The Longitudinal Effects of Disability Types on Income and Employment

Bob Millard

Stony Brook University

2023 Stata Conference

Introduction: Economic Consequences of Disability

Disability is primary income risk: impairs ability to perform tasks in work and daily life

- affects financial independence, individual welfare, social costs of insuring
  - in Canada, 33% lower employment income, 2x as much from transfers (*Wall 2017)*

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  - e.g., mobility limitation affects productivity of an economist less than a brick layer
- disabilities are dynamic in nature

Research Agenda and Approach

Analyze heterogeneity in longitudinal effects of disability types on the level and composition of personal income

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Interaction-weighted estimator of (Sun and Abraham 2020)

- dynamic design: point estimate for each of the ten years after onset
- implemented with `eventstudyinteract`

Contributions

1. longitudinal effects of health shocks
   - *Stephens (2001), Charles (2003), Singleton (2012), Meyer and Mok (2019), Humlum, Munch, Plato (2023), Collischon, Hiesinger, and Pohlan (2023)*
   - analyze type based heterogeneity in unified framework using rich administrative data
2. income shocks and partial insurance
   - *Blundell, Graber, Mogstad (2015), Blundell, Pistaferri, Saporta-Eksten (2016), Autor, Køstal, Mogstad, Setzler (2019), Fadlon and Nielsen (2021)*
   - specificity of source of shocks motivated by taks-based human capital model
3. empirical approach using recent estimator
   - robust to bias in two-way fixed effects estimation with heterogeneous treatment effects and variation in timing
   - *Borusyak and Jaravel (2017), De Chaisemartin and d'Haultfoeuille (2020), Goodman-Bacon (2021), Callaway and Sant'Anna (2021) Sun and Abraham (2021), Imai and Kim (2021), Baker et al (2022)*

Data: The Longitudinal and International Study of Adults (LISA)

Biennial panel survey of Canadian households aged 15 and older (2012-2018)

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  - market income: wages, salaries, and commissions, labor market participation, other employment income
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Sample: ever- and never-disabled in the age range 22-61, living in Canadian provinces, whose onset occurred in age range 23-56

Disability Screening Questions (*Grondin 2016*)

Self-reported frequency of limitation

- "*How often does [this difficulty ...] limit your daily activities?*"

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  - exclusively pain
- **mental-cognitive**:
  - cognitive functioning: learning, memory, attention
  - exclusively mental-health: anxiety, depression, emotional, psychological

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Age of disability onset

- "*at what age did you first start having difficulty or activity limitation?*"

Empirical Framework: Interaction-Weighted estimator

Define cohort-average treatment on the treated, for onset of disability type g

$$CATT^{g}_{e,l} = E[Y^{g}_{i,e+l} - Y^{\infty}_{i,e+l} \,|E_i = e]$$

- E_i is the year, t, of disability onset

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Treatment effect of for disability type g: weighted average of $CATT_{e,l}$

$$v^{g}_{l} = \sum_{e} CATT^{g}_{e,l} \cdot Pr\{E_i = e | E_i \in [-l, T-l]\}$$

- weights are shares of cohorts experiencing at least l periods relative to onset
- separating CATT's removes any "*illegal comparisons*"

Empirical Framework: Interaction-Weighted estimator

Step 1: estimate cohort average treatment effects using `reghdfe` (Correia 2016)

$$Y_{it} = \alpha_i + \gamma_t + \beta X_{it} + \sum_e \sum_l \delta^g_{l,e} A^g_{l,it} A^g_{e,i} + \epsilon_{it}$$

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- $A^g_{l,it} = 1$ if $l \in \{-5, ..., 10\}$ years relative to onset, $A^g_{e,i} = 1$ if treatment cohort e
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- X_{it} controls for differences between treatment and control
- ϵ_{it} serially correlated error

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Step 3: take weighted (step 2) sum of $\delta_{e,l}$'s (step 1)

$$\hat{v}^g_l = \sum_e \hat{\delta}_{e,l} \ \hat{Pr}\{E_i = e | E_i \in [-l, T - l]\}$$

Identifying assumptions

Causal inference relies on never-disabled being counterfactual for no disability onset

1. conditional parallel trends in pre-onset outcomes
   - quadratic age and time trend interacted with education, family composition, sex
   - additional linearity assumption in step 1
2. no anticipation in effects
   - can shift treatment window to accommodate leading effects
   - limitation: anticipation, progression of disability, or measurement error?
3. IW estimator robust to treatment heterogeneity by cohort

Under 1-3, $\hat{v}_l^g$ recovers an average effect of onset of disability type g, l periods relative to onset.

Empirical Results 1: Components of Market Income

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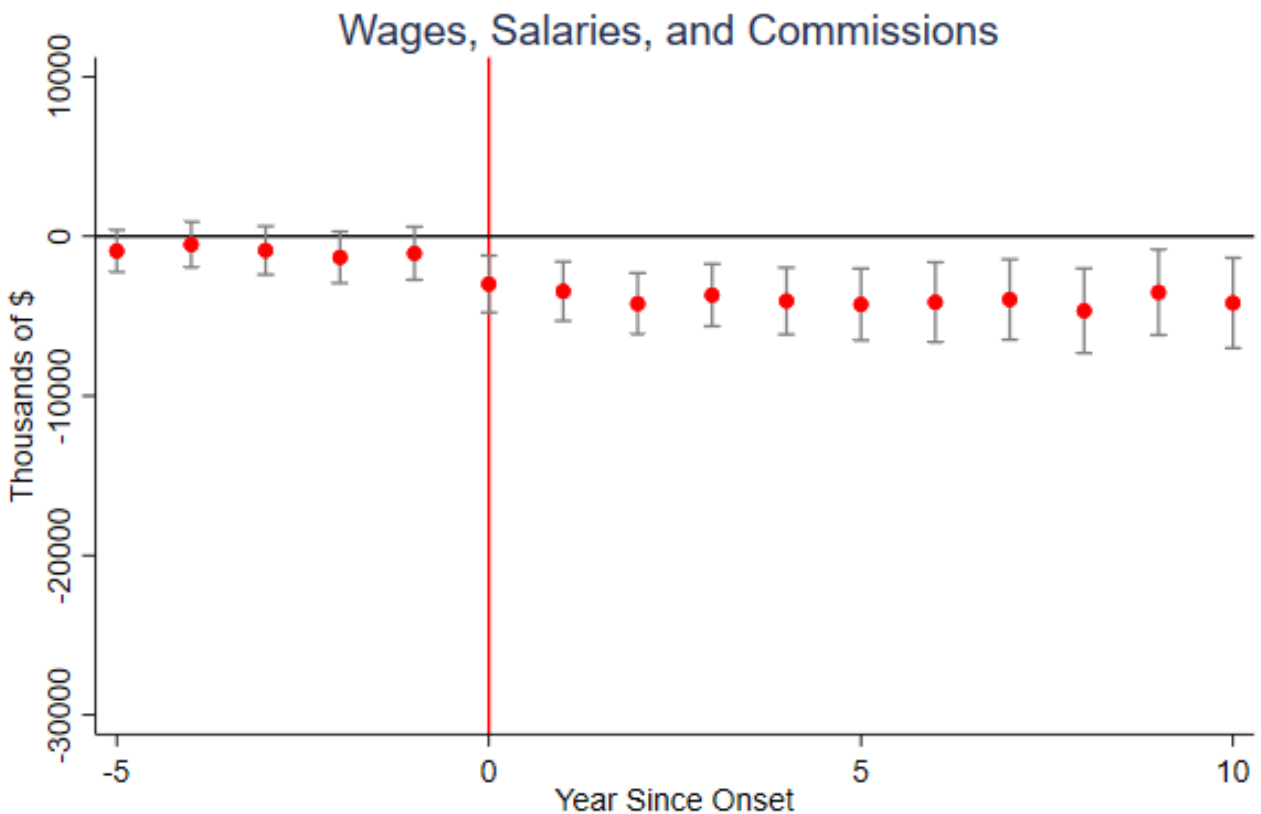
Figure: Aggregate Physical



Empirical Results 1: Components of Market Income

Figure: Mental-Cognitive

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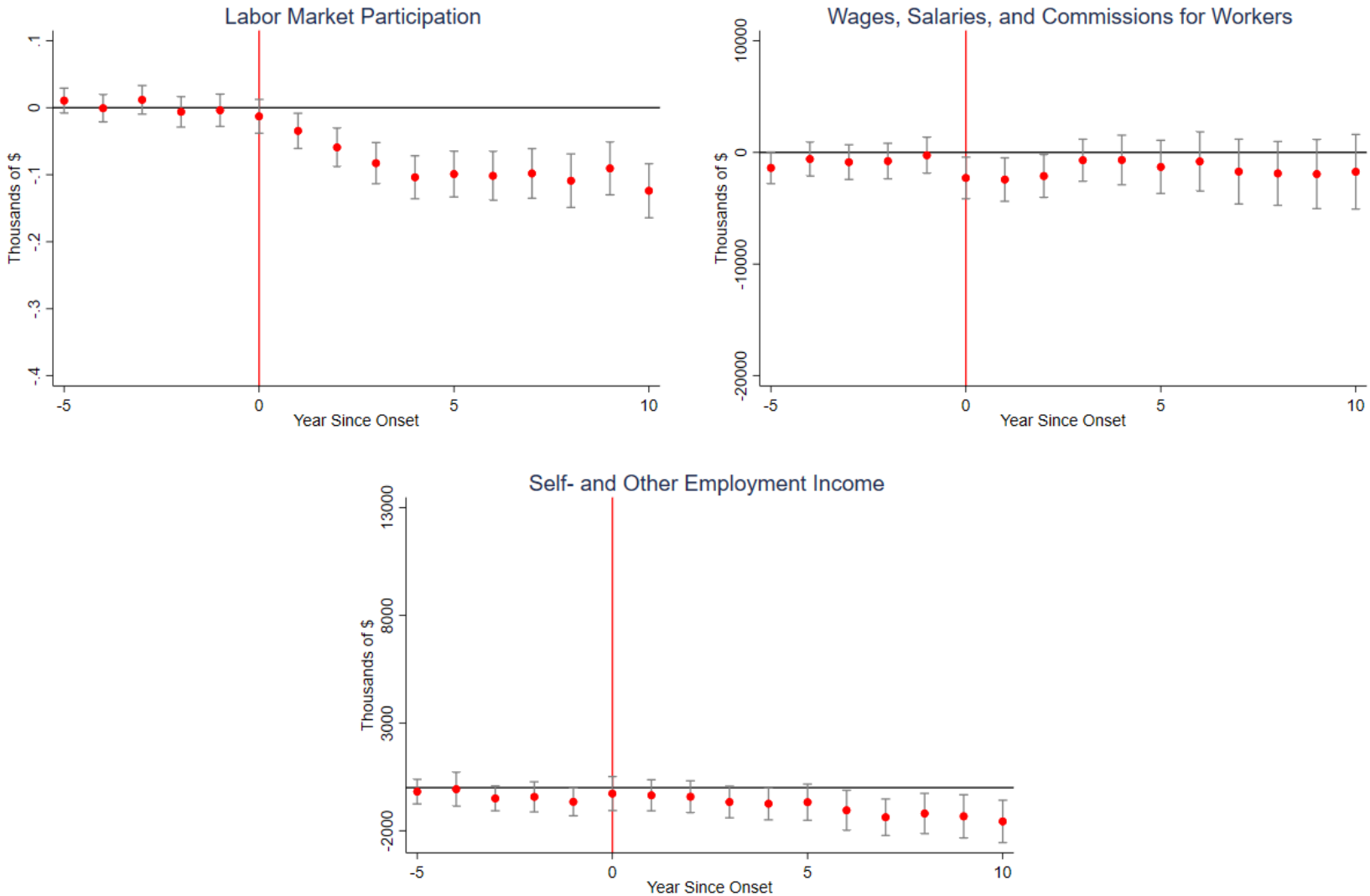

Empirical Results: Market Income

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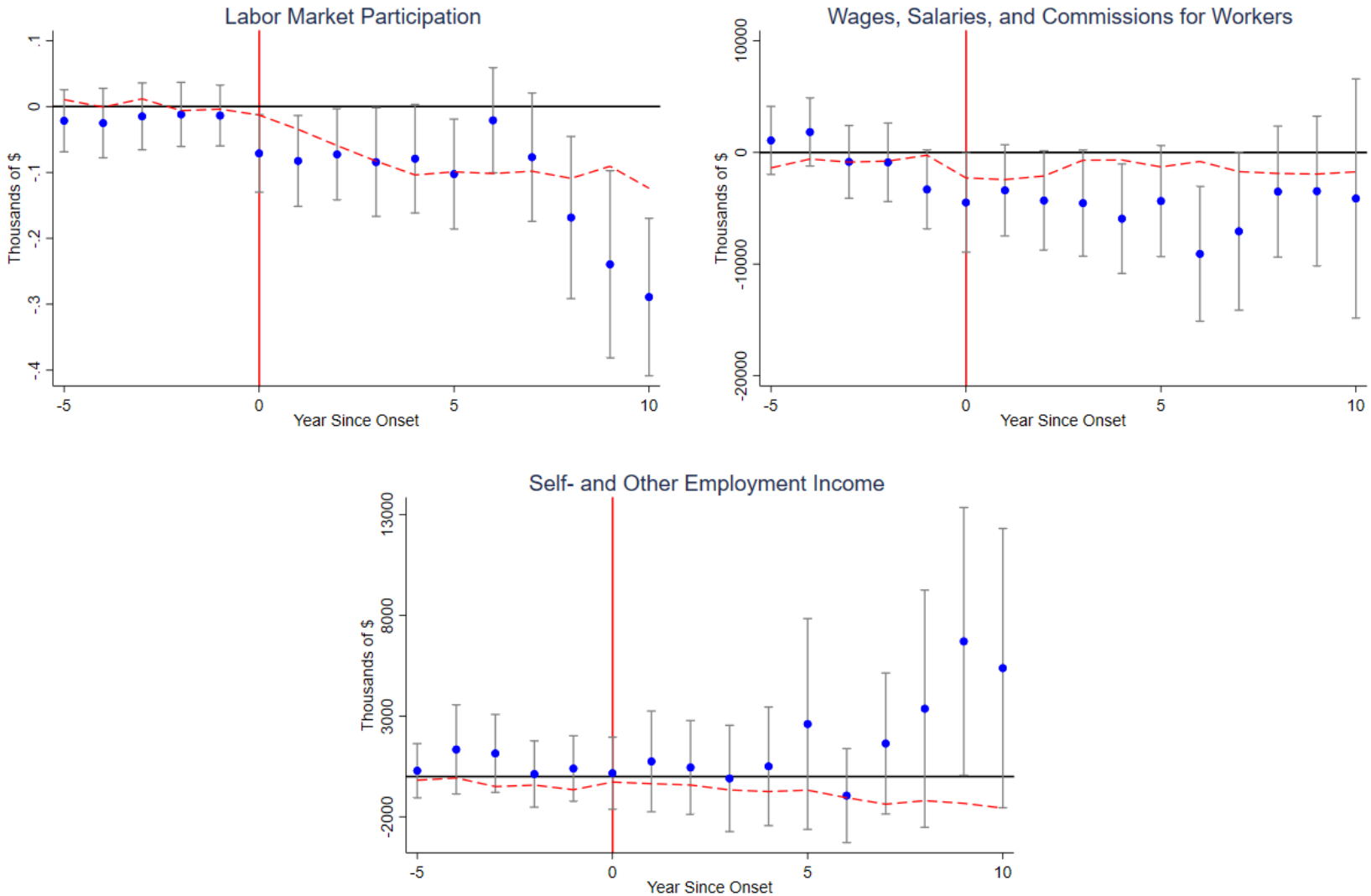

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Figure: Kinetic Ability

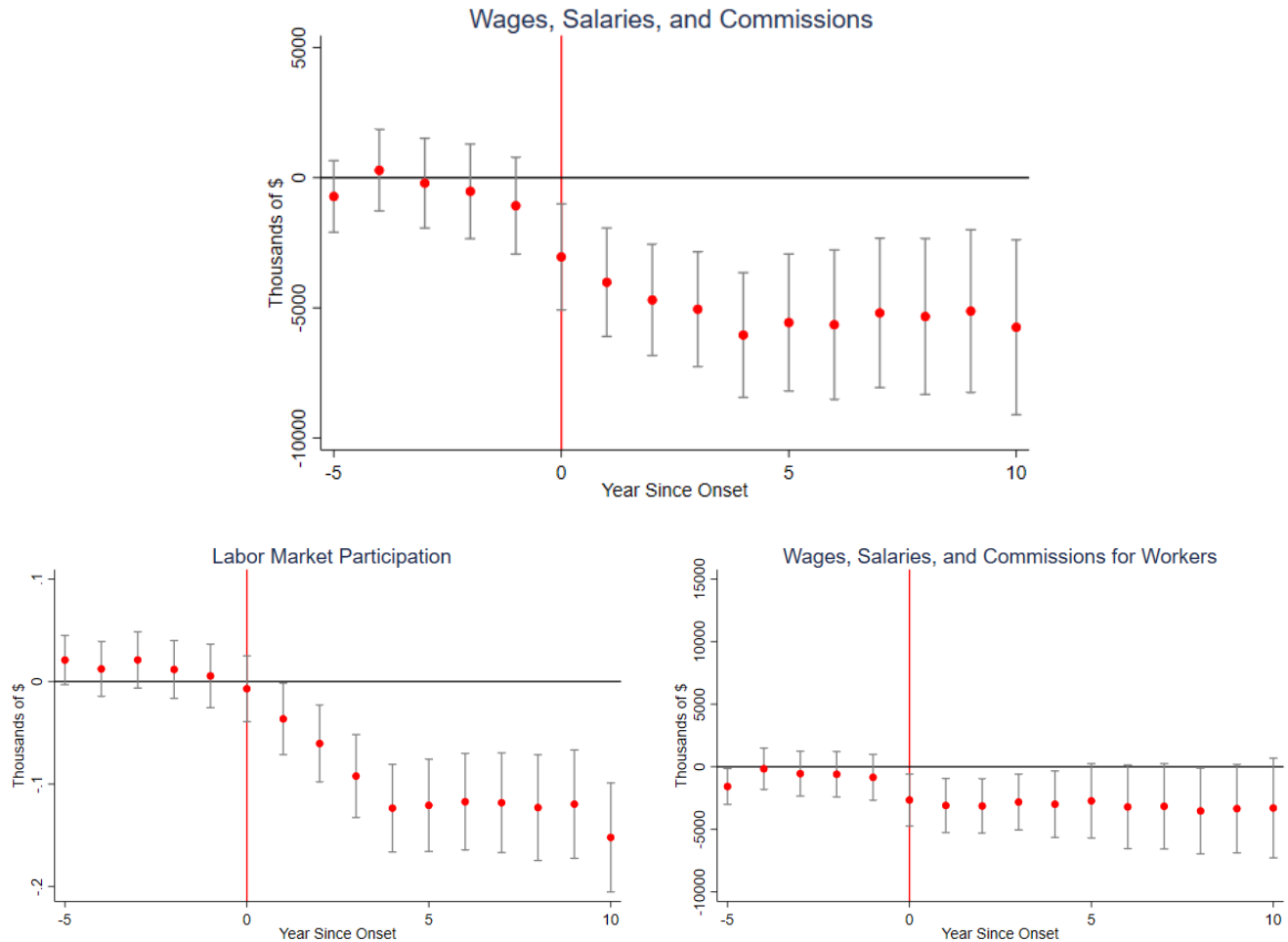

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Figure: Exclusively Pain

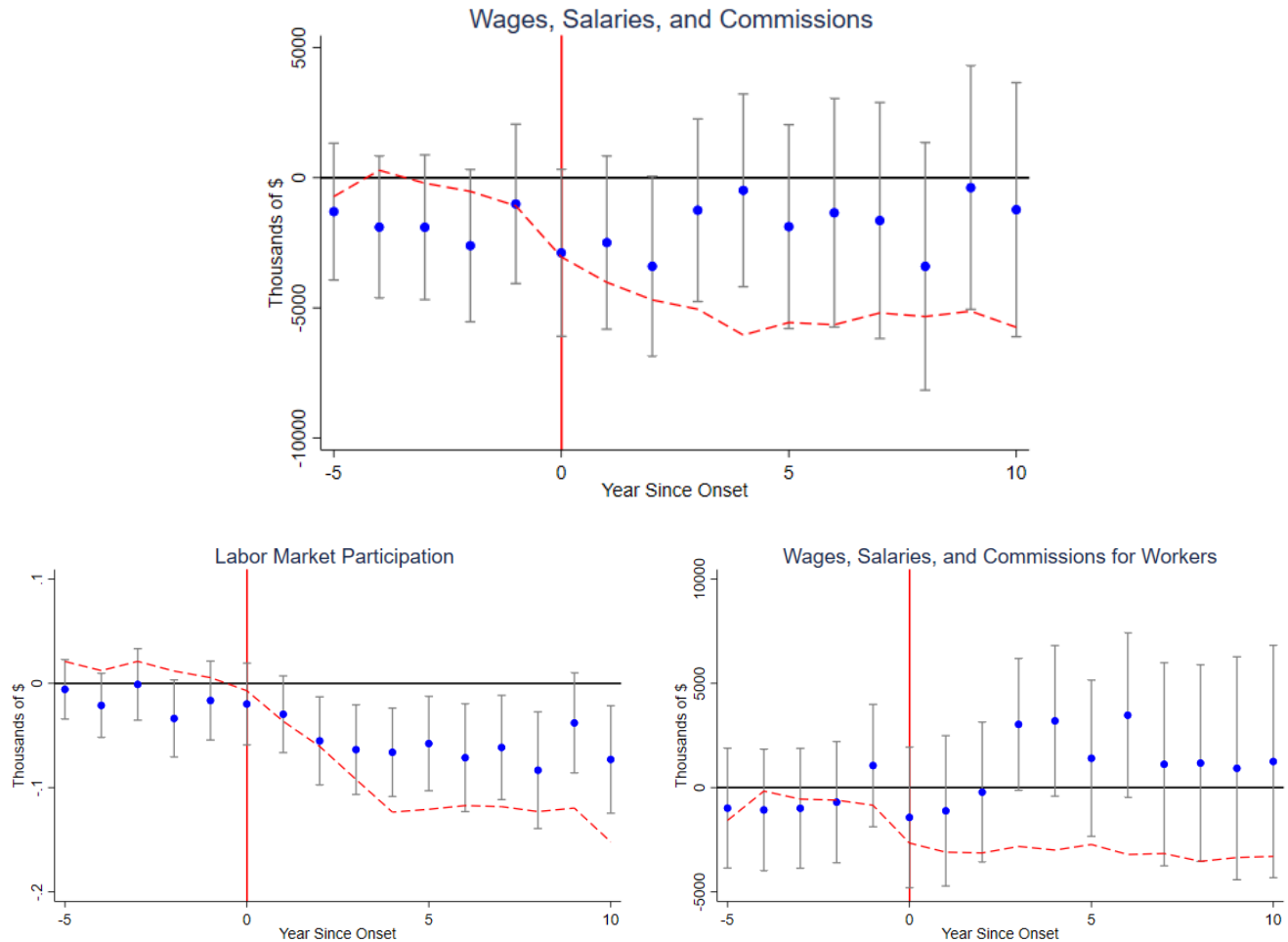

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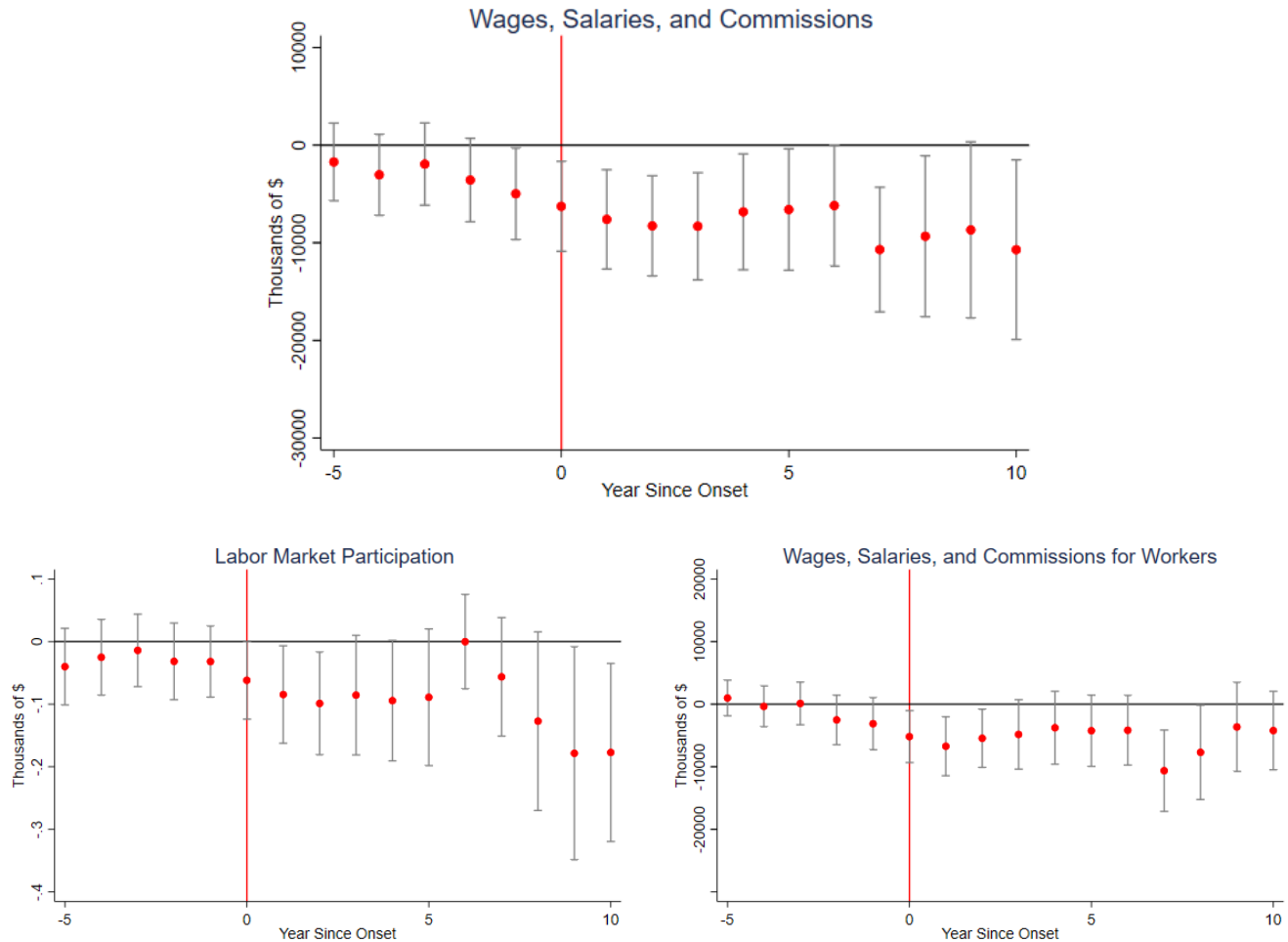
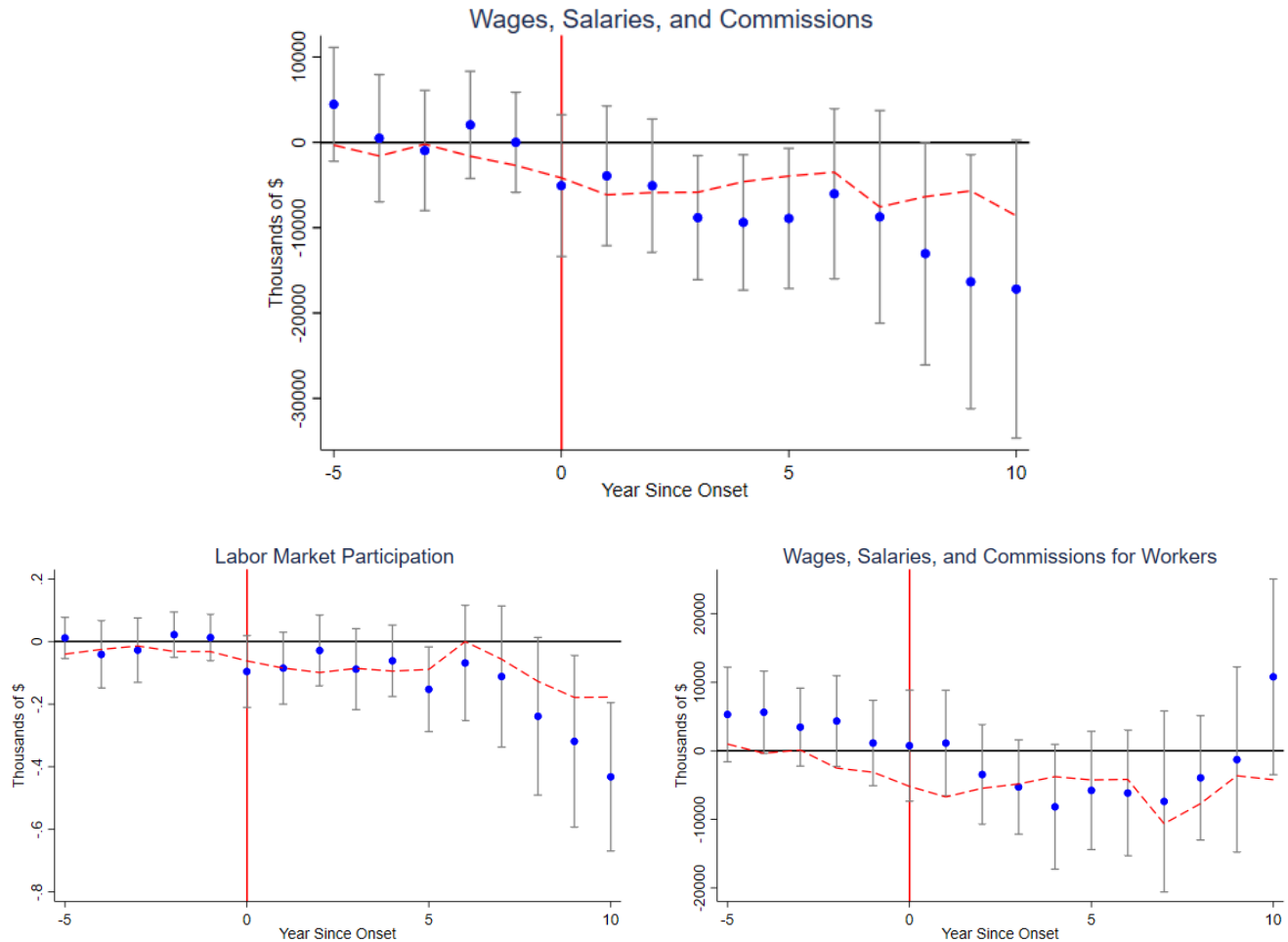
Figure: Exclusively Mental Health



Empirical Results

Figure: Cognitive Functioning



Empirical Results 2: Government Transfers

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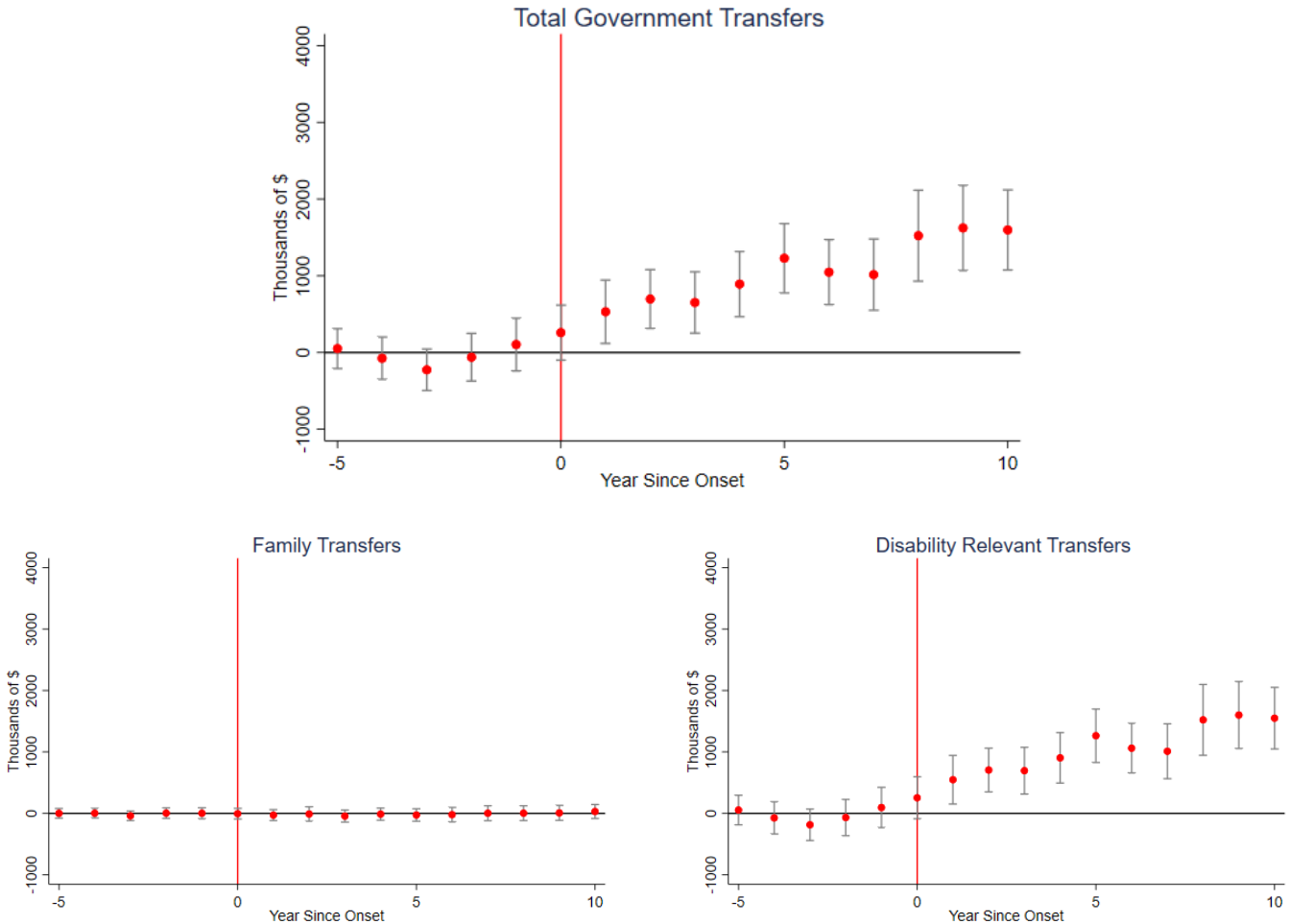

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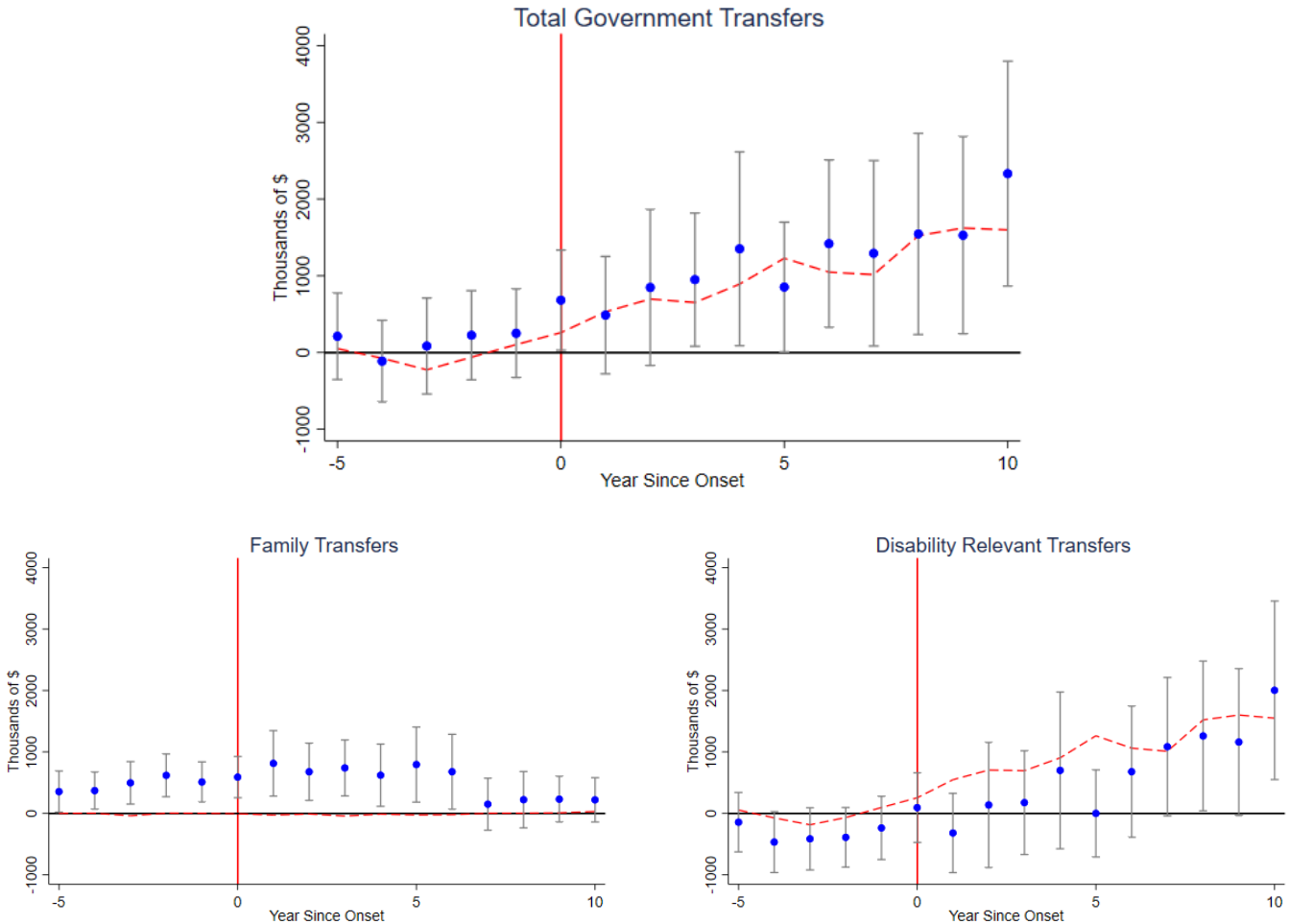
Figure: Mental-Cognitive



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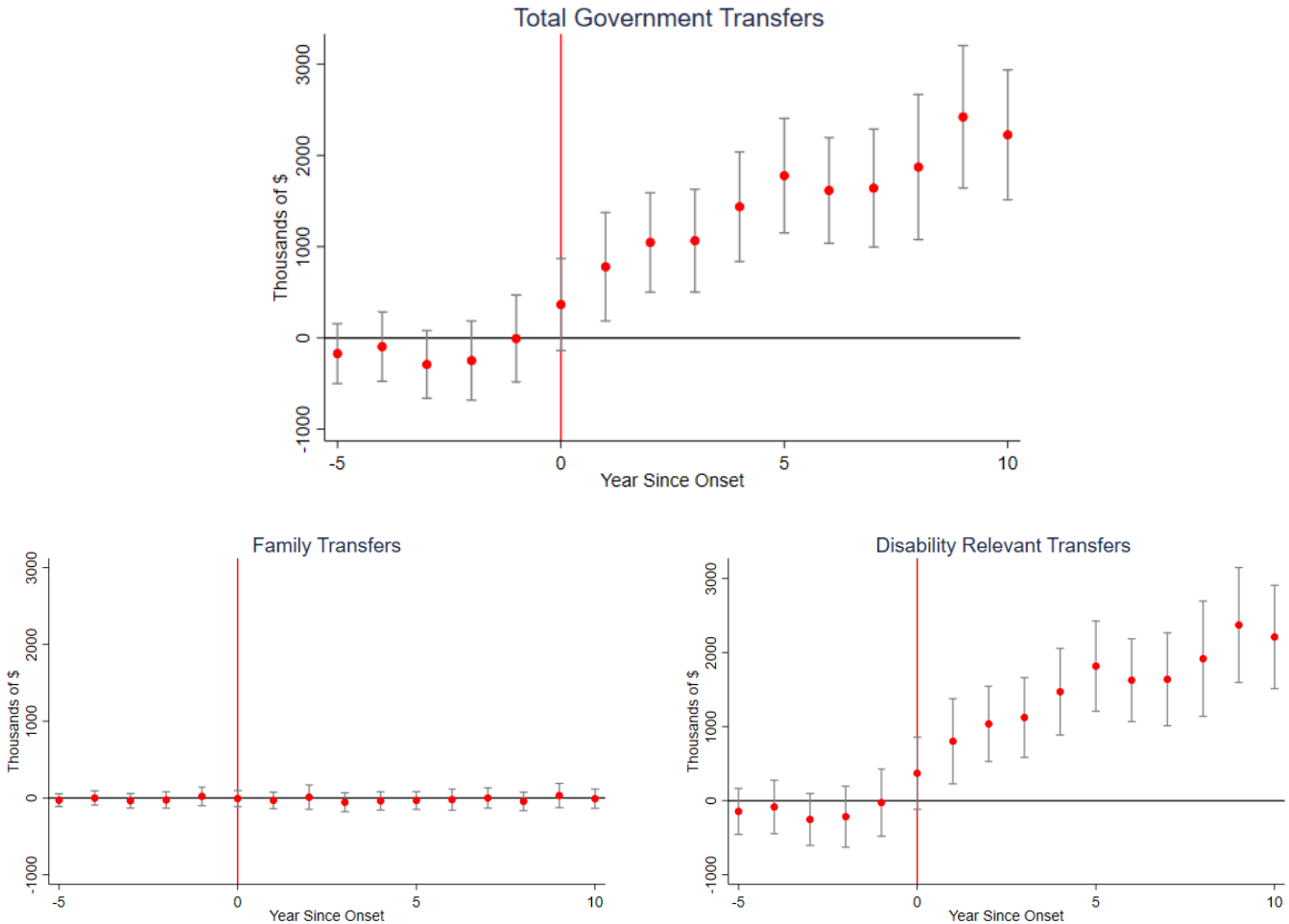

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Figure: Exclusively Pain

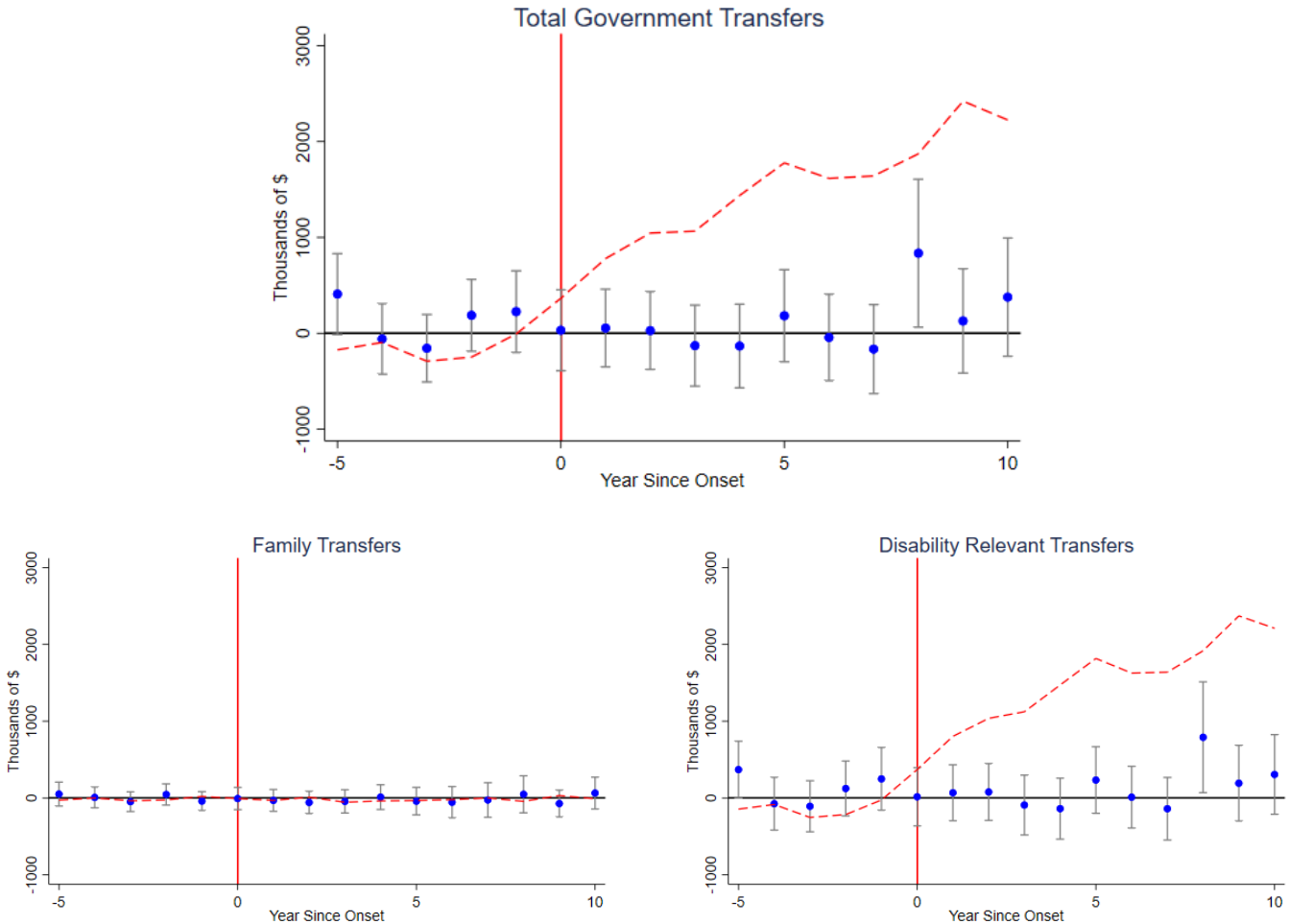

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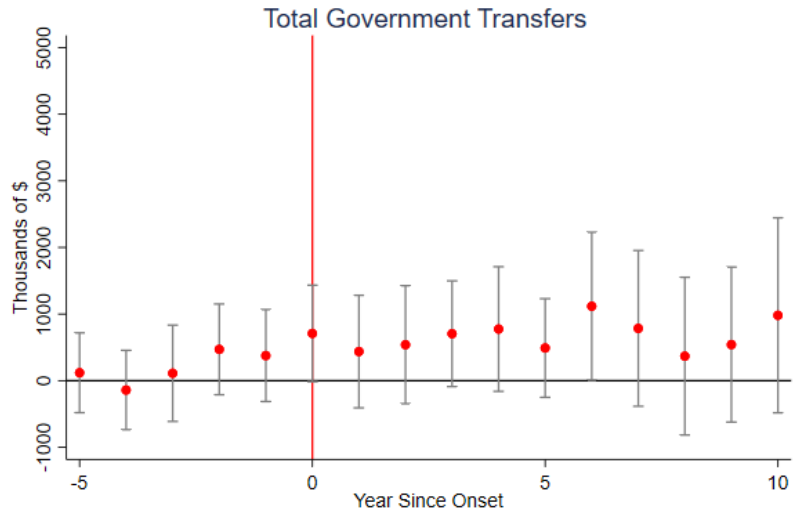
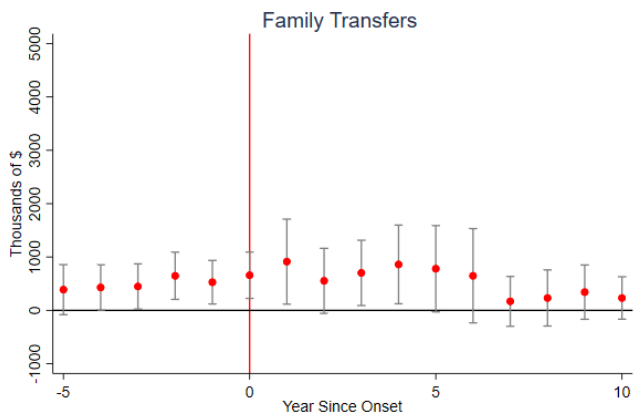
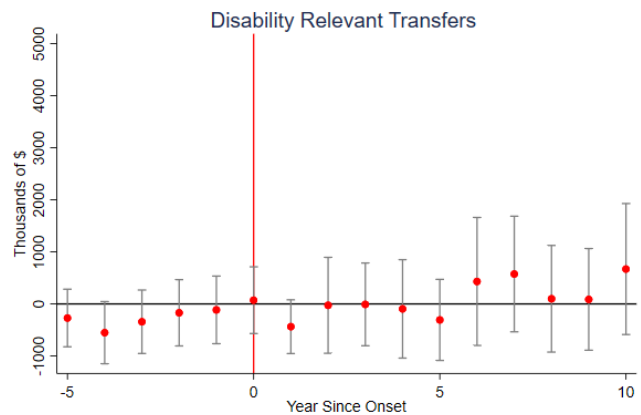
Figure: Exclusively Mental Health







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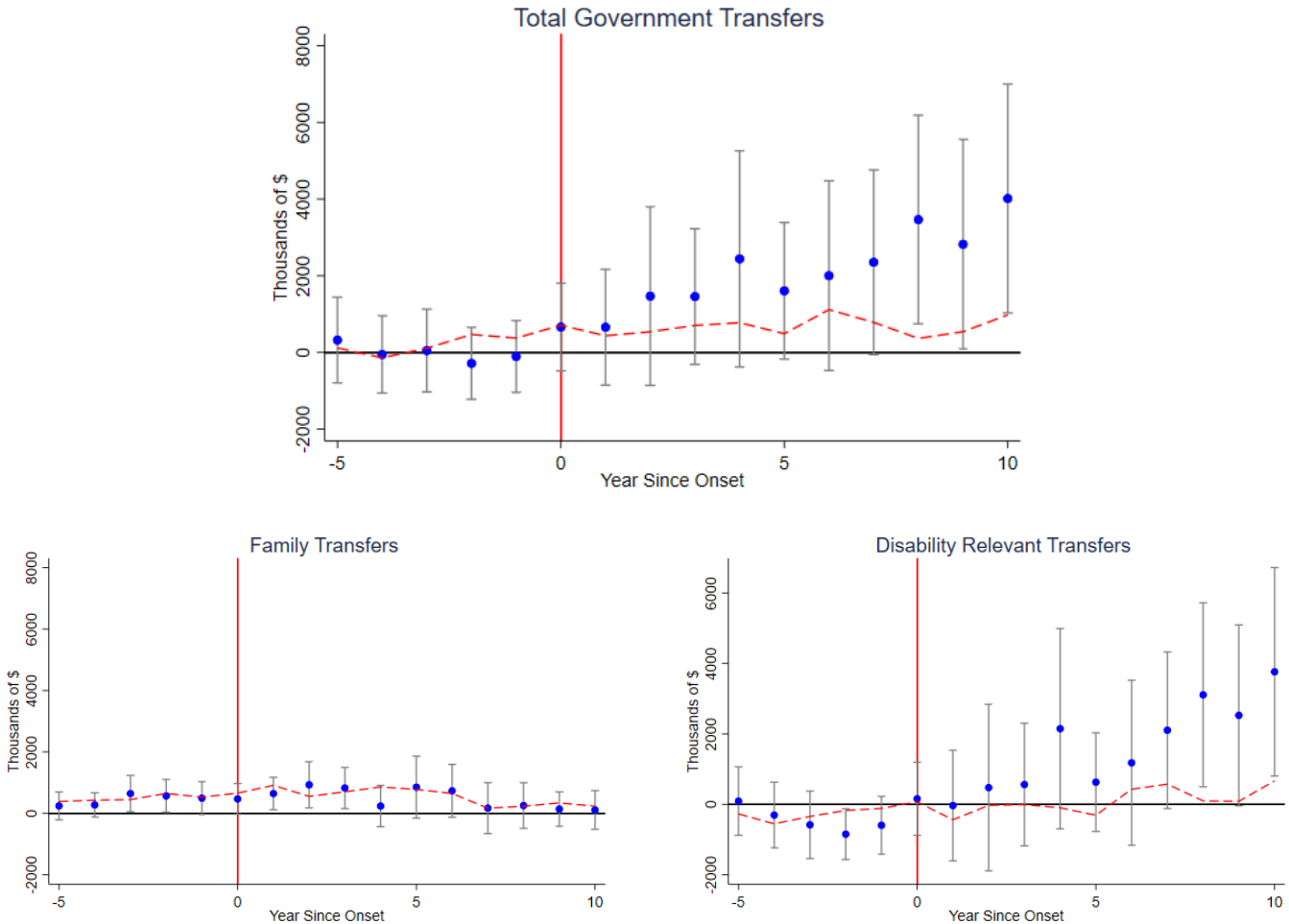
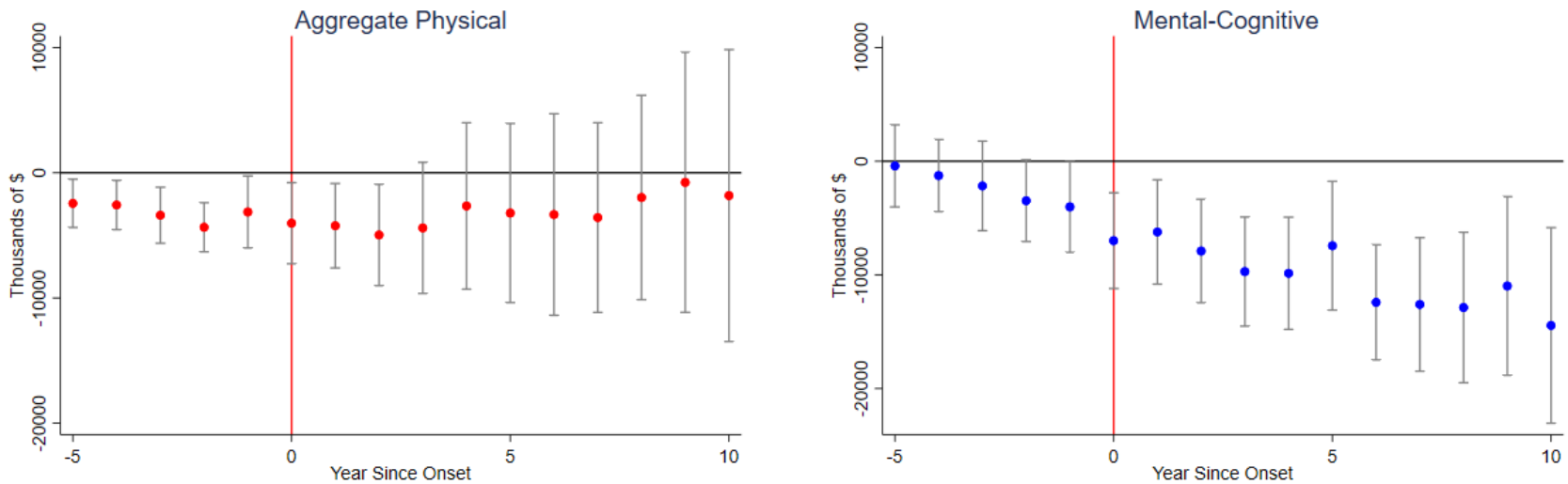


Empirical Results 3: Smoothing Mechanisms

Figure: Before Tax Total Income



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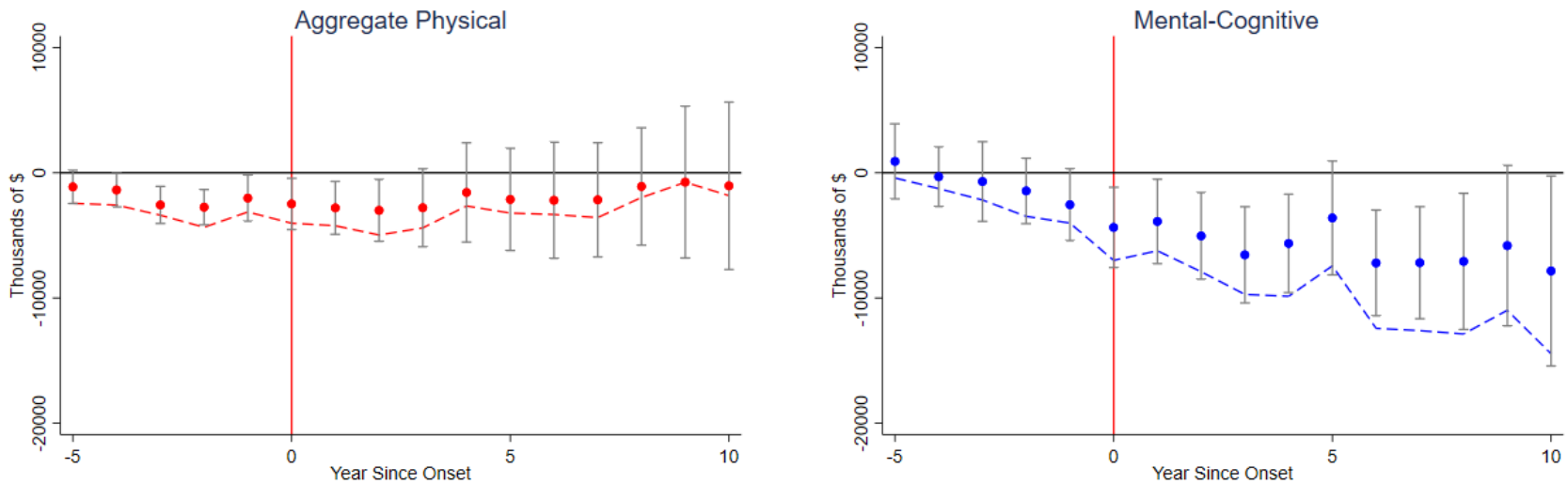

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Figure: Total Non-taxable income

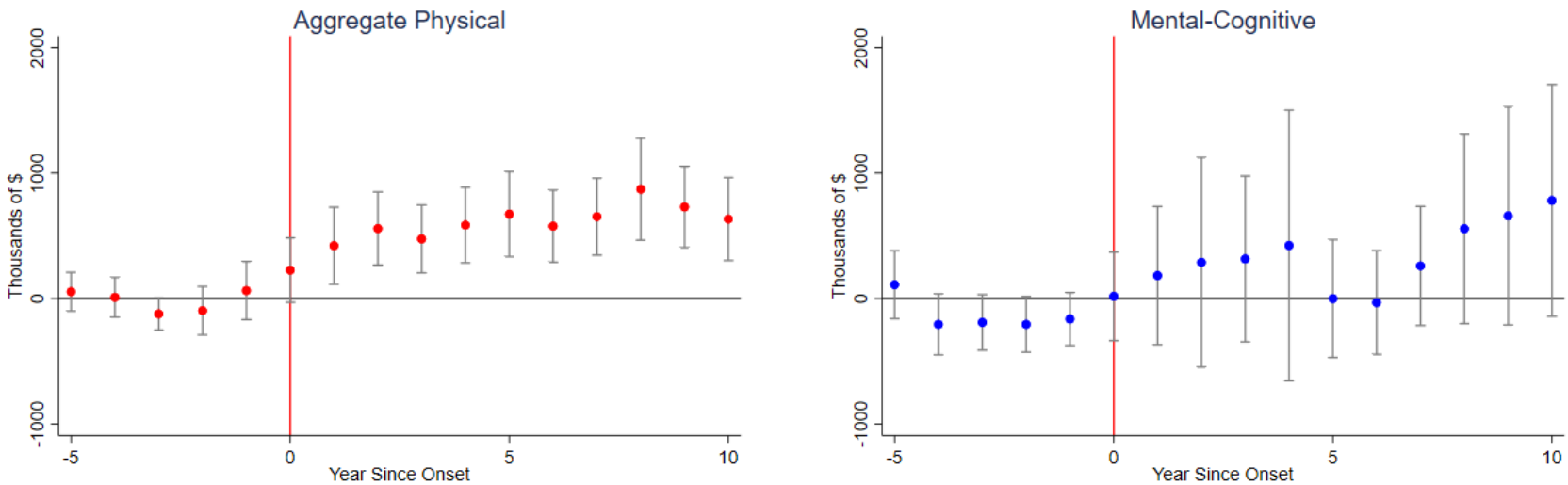

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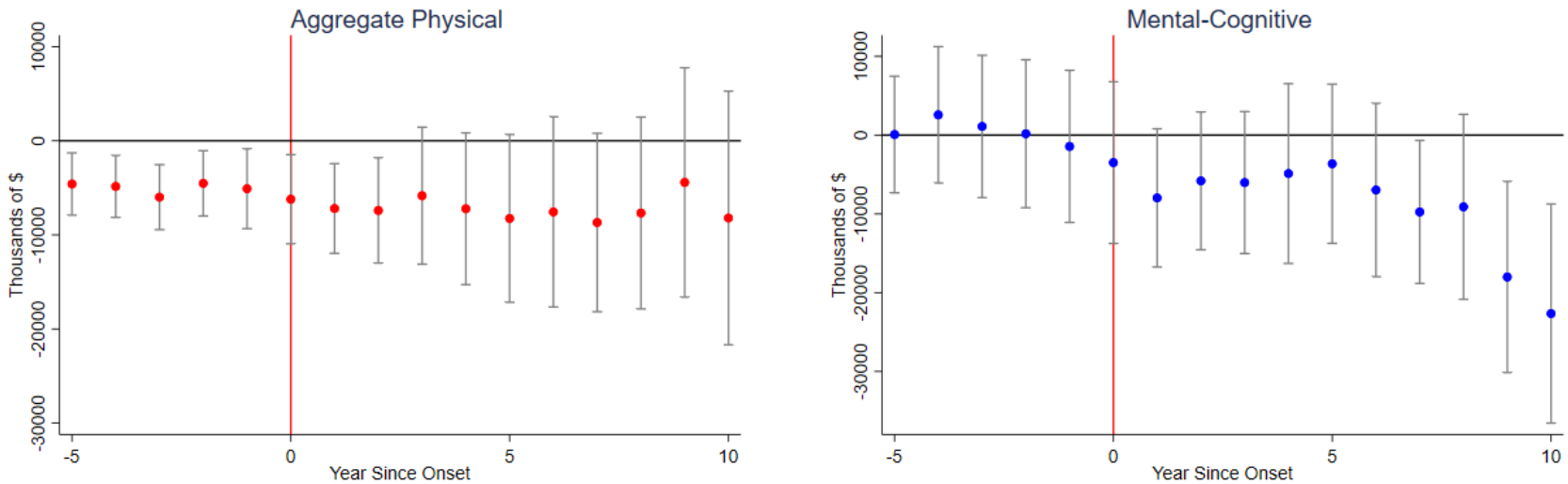
Figure: Family Total Income



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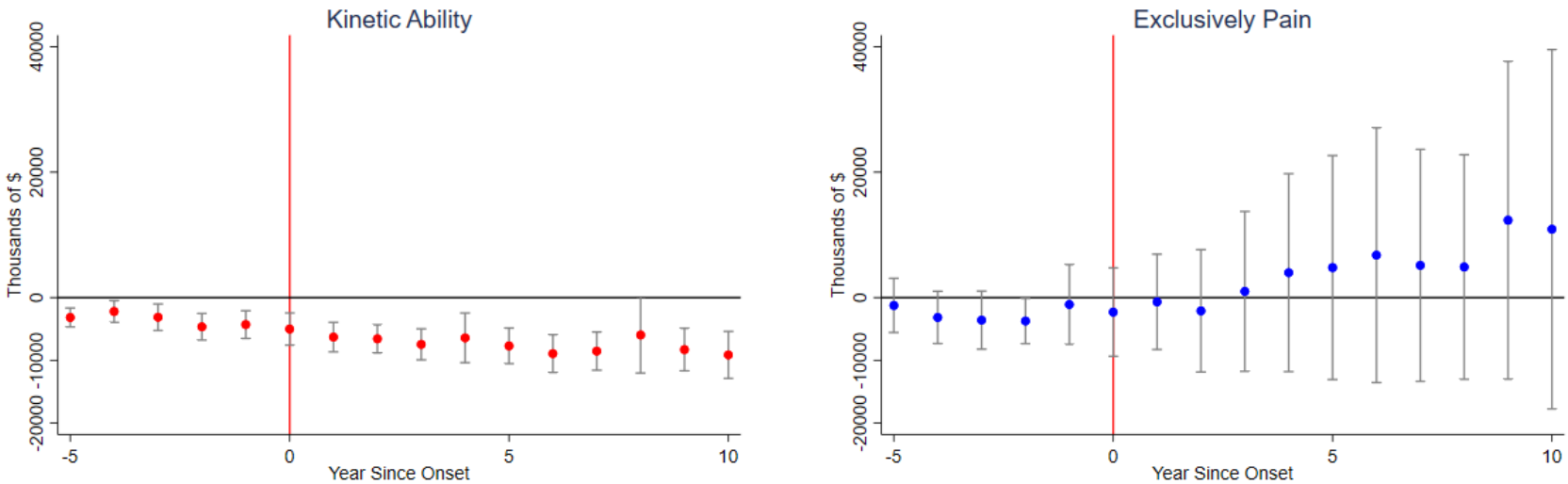

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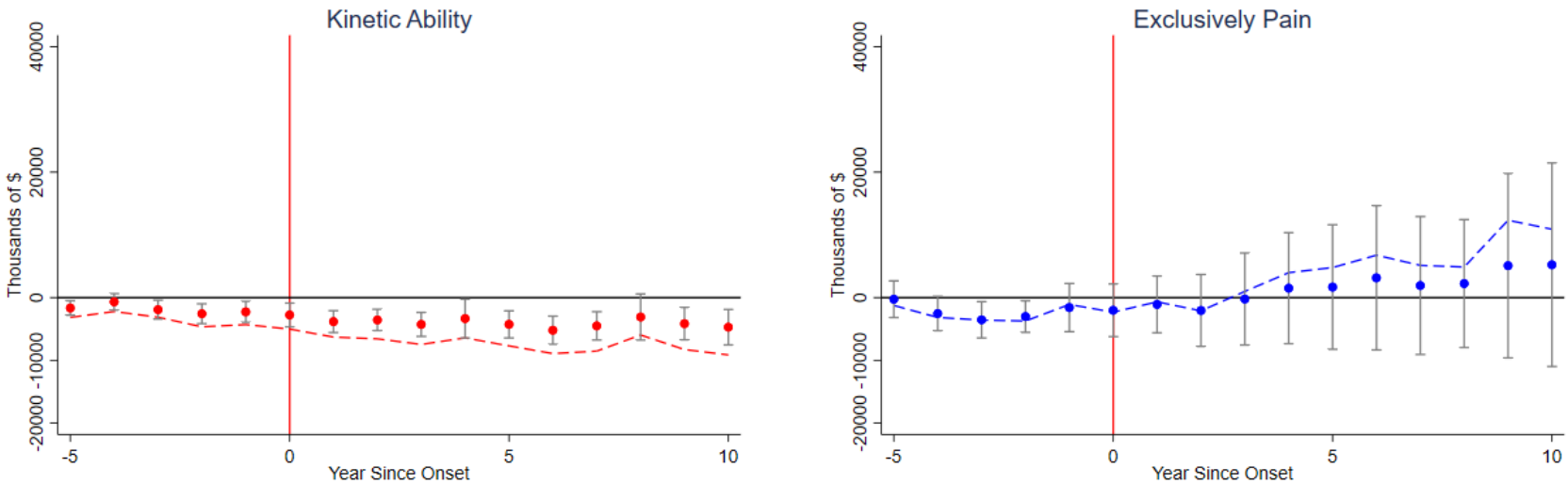

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Figure: Total Nontaxable Income

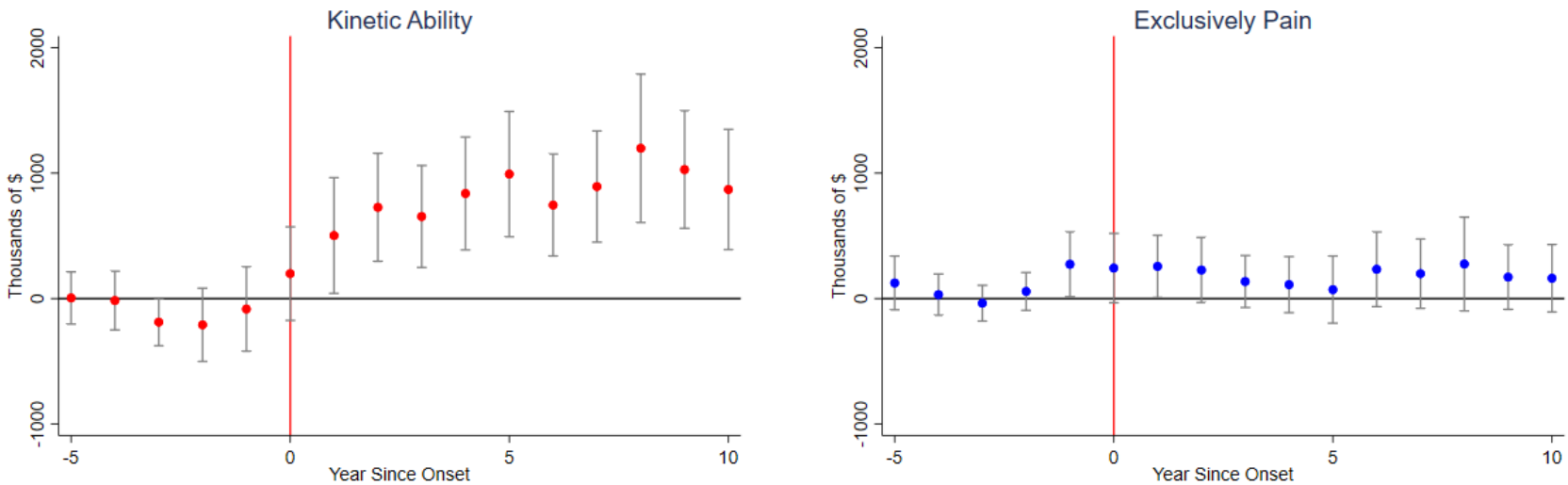

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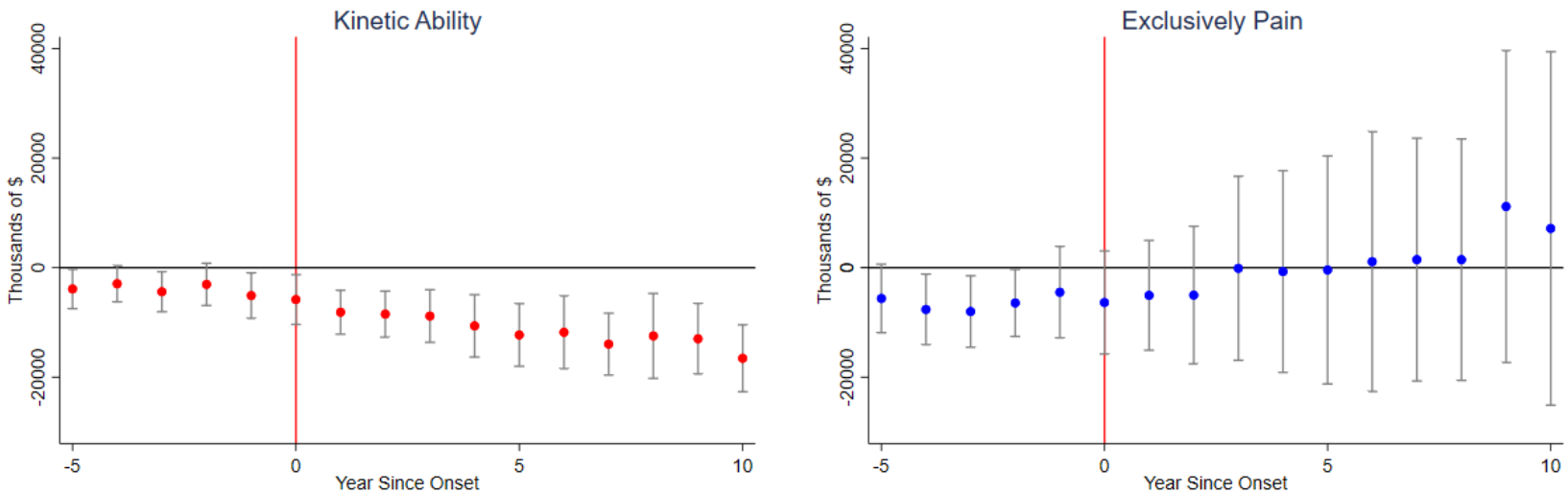
Figure: Total Family Income



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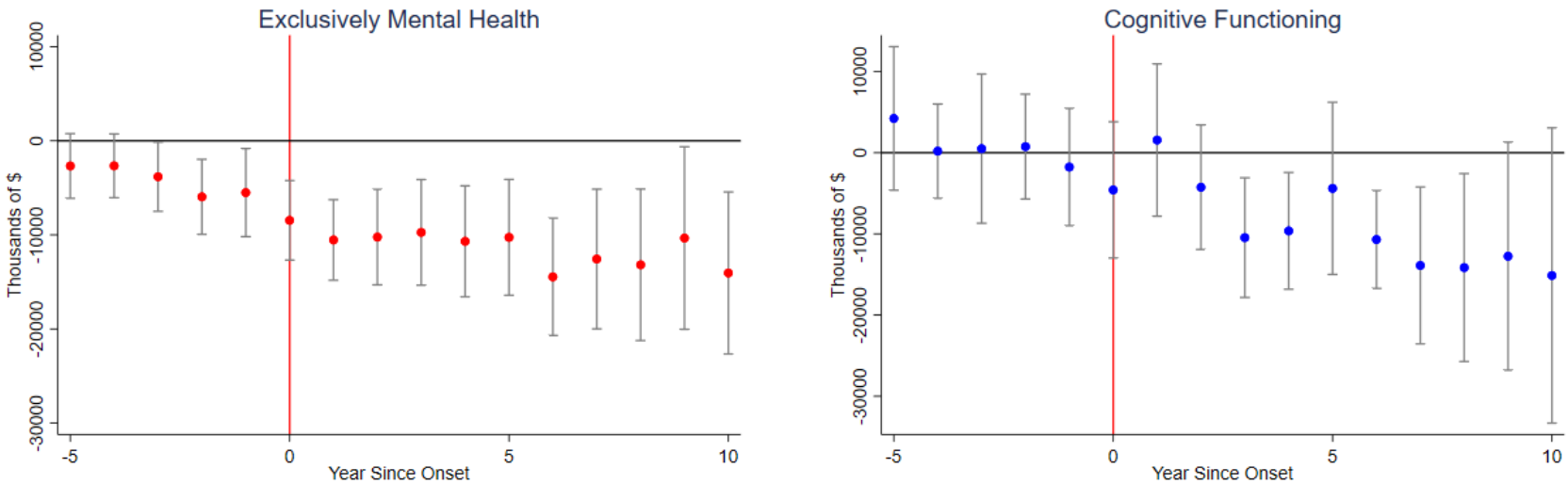

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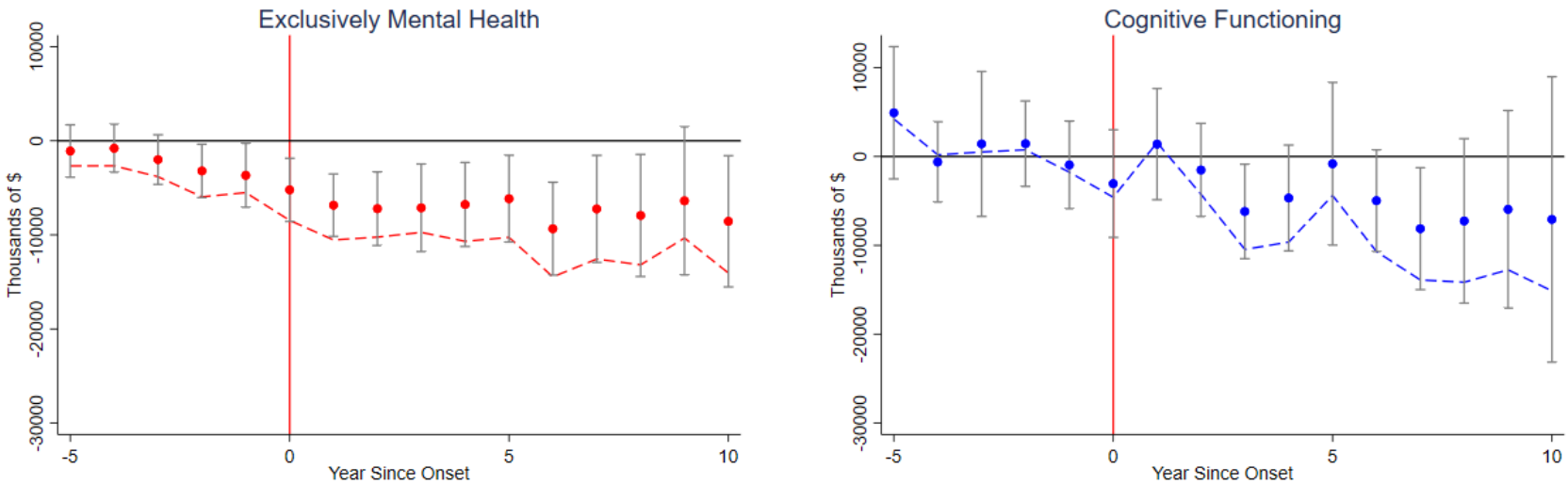

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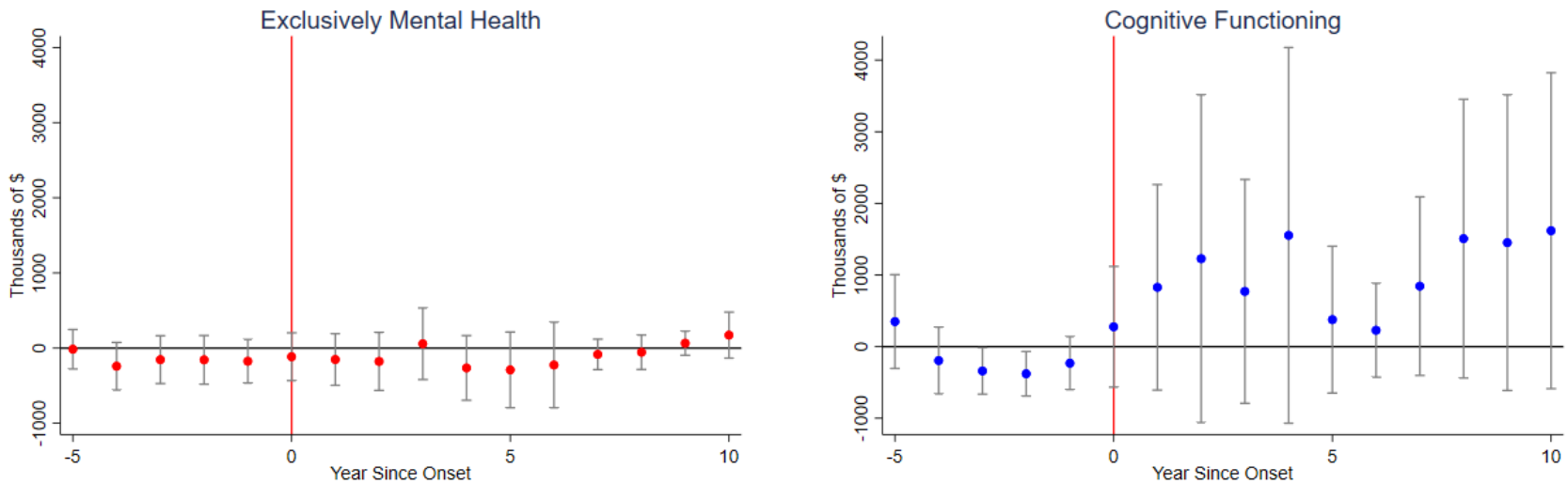

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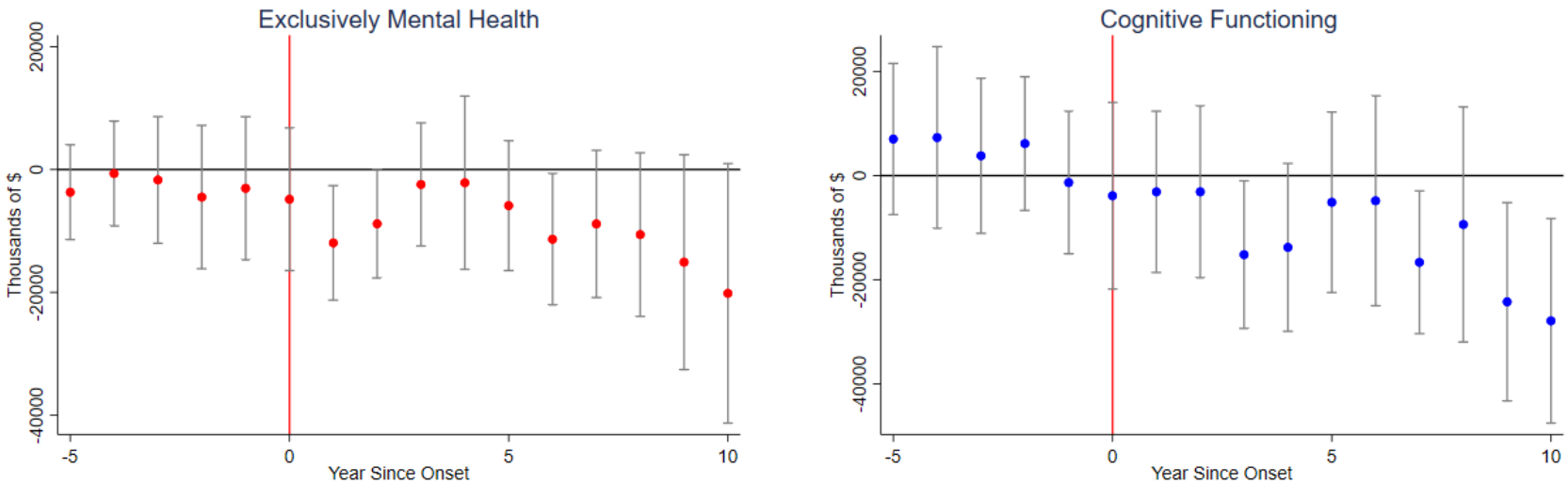

Conclusion

Market Income:

- level effects of mental-cognitive $>$ physical
  - earnings loss driven by extensive margin for physical, combination for mental-cognitive
- within physical: effects driven by limitations to kinetic ability
- within cognitive: large magnitude for both

Government Transfers:

- similar in total government transfers between physical and mental-cognitive
  - entirely from disability relevant transfers for physical, only long run for mental-cognitive
  - within physical: the rise in transfers driven by kinetic ability
  - within cognitive: insurance gaps for mental health

Other smoothing mechanisms

- non-taxable income main insurance for aggregate physical, effect of mental-cognitive buffered by tax system

THANK YOU!!

Conceptual framework: task-specific human capital

Workers

- s_t : k dimension skill portfolio vector
  - $s_t^j \in \mathbb{R}$ represents proficiency in productive skills of type j
- d_t : k dimension extent of disability vector
  - $d_t^j \in [0, 1]$ - extent of limitation for skills of type j

Occupations

- x_t : k-dimensions bundle of skill requirements
  - $x_t^j \in \mathbb{R}$ represents complexity/ intensity of use of skills in production
  - derived from set of task requirements of an occupation

Conceptual framework: wage determination function

Workers hourly wage equals their marginal value product:

$$w_t = \pi(x_t)q(x_t, s_t)exp(\eta_t).$$

- $\pi(x_t)$: is market pricing of output produced by tasks, x_t
- $q(x_t, s_t)$: productivity of worker with skill s_t at job with task complexity x_t
  - $\ln q(x_t, s_t) = \theta'(x_t)s_t$, where $\theta'(x_t)$ is k-dim vector of implicit skill prices
- η_t : I.I.D productivity shocks

Skills matter for productivity as along as you can use them

- define $h_t = s_t \cdot x_t$ to be a workers "*effective skills*"

Disability induced mismatch

$$\begin{aligned}\Delta w &= (q(s_t, x_t) - q(h_t, x_t))\pi(x_t)exp(\eta_t) \\ &= \theta'(x_t)(s_t - h_t)\pi(x_t)exp(\eta_t)\end{aligned}$$

Conceptual framework: dynamic effects of disability

To illustrate, consider simple skill accumulation process

$$s_{t+1} = Ds_t + A_1 x_t + A_2 d_t + \epsilon_{t+1}$$

- D: diagonal elements are depreciation
- A_1: "learning by doing,"
  - diagonal : higher intensity of task x_t^j, higher accumulation of these skills
  - off-diagonal : complementarities between tasks and other skills (e.g., healthy body results in health mind)
- A_2: impact of disability on next period skills
  - diagonal : direct effect limitation in one dimension
  - off-diagonal : limitation in some dimensions, may influence skill accumulation in another

Repeatedly substitute previous periods skills

$$s_{t+1} = D^{t-n} s_{t-n} + \sum_{j=0}^{n} D^j A_1 x_{t-j} + \sum_{j=0}^{n} D^j A_2 d_j + \sum_{j=0}^{n} D^j \epsilon_{t-n+1}$$

Empirical Framework: Treatment effect of interest

We observe the following post-treatment

$$Y_{i,t} = Y_{i,t}^{E_i} = Y_{i,t}^{\infty} + \sum_{0 \leq e \leq T} (Y_{i,t}^{e} - Y_{i,t}^{\infty})\, \mathbb{I}\{E_i = e\}$$

- e is treatment cohort, $\mathbb{I}\{E_i = e\}$ is indicator for i in treatment cohort e
- $Y_{i,e+l}$ is outcome l periods relative to treatment, if i first treated in period e
- $Y_{i,e+l}^{\infty}$ is outcome l periods relative to treatment, if i wasn't treated in period e

Define cohort-average treatment on the treated, k periods relative to treatment

$$CATT_{e,l} = E(Y_{i,e+l} - Y_{i,e+l}^{\infty}) | E_i = e)$$

- average treatment effect l periods from first treatment for cohort first treated at e
- note: timing in terms of l, instead of t.

Intuition of contamination

Workhorse estimator for dynamic treatment effects: Two-way fixed effects

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_l \delta_l A_{l,i,t} + \epsilon_{it} \tag{1}$$

- $A_{l,i,t}$ an indicator for k periods relative to i's initial treatment
- δ_k are dynamic treatment effects of interest

Sun and Abraham (2020) show δ_k is a weighted sum of $CATT_{e,l}$ as well as $CATT_{e,l'}$ from other relative periods (and even excluded periods)

- *why?* with staggered treatment timing, earlier treatment cohorts compared to later treatment cohorts
- *issue?* If weights $w_{e,k'}$ are non-zero, then effects from other relative periods may contaminate interpretation of δ_k
- *solution?* Separately estimate all $CATT_e, l$'s, then take a specific weighted average to recover treatment effect of interest

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Self-reported disability and concerns

Subjectivity in extent of health

- any positive limitations to a specified activity, and abstracts from the degree of impairment

State dependent reporting: justification bias

- **physical**: narrow the scope of justification bias to be anchored to the activities in question

  "How often are you limited walking on a flat surface for 20 minutes"

- **cognitive**: base the existence of a limiting condition to the diagnosis of a medical professional

  "Has a doctor or medical professional ever said you have a learning disability"

- **mental-health**: frame limitations related to mental health with specific examples of diagnoses

  "Do you have an emotional or psychological condition ... such as anxiety, depression, bipolar disorder, etc.."

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