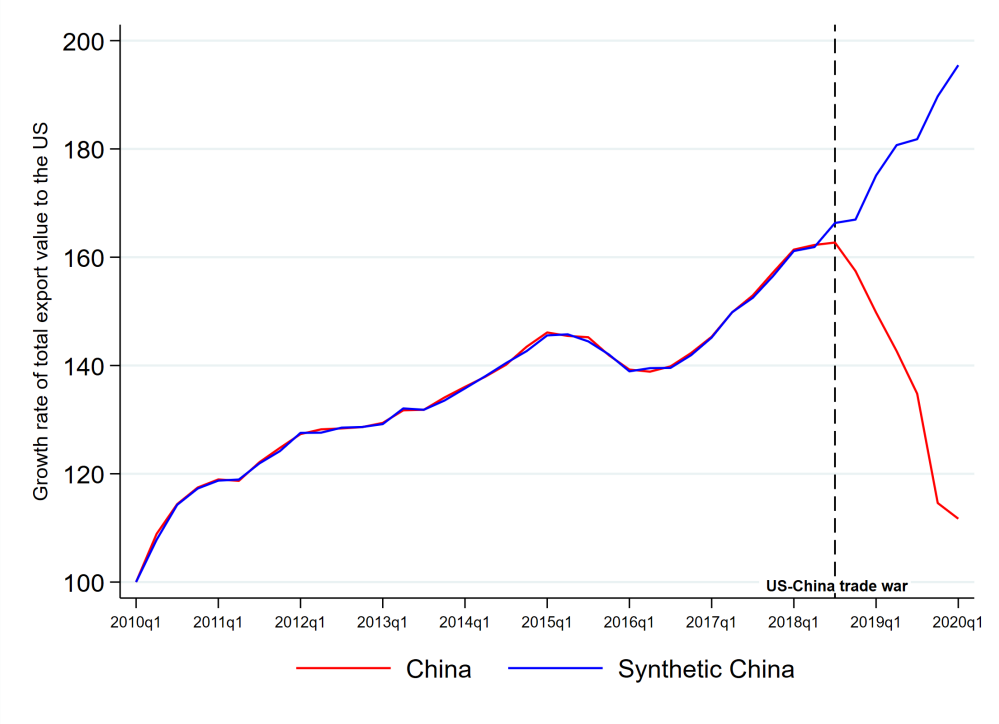
Notes: These figures illustrate the change (from the baseline year) in (a) the proportion of employment (employed at least one month) and (b) annual earnings (NT$1,000) for the treatment group (i.e., displaced workers) and the comparison group (i.e., non-displaced workers) from five years before to ten years after the (pseudo) displacement year. The vertical axis displays the outcomes at event time t relative to the baseline year ($t = -2$). The horizontal axis refers to the number of years from the (pseudo) displacement year.

Figure 2: The Relationship Between GDP Per Capita and the Total Fertility Rate



Notes: Each symbol stands for one country. The total fertility rate is defined as the number of children per 1,000 women. The data year is 2020. Data source: Our World in Data (**??**).

Figure 3: The Relationship Between GDP Per Capita and the Total Fertility Rate



Notes: Each symbol stands for one country. The total fertility rate is defined as the number of children per 1,000 women. The data year is 2020. Data source: Our World in Data (**??**).