Autor-Dorn-Hensen 2013 Critic

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Abstract

This note reconstructs, line by line, the empirical design in Autor–Dorn–Hanson (2013; henceforth ADH), including the shift–share exposure, the supply-driven instrument, the fixed-effects (FE) panel in stacked differences, and the two-stage least squares (2SLS) implementation. It then shows formally why the widely cited macro *share-of-decline* figures cannot be identified from that design. Following Benjamin Moll's critique, the paper's cross-sectional IV with time FE identifies a *relative* slope across regions. The national (aggregate) effect, however, requires an additional intercept shift—a macro channel that time FE absorb. Algebraically, ADH recover β (relative effect), whereas the aggregate elasticity is $(\beta + \gamma)$. Multiplying $\widehat{\beta}$ by the national change in exposure implicitly sets $\gamma = 0$ and is not identified without extra structure.

1 What ADH actually estimate (design and 2SLS mechanics)

1.1 Variables and the exposure ("Bartik/shift–share") measure

ADH study the decade-equivalent change in a commuting zone's (CZ's) **manufacturing employment share of the working-age population**, denoted ΔL_{it}^{m}. Their key regressor is the change in **Chinese import exposure per worker** in CZ i over period t, constructed as a standard shift–share:

$$\Delta IPW_{it}^{u} \equiv \sum_{j} \frac{L_{ijt}}{L_{ujt}} \cdot \frac{\Delta M_{jt}^{uc}}{L_{it}}, \tag{3}$$

where j indexes industries, L_{ijt}/L_{ujt} is CZ i's share of national employment in industry j at the **start** of the period, ΔM_{jt}^{uc} is the **U.S.** import change from China in industry j, and L_{it} is start-of-period CZ employment (the denominator aligns the regressor with a per-worker outcome). ADH emphasize that *all* cross-CZ variation in ΔIPW_{it}^{u} comes from initial industry mix (not from within-period endogenous changes).

1.2 The instrument (supply-driven "shift")

To address endogeneity (domestic product demand shocks correlated with imports), ADH instrument ΔIPW_{it}^{u} using the same initial industry weights but plug in *other high-income countries'* import growth from China and **lag** the employment shares one decade to avoid anticipatory contamination:

$$\Delta IPW_{it}^{o} \equiv \sum_{j} \frac{L_{ij,t-1}}{L_{uj,t-1}} \cdot \frac{\Delta M_{jt}^{oc}}{L_{i,t-1}}. \tag{4}$$

Here ΔM^{oc}_{jt} is Chinese export growth to **eight** other rich economies (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, Switzerland). The idea is to isolate China's supply-side rise that is common across importers.

They also document strong industry-level comovement between U.S. and "other-country" Chinese imports and estimate an industry-level mapping used for prediction (coef. ≈ 1.5; very tight).

ADH provide additional, conceptually similar instruments—including a **gravity-residual** construction that filters out importers' demand—leading to an alternative exposure ΔIPW^{g}_{it} (Theory Appendix (B6)).

1.3 The estimating equation and fixed effects

The *stacked first-difference* specification for two subperiods (1990–2000, 2000–2007) is:

$$\Delta L^{m}_{it} \;=\; \gamma_t \;+\; \beta\,\Delta IPW^{u}_{it} \;+\; X'_{it}\theta \;+\; e_{it}, \tag{5}$$

with period dummies γ_t, rich start-of-period controls X_{it}, state-clustered SEs, and weights equal to start-of-period CZ population. In this stacked-difference setup, the model is *equivalent to a panel with time fixed effects*, i.e., the γ_t absorb **any aggregate shocks common to all CZs** in a given decade.

First stage and reduced form are strong and in the expected direction (added-variable plots): first-stage slope ≈ 0.82 (robust SE 0.09); reduced-form slope ≈ -0.34 (SE 0.07). Appendix/Table entries also report first-stage $t \approx$ 7–9.

1.4 1.4 The second-stage estimates (local effects)

Using column (6) with full controls (Table 3), ADH's **2SLS** estimate is

$$\widehat{\beta}_{\text{2SLS}} \approx -0.596$$

meaning: a \$1,000 increase in Chinese import exposure per worker over a decade reduces the **manufacturing employment/population** share by roughly **0.596 percentage points**. Estimates are robust to many perturbations (e.g. excluding certain sectors), and variants that broaden exposure (domestic+international) reduce the coefficient magnitude to about 0.51.

They further decompose outcomes across non-manufacturing, unemployment, NILF, and transfers; but for our purpose the key is the **local** response of manufacturing share to *cross-sectional* exposure.

2 How ADH turn micro 2SLS into national ("share of the decline") numbers

2.1 The mechanical "benchmarking" step in the appendix

Let σ^2_I be the variance of observed ΔIPW, and σ^2_{IIV} the variance of the instrument-predicted (supply-driven) component; let σ_{MI} be the covariance with ΔL^m. ADH derive the standard decomposition:

$$\widehat{\beta}_{\text{OLS}} \;=\; \widehat{\beta}_{\text{IV}}\,\frac{\sigma^2_{IIV}}{\sigma^2_{IIV}+\sigma^2_{I^e}} \;+\; \widehat{\beta}_{e}\,\frac{\sigma^2_{I^e}}{\sigma^2_{IIV}+\sigma^2_{I^e}}.$$

From their numbers they infer the instrumented (supply-driven) share of exposure variance is about **0.48**. Hence ADH's "supply-driven" macro impact is operationalized as:

$$\widehat{\text{Macro Effect}} \;\approx\; \widehat{\beta}_{\text{IV}} \times \Delta IPW^{\text{aggregate}} \times 0.48.$$

That is, they **scale the cross-sectional 2SLS slope by the *national* change in exposure** and by the instrumented variance share.

2.2 The headline percentages

Using this scaling, ADH state that Chinese import competition explains about **33%** of the contemporaneous national decline in manufacturing employment from 1990–2007, **55%** for 2000–2007, and **44%** for 1990–2000; restricting to the *supply-driven* component lowers these to about **16%**, **26%**, **21%** respectively. They also convert estimated effects into **headcounts**, yielding ≈ **1.53 million** fewer manufacturing jobs due to the (supply-driven) China shock, by multiplying the per-capita effect by national working-age population and period changes. This calculation explicitly assumes the effect pertains to the **absolute national level** of manufacturing employment.

3 Moll's "Missing Intercept" critique—formalizing the error

3.1 The core identification point (general form)

Suppose the true regional model is

$$y_{it} \;=\; \alpha \;+\; \beta\, x_{it} \;+\; \gamma\, X_t \;+\; \varepsilon_{it}, \quad \text{where} \quad X_t \equiv \sum_i \omega_i x_{it}$$

and y_{it} is the outcome, x_{it} a local treatment/exposure, and X_t the **aggregate** treatment (sum/average of x_{it} across regions). The **aggregate** relationship is

$$Y_t \equiv \sum_i \omega_i y_{it} \;=\; \alpha \;+\; (\beta+\gamma) X_t \;+\; \bar{\varepsilon}_t.$$

Thus the national (macro) elasticity is $\beta+\gamma$, not β. But if you estimate the regional equation with **time fixed effects** α_t, you difference out the aggregate regressor X_t (there is no cross-sectional variation in it), so the regression becomes

$$y_{it} \;=\; \underbrace{(\alpha+\gamma X_t)}_{\alpha_t} \;+\; \beta\, x_{it} \;+\; \varepsilon_{it},$$

and the *cross-sectional* IV/2SLS recovers β—the **relative** effect—while **the macro effect of changing** X_t is $\beta+\gamma$. Scaling $\hat{\beta}$ by ΔX_t therefore omits $\gamma\,\Delta X_t$ and is generally wrong (sign and magnitude ambiguous).

Moll labels this the **Missing Intercept** problem: *cross-sectional strategies with time FE identify slopes for **relative** changes across regions, but the national aggregate response requires the **intercept shift** embodied in the time FE.*

3.2 Mapping Moll to ADH's specification

Take ADH's estimating equation (5):

$$\Delta L_{it}^{m} \;=\; \gamma_t \;+\; \beta\,\Delta IPW_{it} \;+\; X_{it}'\theta \;+\; e_{it}.$$

If the **true** regional data-generating process includes a term $\Gamma_t := \gamma^\star\,\Delta IPW_t^{\text{agg}}$ that shifts *all* regions' manufacturing employment when aggregate import exposure rises, that term is perfectly collinear with the time FE and hence **absorbed in** γ_t. The IV estimate $\hat\beta$ from (5) is valid for the *relative* cross-sectional effect of local exposure—but tells us **nothing** about $\gamma^\star$ (the macro spillover). In Moll's notation, the aggregate elasticity is $\beta + \gamma^\star$, not β. **Therefore, multiplying $\hat\beta$ by the national change in exposure $\Delta IPW_t^{\text{agg}}$ cannot recover the aggregate job loss.**

Crucially, **ADH themselves acknowledge** that any **general-equilibrium effects on national employment and wages are absorbed by time dummies in our estimates**—exactly the "missing intercept" Moll warns about. That sentence makes explicit that their design *cannot* sign or quantify the aggregate response without extra structure.

Aggregation algebra (explicit). Let $x_{it} \equiv \Delta IPW_{it}$ and $X_t \equiv \sum_i \omega_i x_{it}$. Suppose the structural regional law is

$$\Delta L_{it}^{m} = \underbrace{\alpha + \eta_t}_{\text{other aggregate shocks}} + \beta\,x_{it} + \gamma\,X_t + u_{it}.$$

The **national** change is

$$\Delta L_{t,\,\text{agg}}^{m} = \sum_i \omega_i\,\Delta L_{it}^{m} = \alpha + \eta_t + \underbrace{(\beta+\gamma)}_{\text{macro elasticity}} X_t + \bar u_t.$$

The ADH regression with time FE recovers β (relative effect) by sweeping out $\alpha + \eta_t + \gamma X_t$ in γ_t. ADH then compute a national effect as $\hat\beta \cdot X_t$ (with a supply-driven discount), **implicitly imposing** $\gamma = 0$. This is precisely the error: **the intercept shift tied to X_t is not identified by cross-sectional variation**, yet it is exactly what's needed for an aggregate counterfactual.

4 Why the extrapolation can be badly biased (economics)

- **General equilibrium channels** (prices, wages, factor reallocation, exports, input variety, non-traded activity) can make γ positive, negative, or close to zero. ADH explicitly explore some margins: e.g., net-import specifications, gravity-residual exposures, intermediate-input adjustments, and spillovers to transfers and non-manufacturing—but all those are still identified **off cross-sectional variation with time FE**, so the macro intercept remains unpinned.
- **No-migration findings** do not solve the macro identification problem. Even if people do not move across CZs, the *aggregate* absorption of a national import shock still runs through γ (non-traded activity, wages, prices, exports), and ADH's own text reiterates that such national effects are absorbed by γ_t.

- **Sign ambiguity**: If, for instance, factor mobility or displacement in many regions depresses national wages (tightening real product wages), the **national** effect can be *more negative* than β (i.e., $\gamma < 0$). Conversely, if offsetting general equilibrium forces (exports, non-traded expansion, input variety) partly counteract local job losses, then $\gamma > 0$ and national losses are *smaller* than βX_t. Cross-sectional data with time FE cannot tell which case holds without a model.

Hence ADH's 33%/55%/44% "shares" (and 16%/26%/21% "supply-only" versions) simply **are not identified by their research design**. They would be valid **only** under the *strong assumption* that the national effect equals the local relative effect (i.e., $\gamma = 0$), which ADH's own discussion of time dummies explicitly contradicts.

5 What in ADH remains credible vs. what does not

Credible (identified):

- The **cross-sectional** 2SLS estimate that **more exposed CZs** lost a larger share of manufacturing employment relative to less exposed CZs. This is what $\widehat{\beta}_{\text{2SLS}}$ measures in (5). It is a *relative* effect across regions, conditional on time FE and controls.

Not identified as implemented:

- Any statement about the **aggregate** (national) number of jobs lost or the **share of the nationwide decline** attributable to China, because the **macro intercept** channel is soaked up by time FE. Those headline percentages and headcount figures require information on γ (macro spillovers) which the cross-sectional design cannot reveal.

6 How one *could* recover the aggregate effect (what is missing)

Moll's slides are explicit: to recover the **missing intercept**, you need **extra structure**. Possibilities include (i) a macro/GE model that maps the regional relative effect into an aggregate effect ($\beta \to \beta + \gamma$), (ii) complementary **time-series** identification of Y_t on X_t, or (iii) hybrid approaches that combine cross-sectional identification with VAR/model-based aggregation. But **simply scaling** the cross-sectional slope by national exposure is methodologically unsound.

Appendix: ADH's 2SLS, written formally

Let W be the within-transform that partials out time FE and controls. The two-stage least squares with weights w_i solves

First stage:

$$\tilde{x}_{it} \equiv W(\Delta IPW^{u}_{it}) \;=\; \pi\, W(\Delta IPW^{o}_{it}) + v_{it}, \quad \pi > 0.$$

Second stage:

$$\tilde{y}_{it} \equiv W(\Delta L^{m}_{it}) \;=\; \beta\, \hat{\tilde{x}}_{it} + u_{it}, \quad \widehat{\beta}_{\text{2SLS}} = \frac{\text{Cov}_w(\tilde{y}_{it},\, P_Z\tilde{x}_{it})}{\text{Var}_w(P_Z\tilde{x}_{it})}.$$

Here P_Z projects $\tilde{x}$ on the instrument $\tilde{z} \equiv W(\Delta IPW^o)$. Because W removes **all aggregate variation common to CZs in each period** (including any $f(\Delta IPW_t^{\text{agg}})$), the target is the **relative** slope β. Any macro component $\gamma\,\Delta IPW_t^{\text{agg}}$ sits in the time FE and is **not** identified. That is exactly what ADH write ("general equilibrium effects on national employment and wages [...] are absorbed by time dummies"), and exactly why Moll's "Missing Intercept" applies.

Bottom line

- ADH's empirical design **credibly estimates a relative, cross-sectional effect**: more-exposed CZs lost more manufacturing jobs, instrumented by foreign exposure shifts.
- Their later step that **scales** this micro coefficient to an **aggregate** job loss or **share of national decline** rests on an **invalid identification move**: the **time fixed effects explicitly remove the aggregate channel** needed to speak about national totals (the "missing intercept").
- Therefore the numbers like "one-quarter of the national decline" (or 33%, 55%, 44%; and 16%, 26%, 21% supply-only) **do not follow from their IV design** without *additional* macro structure tying β to $\beta + \gamma$.