Money that grows on trees

Household consumption during an agricultural export boom

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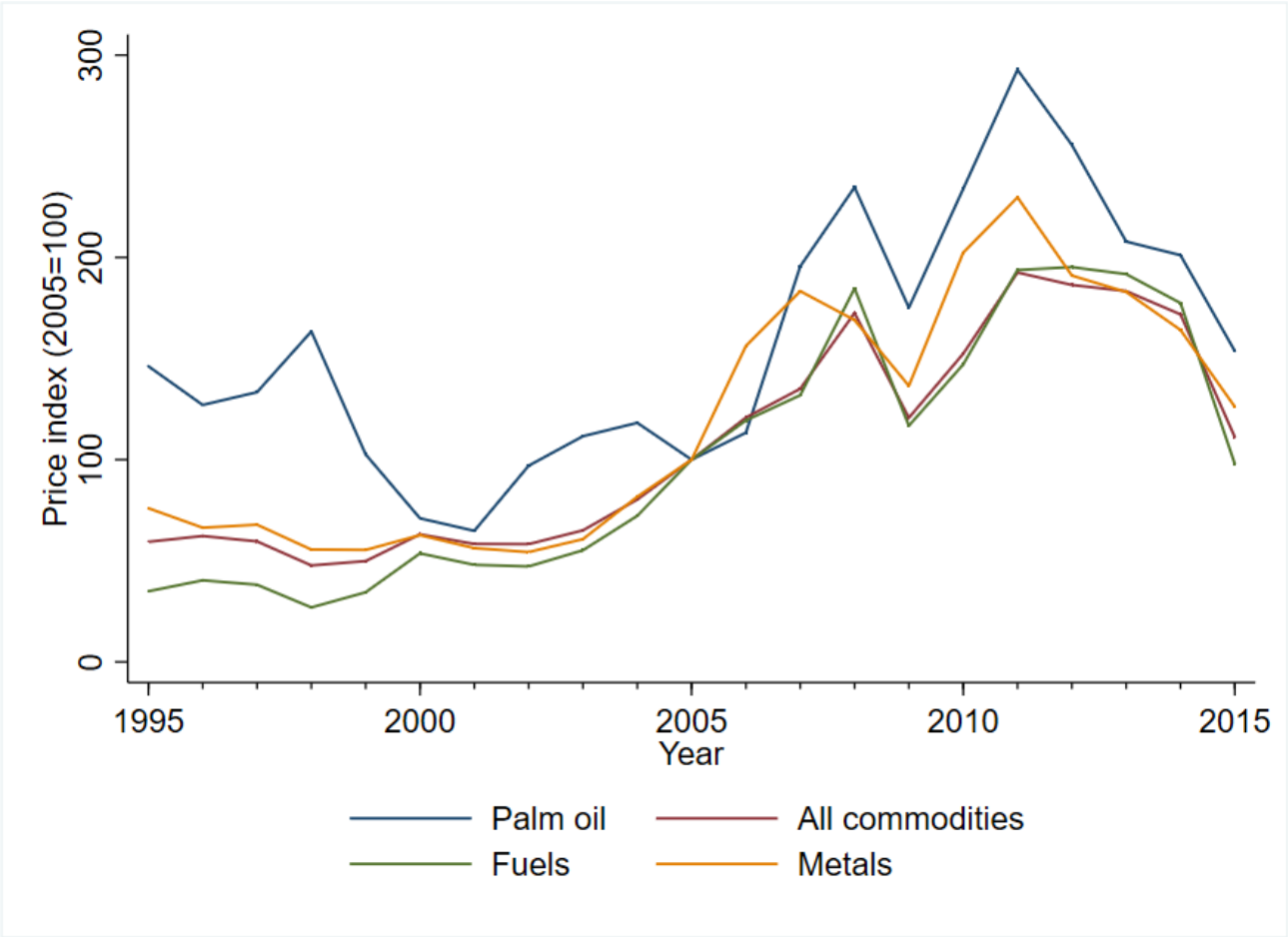
How do agricultural export booms affect households in developing countries?

- Expect boom to raise consumption and a bust to lower it
- Setting: the palm oil price boom and bust in Indonesia
- Does household expenditure follow the expected pattern?
- Expenditure is a measure of consumption, proxy for income
- Deeper analysis of producer characteristics

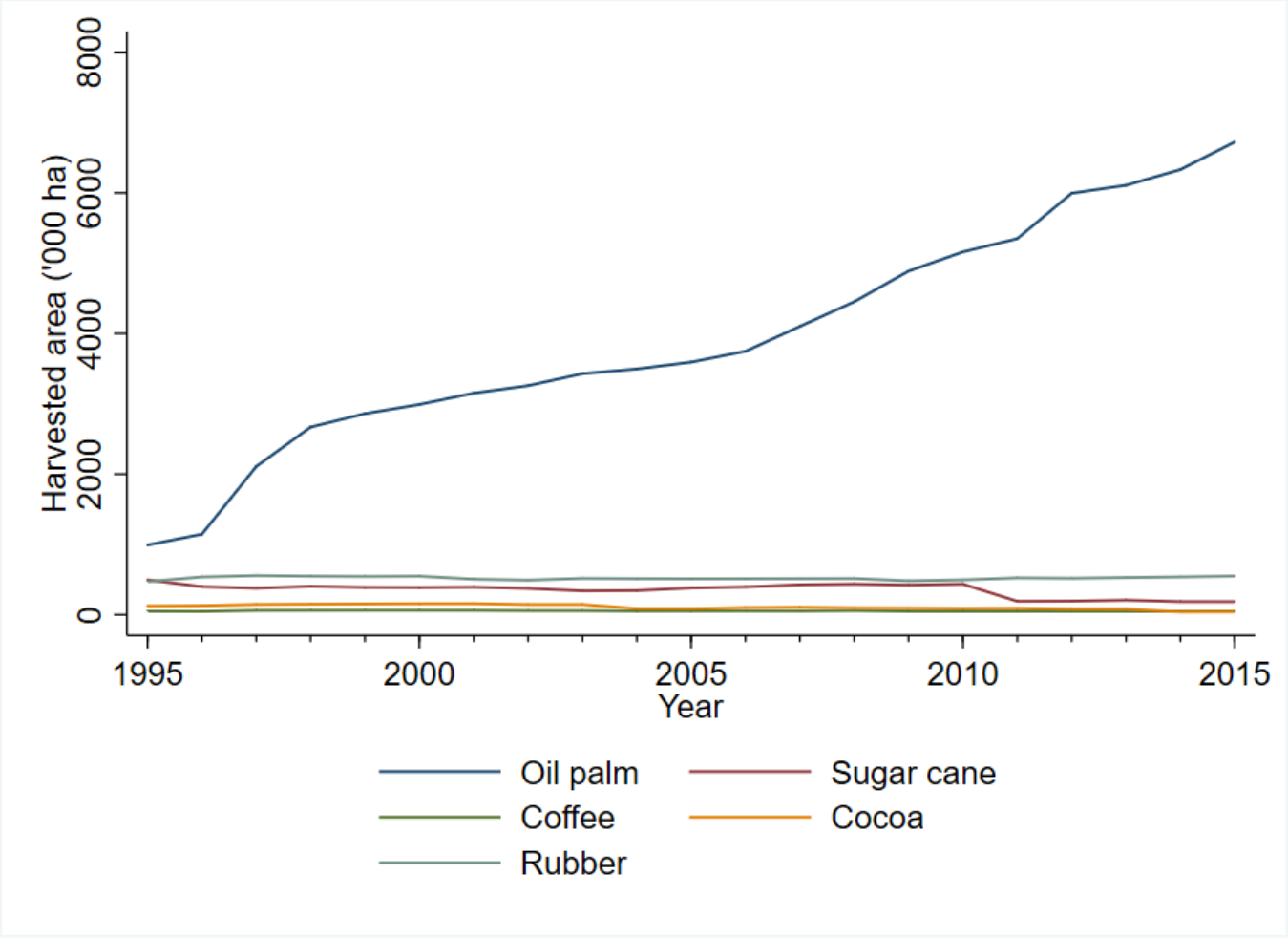
Commodity price boom and bust, 2005-2014

- Global price of palm oil determines aggregate palm oil revenue
- But how much of this revenue reaches households?
- Identify changes in household expenditure through these exogenous price changes
- Compare small to large plantations: land ownership
- Compare new to established plantations: fixed costs and price exposure

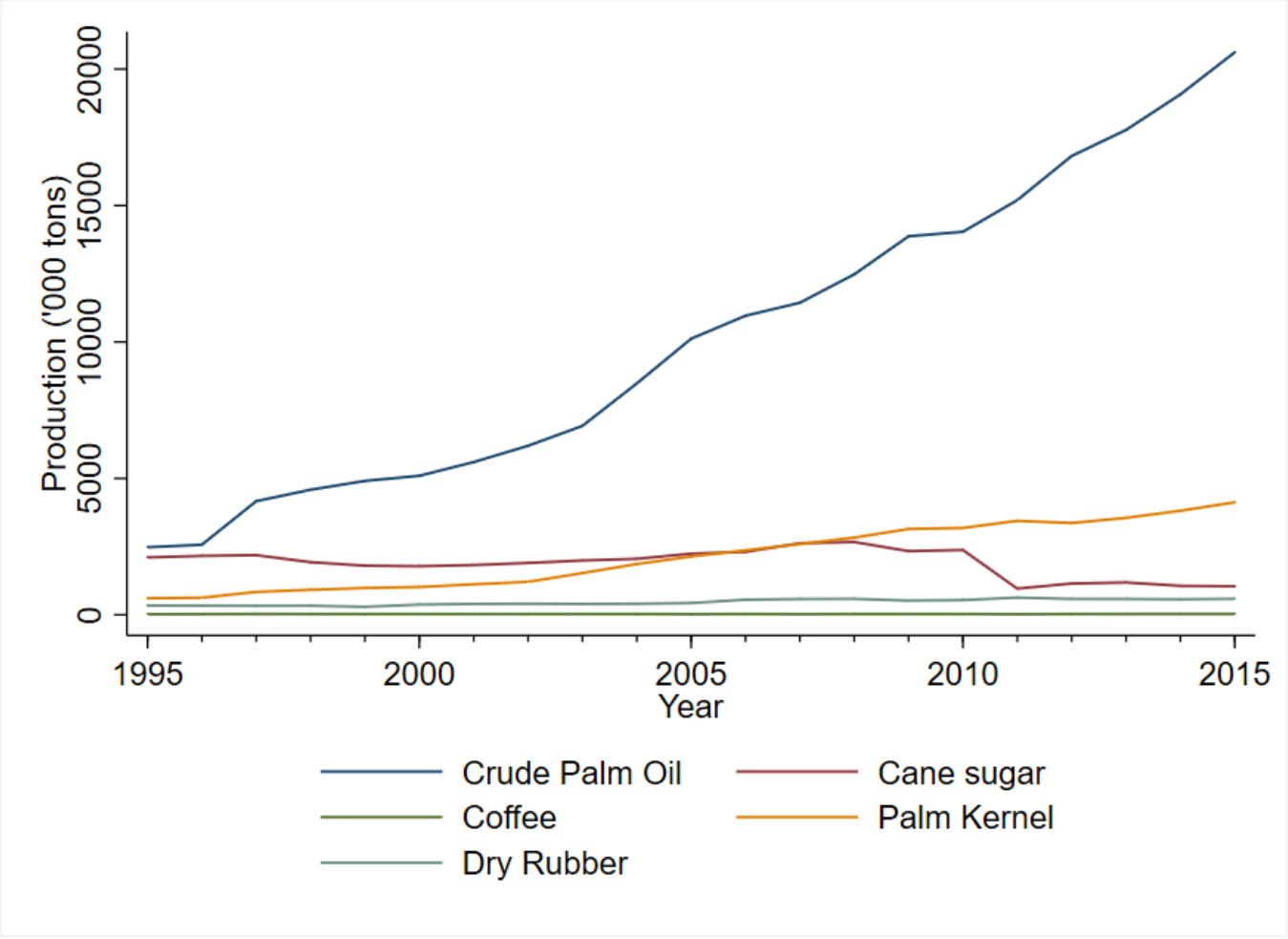
Comparison of price indices for several commodity categories, 1995-2015



Estate crops harvested land area in Indonesia ('000 Ha), 1995-2015



Estate crops production in Indonesia ('000 tons), 1995-2015



Preview of results

I compare palm oil producer to non-producer districts during the boom and bust.

- Producing districts: average household expenditure rises during the boom and falls during the bust
- Expenditure is more sensitive to a price decrease than an equivalent price increase

Producer characteristics

- Small plantations: average household expenditure rises during the boom and falls by the same magnitude during the bust
- Large plantations: expenditures do not significantly change during either period
- New and established producer districts: expenditure also rises and falls, though the increase during the boom is larger for established producers

Health and education spending

- Education spending does not change during the boom and falls during the bust
- Health spending increases during the boom by more than total expenditure, falls again during the bust

Expands on current literature

- Large literature on energy booms in the US and Canada (Black et al, 2005; Marchand 2012; Weber 2012; Jacobsen and Parker 2015)
- Local impacts of a Peruvian gold mine (Aragon et al, 2013; Zambrano 2014)
- All find that booms increase local incomes and employment
- Following a bust, these trends are reversed
- Literature lacks analysis of agricultural boom

Specialization in agricultural exports

- Extractive resource v.s. agricultural export boom:
  - Agriculture is more labor intensive
  - Rents from extractive resources easily captured by a few
- Similar in other ways:
  - A type of resource curse
  - Exposes economy to high volatility through volatile global prices

Palm oil and poverty reduction

- Study found palm oil plantation expansion reduced poverty in Indonesia from 2000 to 2008 (Edwards 2015)
- Flaw: examines period during which price tripled
- Does not answer what happened after the bust
- I expand the time frame to 2015

Policy debate: the economy and the environment

- Debate has traditionally been about economic benefits v.s. environmental costs
- Environmental costs are large: deforestation, carbon emissions
- Economic benefits are much smaller than previously thought

Modifying a classic model to new context

- Traditionally used with energy export booms
- General equilibrium model with three goods and three factors
- I modify the booming sector model (Corden and Neary 1982) to an agricultural export boom
  - Different assumptions about factor intensity
  - Use price shock instead of resource discovery
- Model generates static, short-run predictions

Assumptions

- Goods: agricultural export, other export, and nontraded goods
- Factors: labor, capital, and land
- Small, open economy (price taker)
- Assume factors are fixed in the short run
- Supply of palm oil is fixed in the short run–three years from planting seedlings to maturity
- In the long-run, no factors are fixed

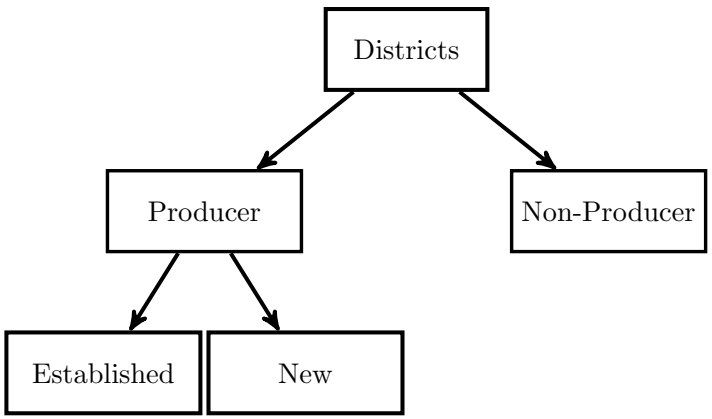
Model predictions: positive price shock

1. Increase in the return to palm oil producing land
2. Increase in the nominal wage, ambiguous effect on real wage
3. Decrease in nominal and real return to capital
4. Expansion of palm oil industry
5. Contraction of the other traded sector
6. Expansion of nontraded sector

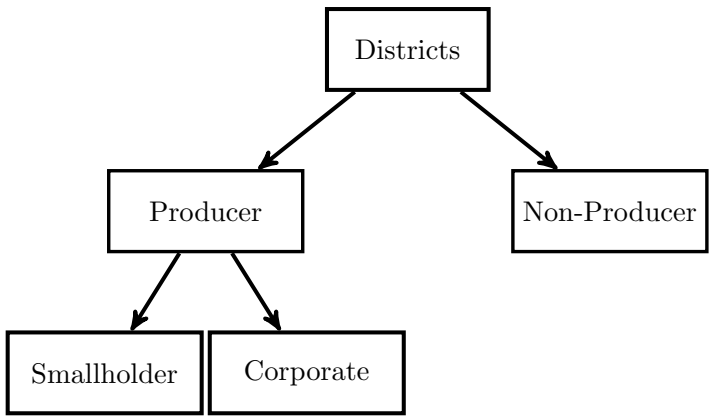
Sources

- Household expenditure and other characteristics: SUSENAS (Indonesian government-collected household surveys), 2000-2015
- Instrument for palm oil producer district: agroclimatic suitability for palm oil cultivation data (FAO)
- Palm oil production data and district characteristics: INDO-DAPOER (World Bank), 2001-2010
- Commodity prices: International financial statistics (IMF), 1980-present
- Aggregated data up to district level to create a pseudo-panel from 2000 to 2015

District classifications

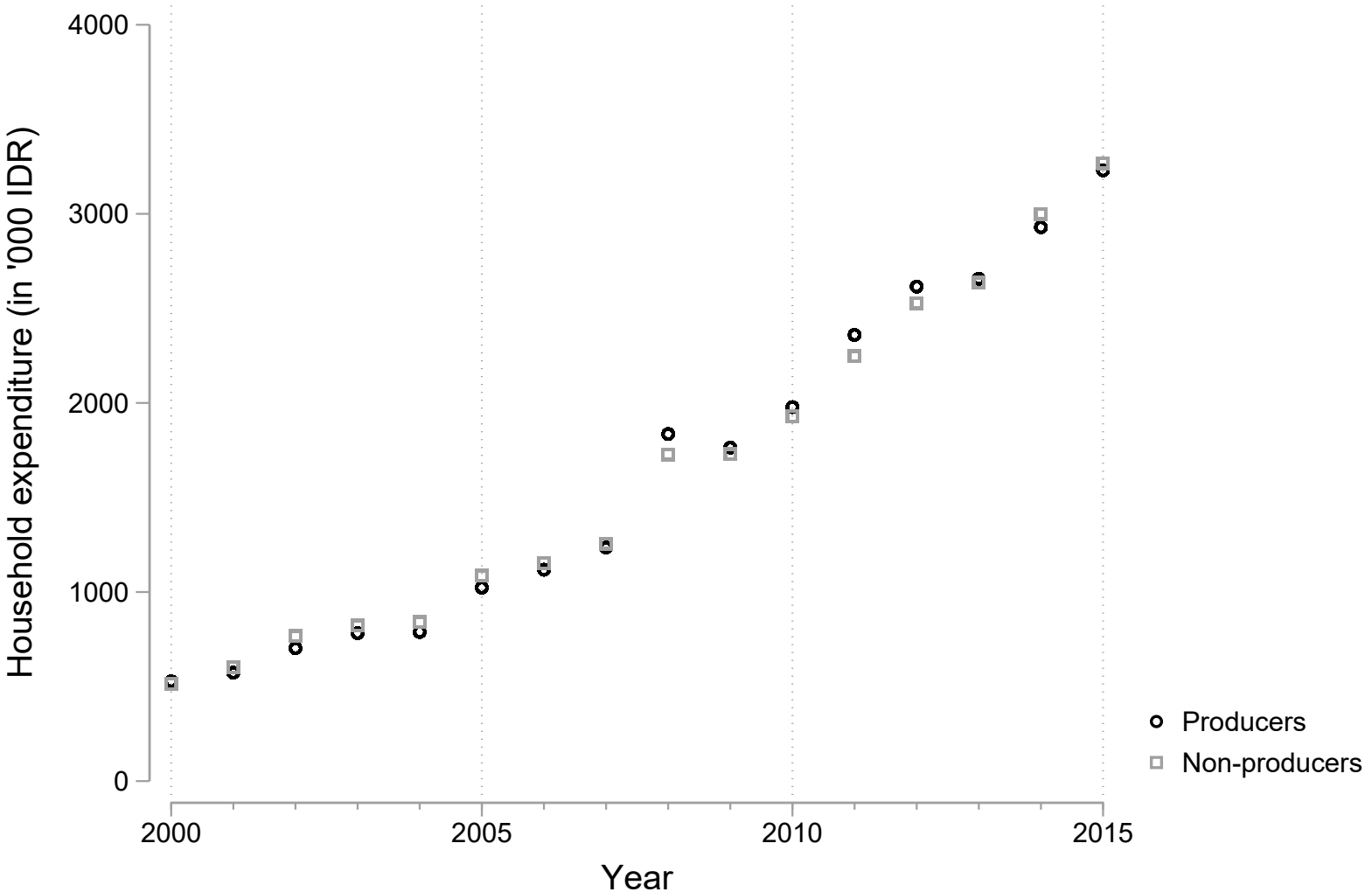


(a) By plantation age

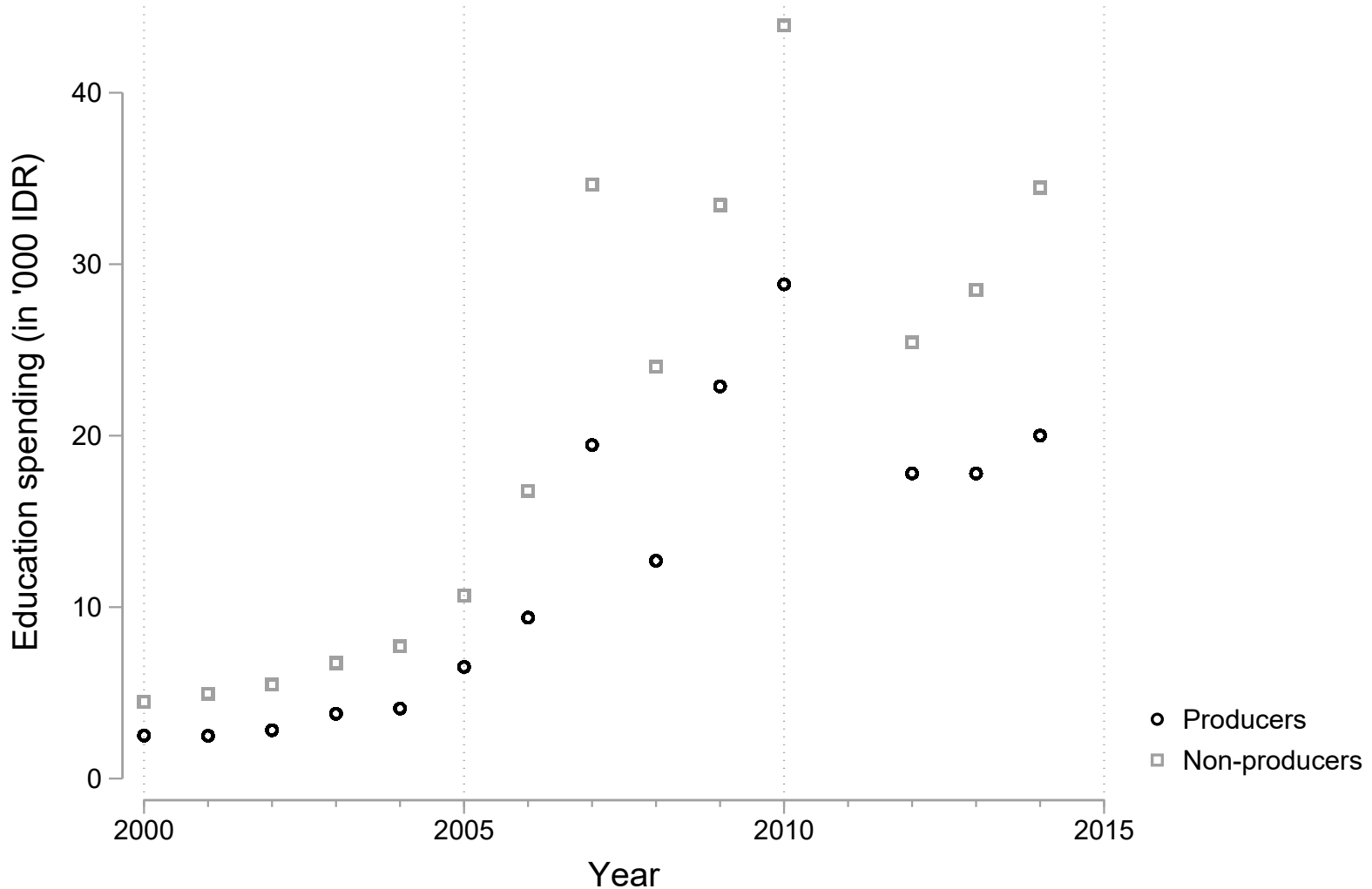


(b) By plantation ownership

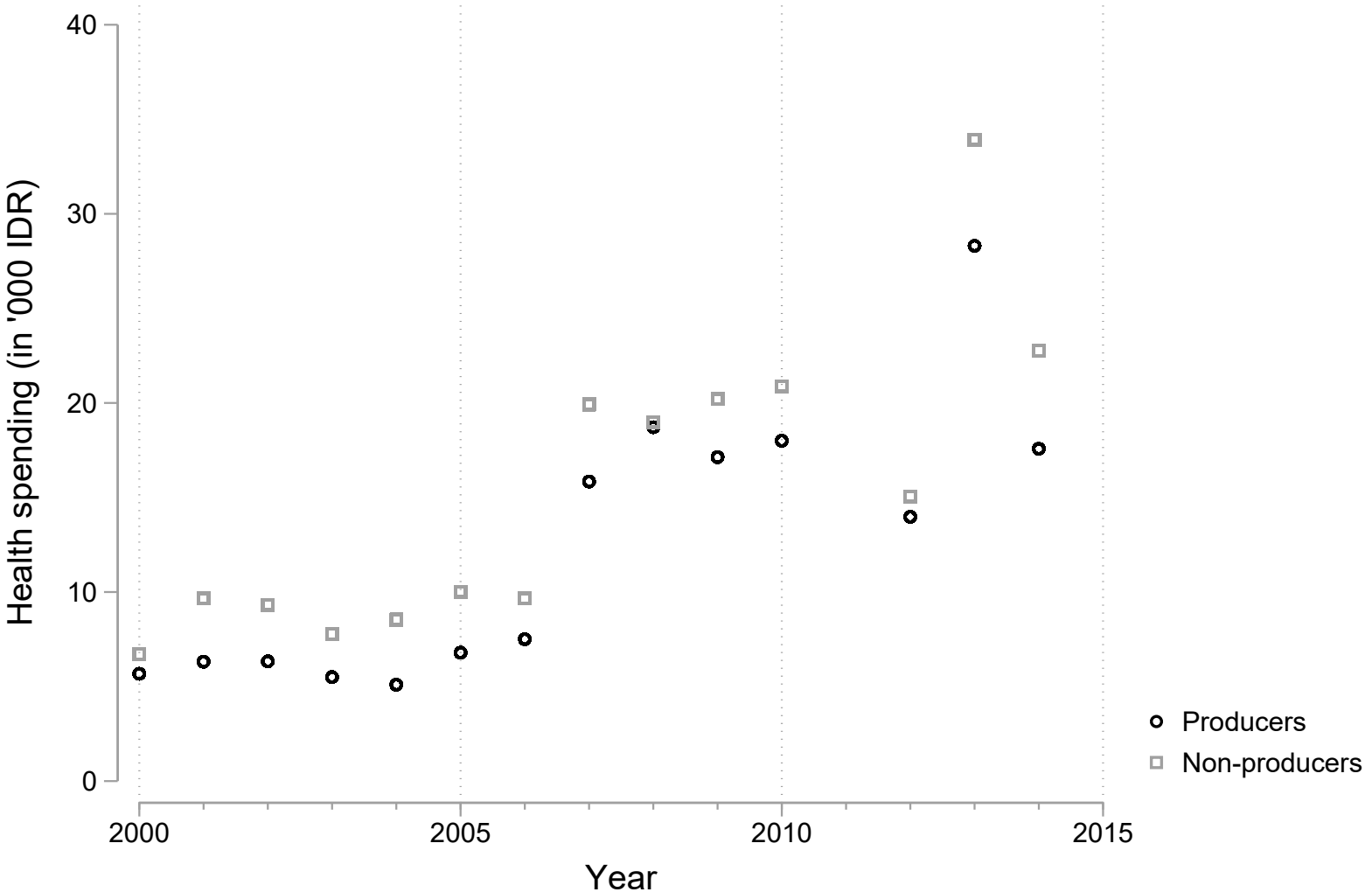
Parallel trend



Parallel trend: education spending



Parallel trend: health spending

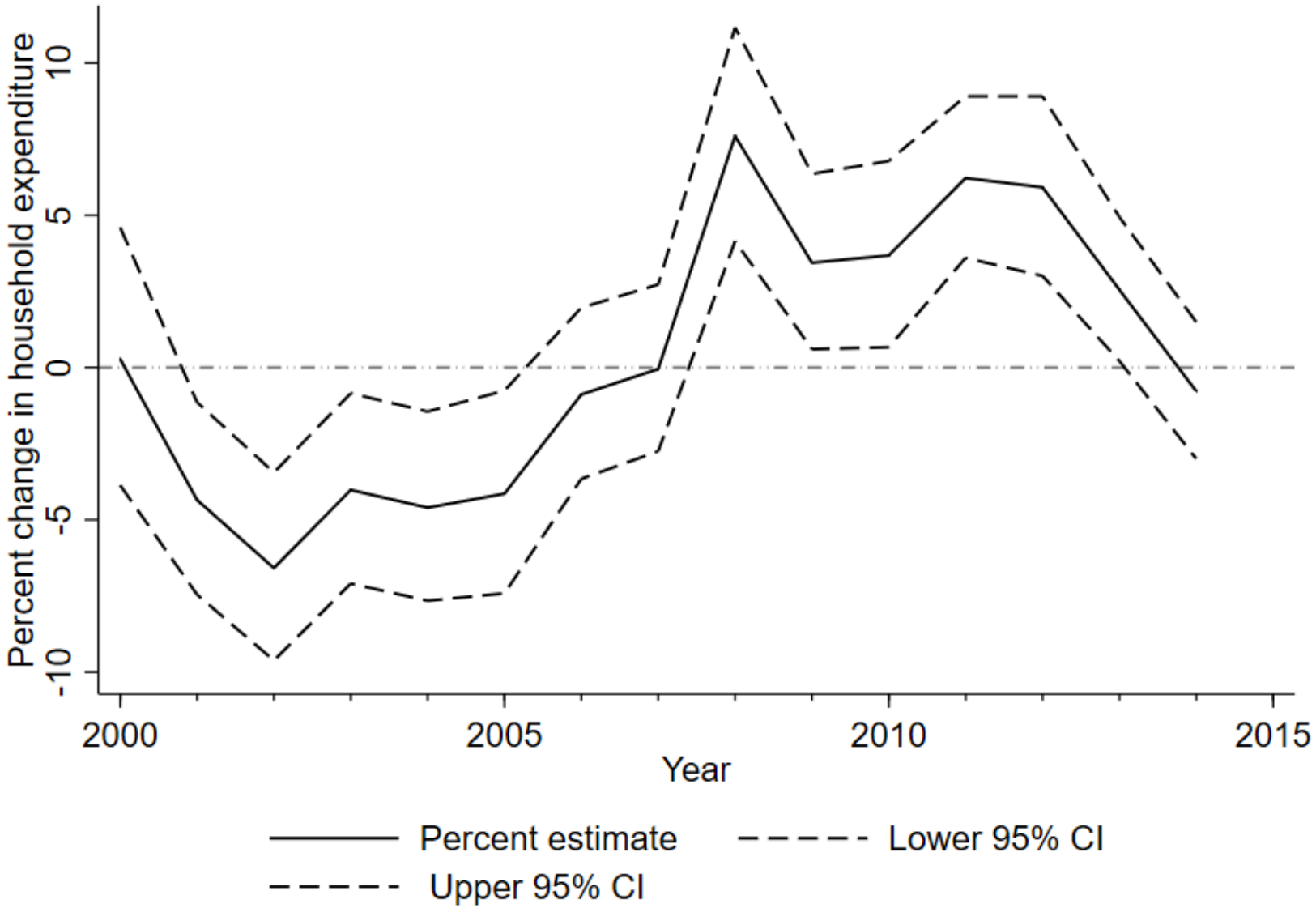


Dynamic effects by year

$$E_{it} = \beta_t Producer_i \times Year_t + \gamma_t + \alpha_i + \epsilon_{it}$$

- E_{it}: district average household expenditure
- $Producer_i$: indicates producer
- $Year_t$: year indicator
- γ_t: period fixed effect
- α_i: district fixed effect

Producer and non-producer districts: percent

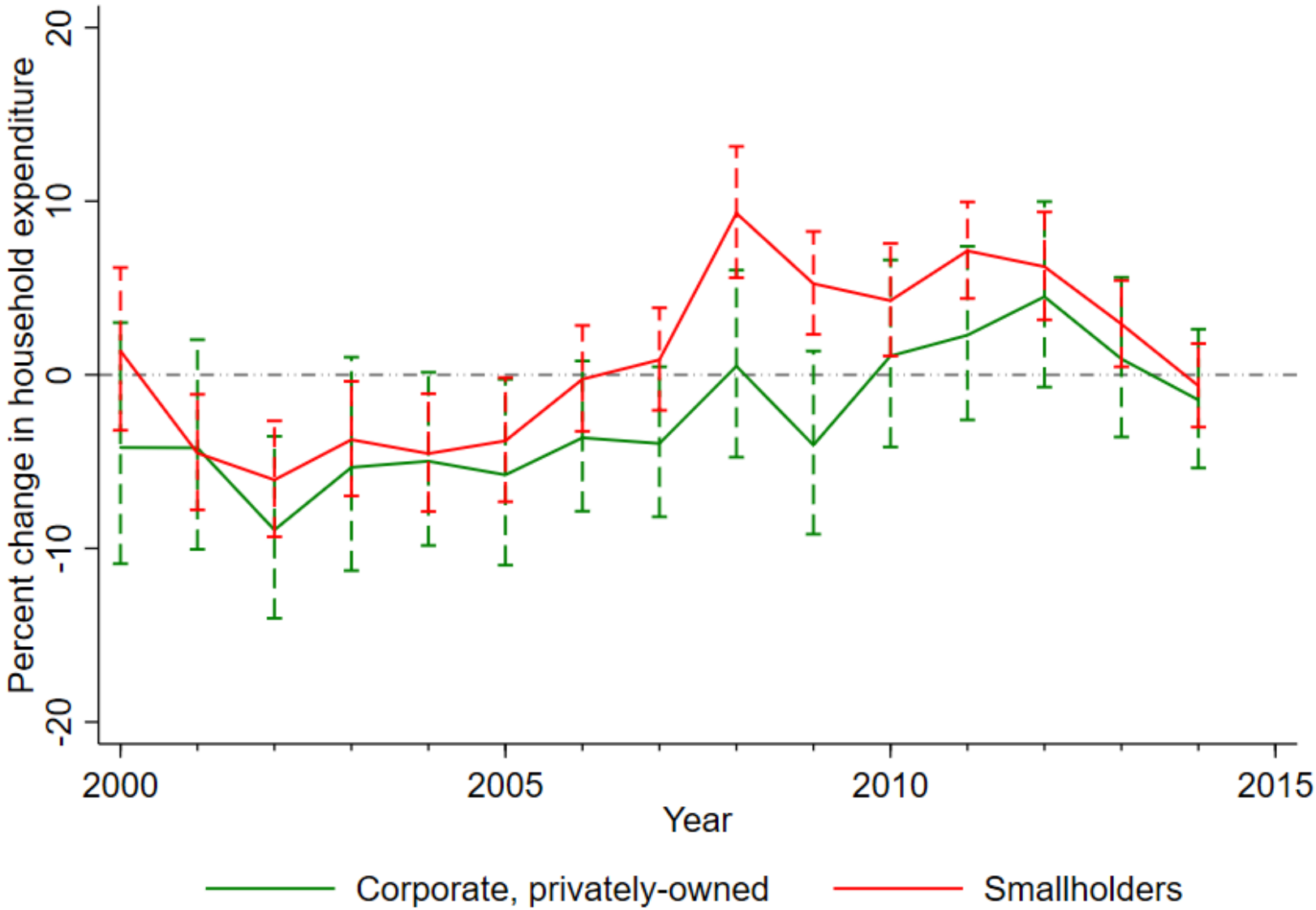


Producer type and dynamic effects

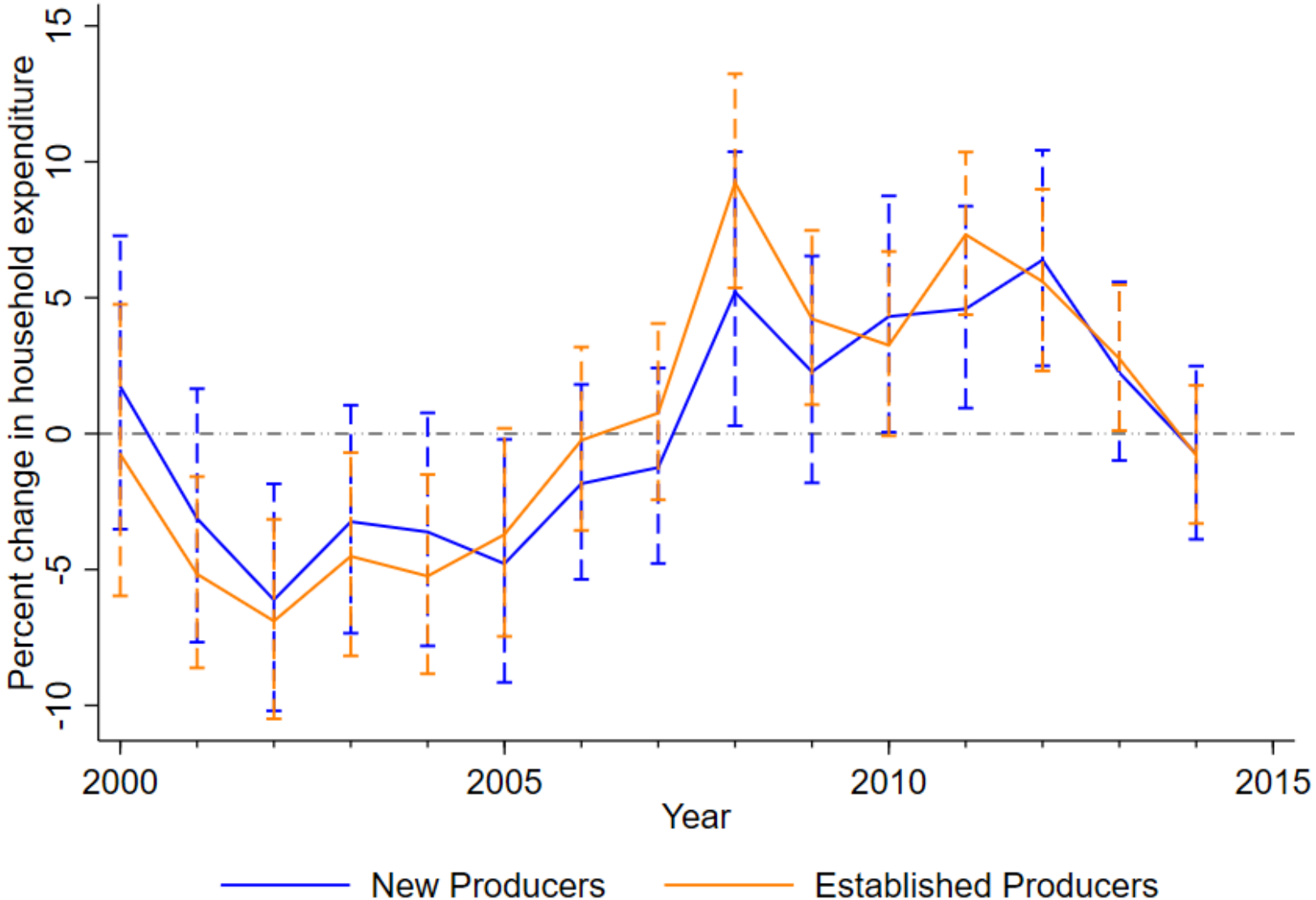
$$E_{it} = \delta_{(Type,t)} Type_i \times Year_t + \gamma_t + \alpha_i + \epsilon_{it}$$

- E_{it}: district average household expenditure
- $Type_i$: indicates producer type
- $Year_t$: year indicator
- γ_t: period fixed effect
- α_i: district fixed effect

Smallholder and corporate producers



New and established producers



Next step

- Household expenditure in producing districts follows the palm oil price
- Next step: collapse data to "boom" and "bust"
- Estimates more robust

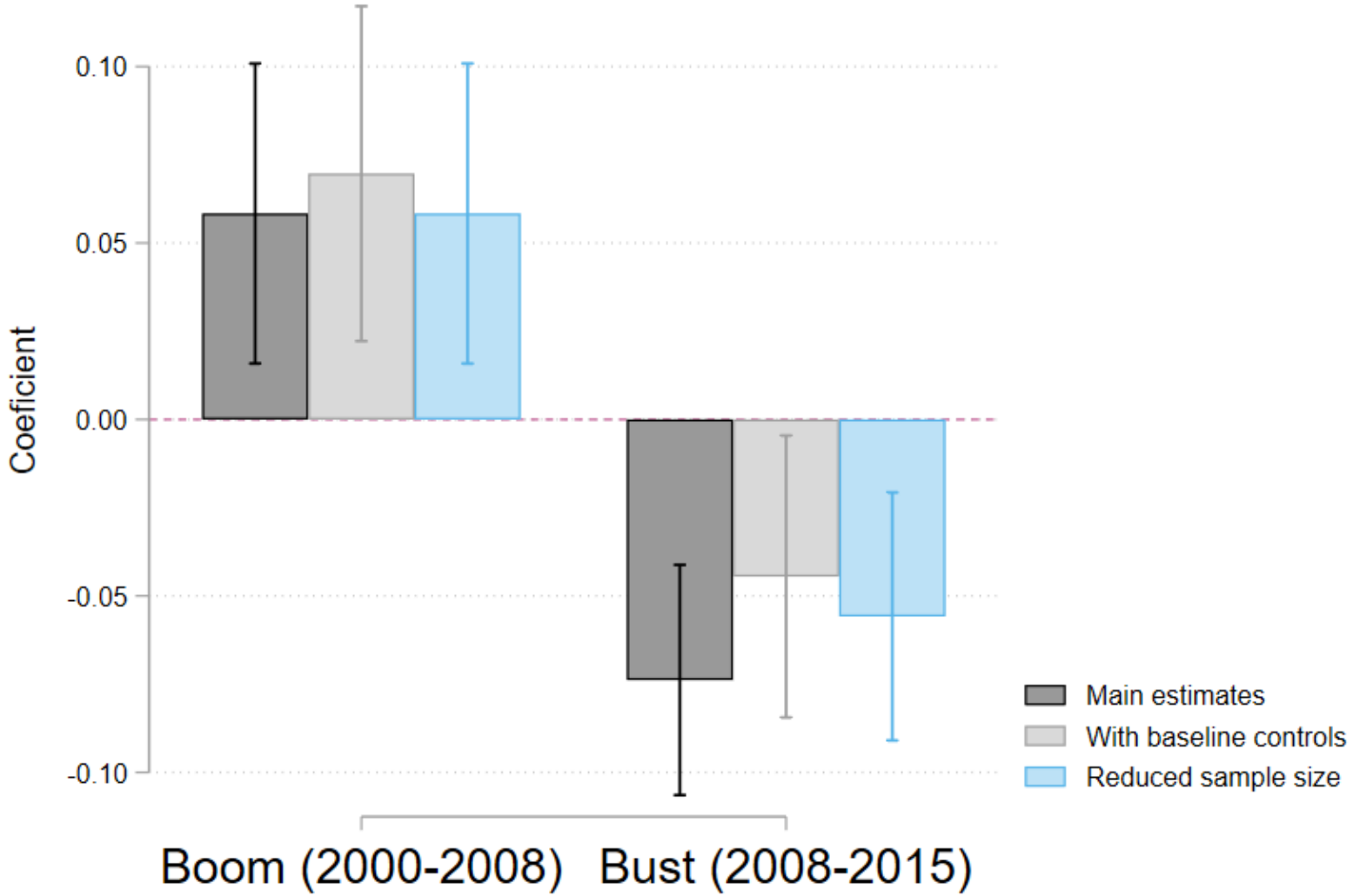
Producers and non-producers

$$\Delta E_{it} = \phi_1 Producer_i \times Period_1 + \phi_2 Producer_i \times Period_2 + \gamma_t + \eta_{it}$$

- ΔE_{it}: eight year change in district average household expenditure
- $Producer_i$: indicates producer
- $Period_1$: indicates 2000-2008
- $Period_2$: indicates 2008-2015
- γ_t: period fixed effect

Change in household expenditure in producing districts

	(1)	(2)	(3)
Producer × Period 1	0.058***	0.070***	0.058***
	(0.022)	(0.024)	(0.022)
Producer × Period 2	−0.074***	−0.045**	−0.056***
	(0.017)	(0.020)	(0.018)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.70	0.70	0.70


0.10
0.05
0.00
-0.05
-0.10
Coeficient
Main estimates
With baseline controls
Reduced sample size
Boom (2000-2008)
Bust (2008-2015)

By plantation size and age

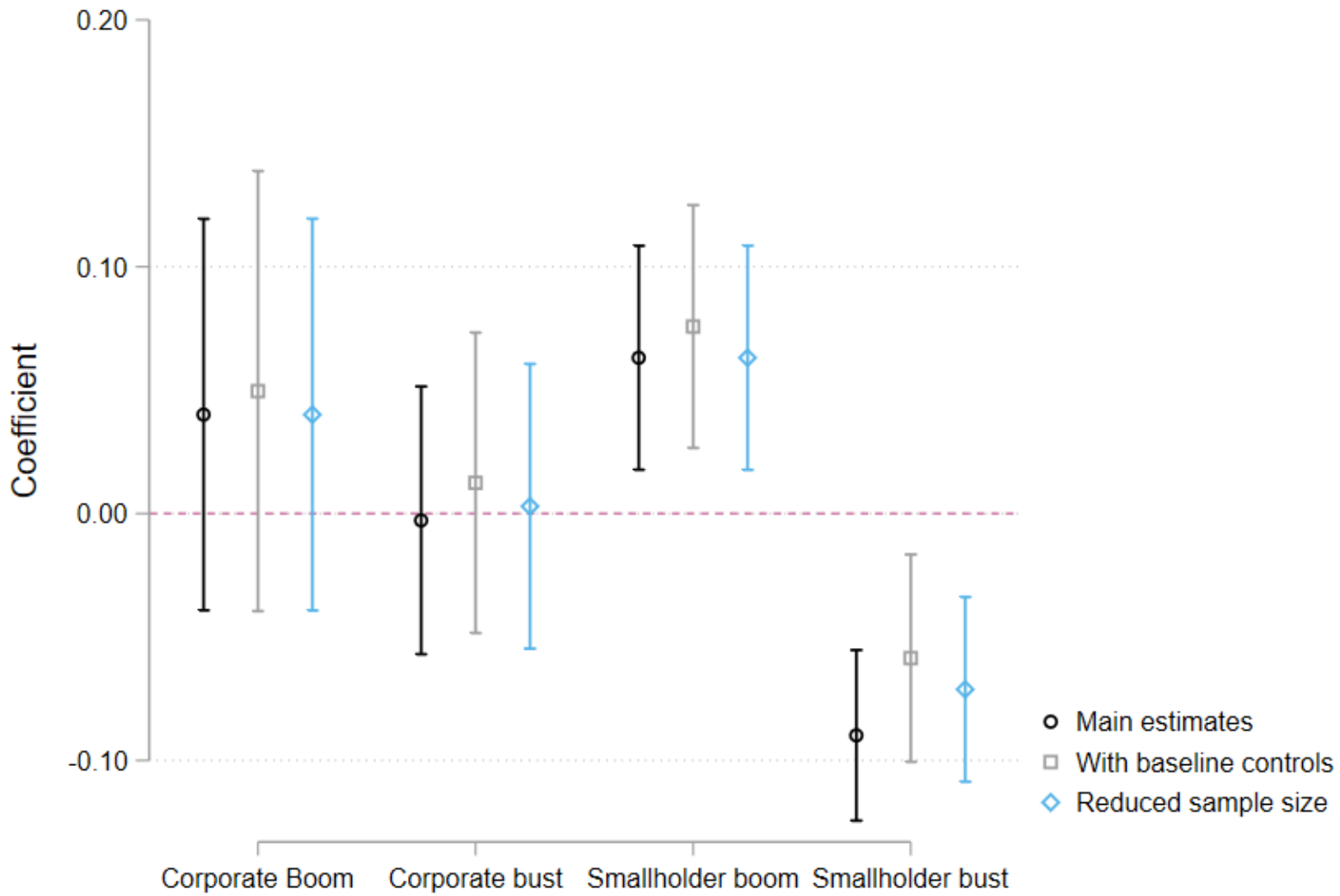
$$\Delta E_{it} = \lambda_{(Type,t)} Type_i \times Period_t + \gamma_t + \eta_{it}$$

- ΔE_{it}: eight year change in district average household expenditure
- $Type_i$: indicates the producer type
- $Period_t$: indicates period 2000-2008 or 2008-2015
- γ_t: period fixed effect

Smallholder and corporate producers

	(1)	(2)	(3)
Corporate × Period 1	0.040	0.050	0.040
	(0.040)	(0.045)	(0.040)
Corporate × Period 2	−0.003	0.012	0.003
	(0.028)	(0.031)	(0.029)
Smallholder × Period 1	0.063***	0.076***	0.063***
	(0.023)	(0.025)	(0.023)
Smallholder × Period 2	−0.090***	−0.059***	−0.071***
	(0.018)	(0.021)	(0.019)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.71	0.70	0.70

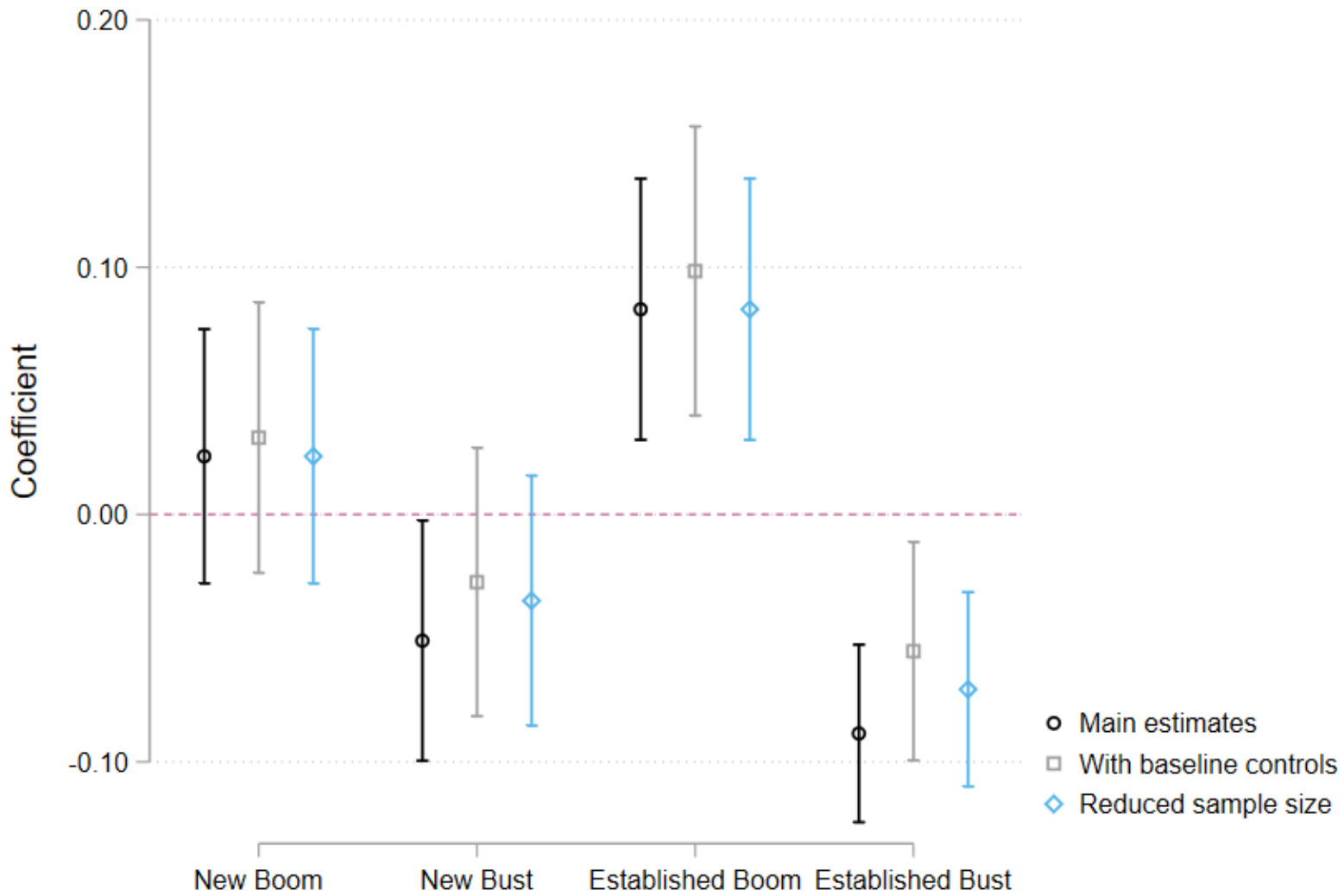
Coefficient plot for corporate and smallholder producers



New and established producers

	(1)	(2)	(3)
New × Period 1	0.024	0.031	0.024
	(0.026)	(0.028)	(0.026)
New × Period 2	−0.051**	−0.027	−0.035
	(0.025)	(0.028)	(0.026)
Established × Period 1	0.083***	0.098***	0.083***
	(0.027)	(0.030)	(0.027)
Established × Period 2	−0.089***	−0.055**	−0.071***
	(0.018)	(0.023)	(0.020)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.71	0.70	0.70

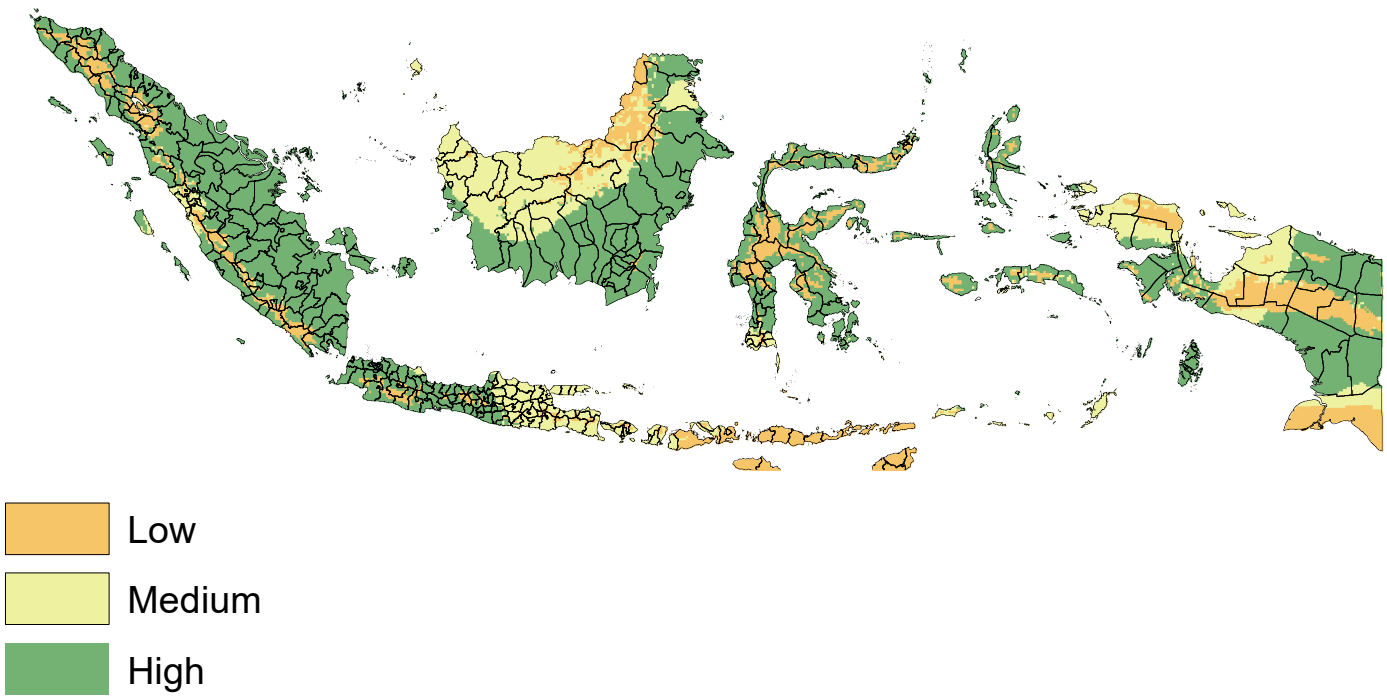
Coefficient plot for new and established producers



Concerns about endogeneity

- The development of a palm oil industry in a given district could be correlated with household expenditure
- For instance, palm oil corporations could chose to locate in districts where households are poor and unskilled labor is relatively cheap
- Districts with many poor, land-owning households self-select into palm oil cultivation expecting higher profits and household incomes
- I use the percentage of district land highly suitable for palm oil production as an instrument for the producer indicator

Land suitability for oil palm cultivation



IV estimation

First stage:

$$\text{Producer}_i \times \text{Period}_1 = \text{Suit}_i \times \text{Period}_1 + \text{Suit}_i \times \text{Period}_2 + \gamma_t + \eta_{it}$$
$$\text{Producer}_i \times \text{Period}_2 = \text{Suit}_i \times \text{Period}_1 + \text{Suit}_i \times \text{Period}_2 + \gamma_t + \eta_{it}$$

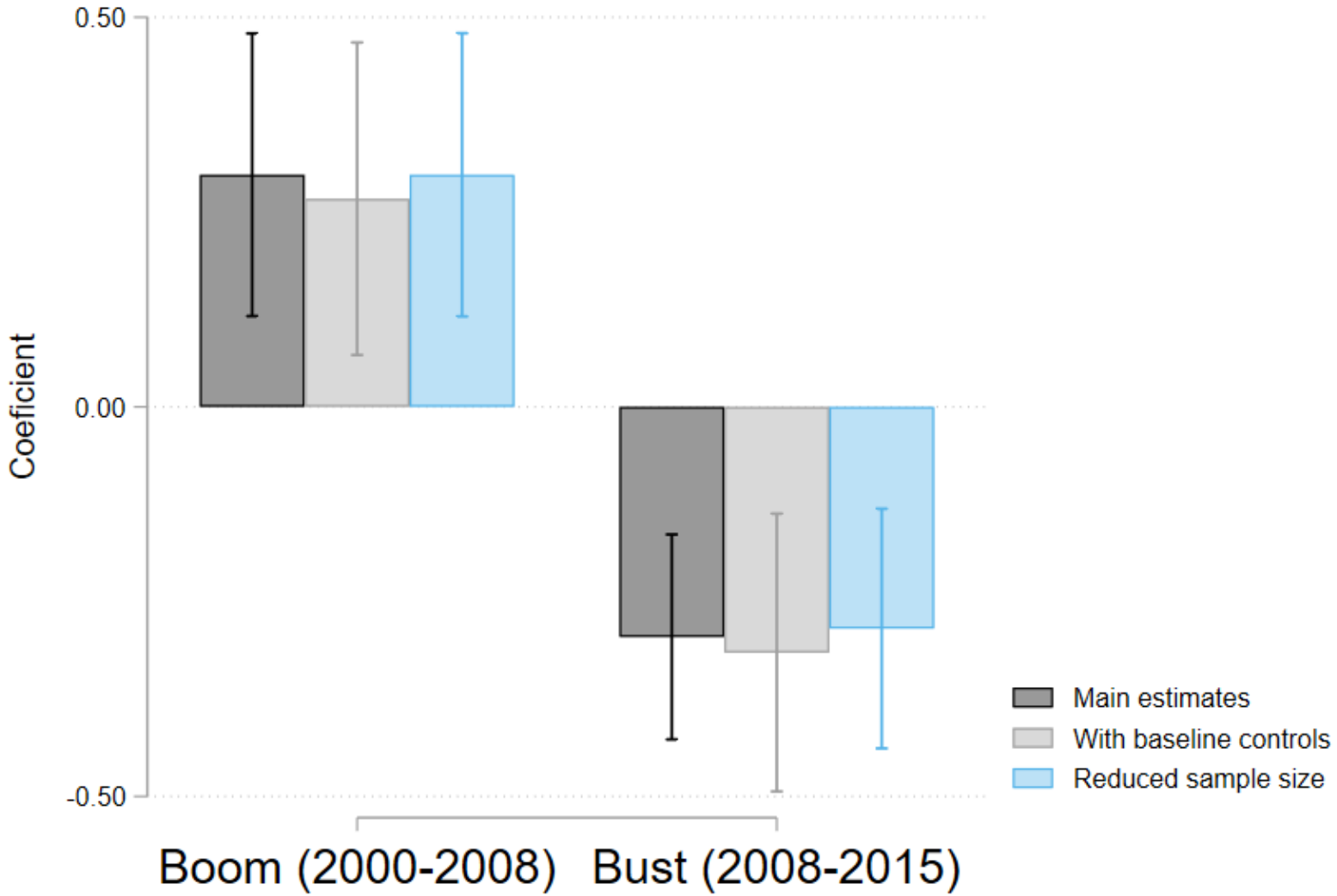
Second stage:

$$\Delta E_{it} = \phi_1 \widehat{\text{Producer}_i \times \text{Period}_1} + \phi_2 \widehat{\text{Producer}_i \times \text{Period}_2} + \gamma_t + \eta_{it}$$

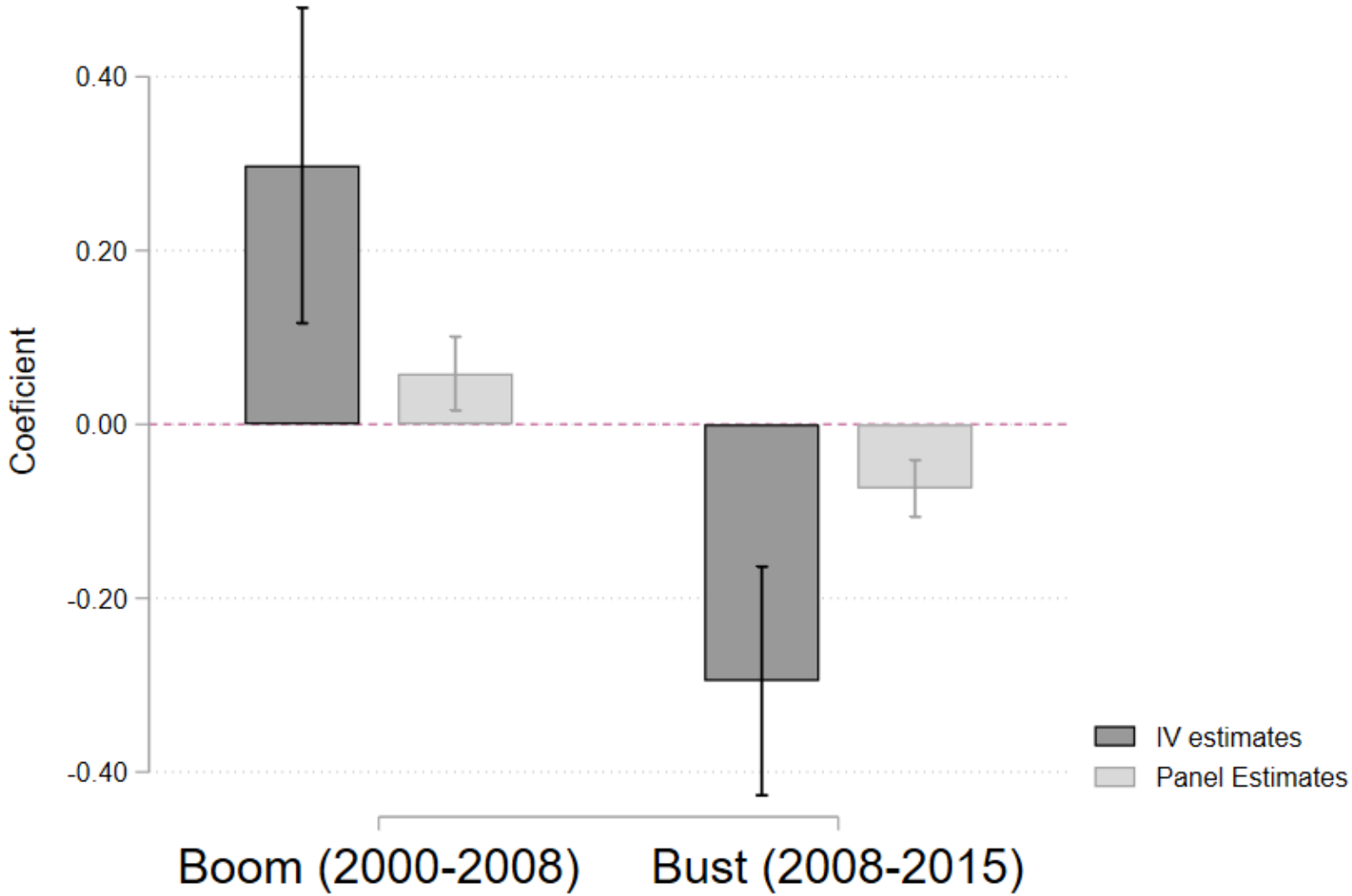
IV: Change (2000-2008 and 2008-2015) in district average household expenditure

	(1)	(2)	(3)
Producer × Period 1	0.298***	0.267***	0.298***
	(0.092)	(0.102)	(0.092)
Producer × Period 2	−0.295***	−0.315***	−0.285***
	(0.067)	(0.091)	(0.078)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.60	0.60	0.59
F-Statistic	208.74	36.76	172.85

Coefficient plot for IV estimates



Panel OLS estimates are downward biased



Discussion

- Boom: $\uparrow$ 34 percent
- Translates into elasticity of 0.1
- Bust: $\downarrow$ 25 percent
- Translates into an elasticity of 0.5

Household expenditure is much **more responsive to a negative shock**

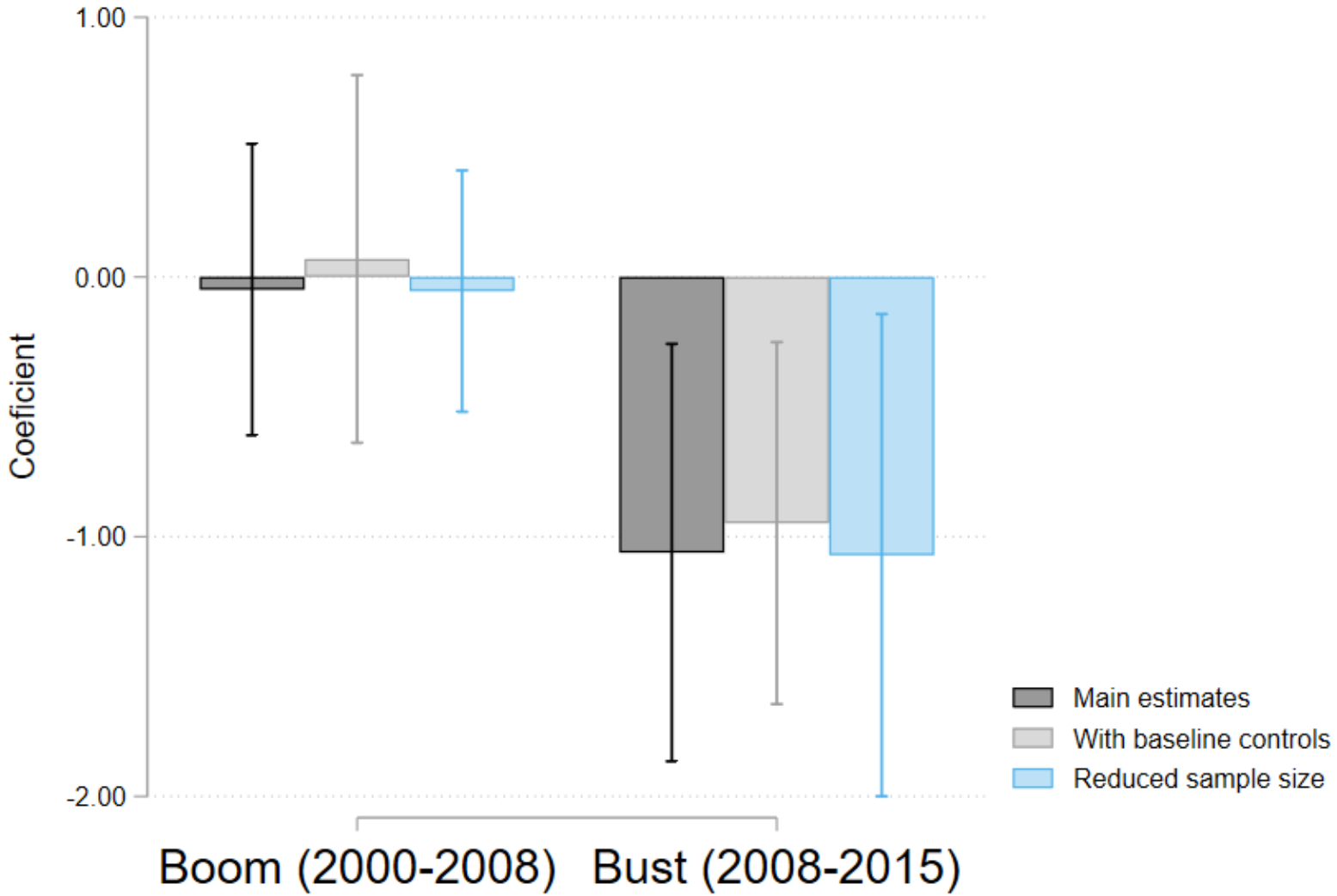
Education and health spending

- Next look at specific spending on education and health
- These two categories can be seen as spending on human capital
- Follow same IV strategy as with total expenditure

Spending on education (IV)

	(1)	(2)	(3)
Producer × Period 1	−0.049	0.069	−0.054
	(0.285)	(0.359)	(0.236)
Producer × Period 2	−1.061***	−0.948***	−1.071**
	(0.408)	(0.354)	(0.471)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.98	0.99	0.98
F-Statistic	7649.83	1511.39	7065.72

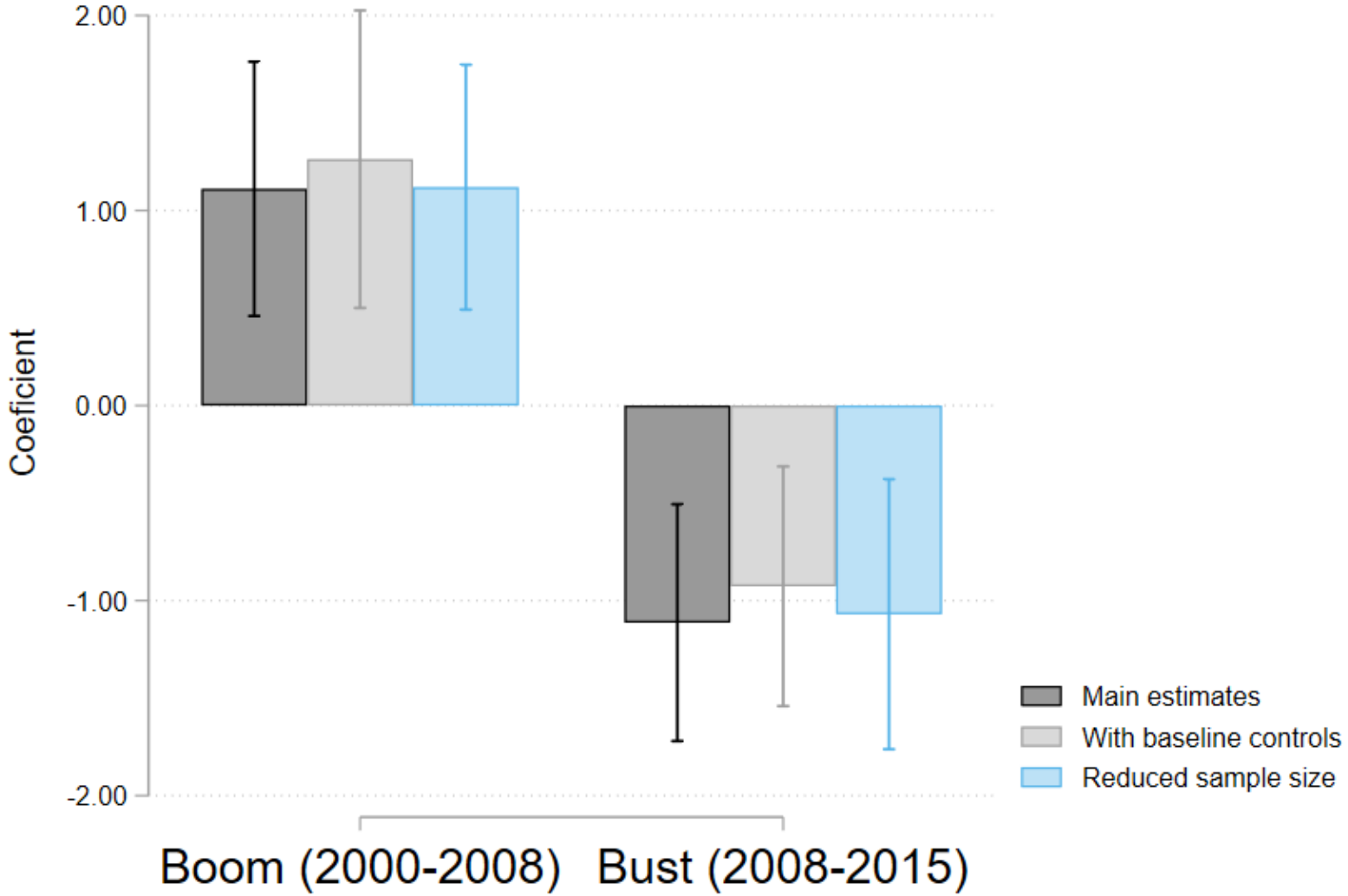
Coefficient plot for education estimates



Spending on health (IV)

	(1)	(2)	(3)
Producer × Period 1	1.111***	1.263***	1.119***
	(0.331)	(0.387)	(0.319)
Producer × Period 2	−1.113***	−0.926***	−1.070***
	(0.309)	(0.312)	(0.352)
Baseline controls	No	Yes	No
Period FE	Yes	Yes	Yes
Observations	604	534	534
R^2	0.98	0.98	0.98
F-Statistic	5794.15	1111.25	5162.24

Coefficient plot for health estimates



Discussion

Education:

- Boom: no change
- Bust: $\downarrow$ 65 percent
- Translates into an elasticity of 1.3

Health:

- Boom: $\uparrow$ 200 percent
- Translates into elasticity of 0.7
- Bust: $\downarrow$ 67 percent
- Translates into an elasticity of 1.3

Limitations

- Does not account for the intensity of production
- Only see aggregate changes in a district; does not say anything about the response of specific households
- Does not take into account local CPI changes; effect on real consumption could be negative
- These are only short-run estimates–more time is needed to observe long-run effects

Conclusions (1)

Key empirical results:

- Household spending is more sensitive to the boom than the bust
- Smallholders are more exposed to price changes, while corporate districts are more insulated
- Spending on health and education exhibit drastically different behavior

Conclusions (2)

- This paper offers a richer theory for the impact of commodity price shocks on household consumption
- Emphasize that the structural properties of commodity production matter for predicting the impact of a boom and bust
- Palm oil production may not be a sustainable poverty reduction strategy because benefits to households rely on a high global price

Future work

- Estimate changes in employment by sector, labor movements between sectors
- Impact of the bust on poverty
- Spillover effects into adjacent but non-producing districts
- Are households vulnerable to negative shocks because they lack access to savings and credit?