China's Economic Slowdown: A Firm-Level Perspective

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Motivation

Claim: China's Growth in GDP and TFP has fallen since 2007

- Is it true? Empirical question
- If so, why? Alternative narratives:
  - Low-hanging fruits exhausted
  - Slowdown in US/OECD
  - Government policies
    - Long shadow of fiscal expansion in aftermath of GFC
    - Anti-corruption campaign
    - Misguided strategic priorities, e.g., MIC 2025
  - **More generally:** Return of firm-level distortions and barriers
    $\Rightarrow$ more misallocation, less churn and entrepreneurial activity

This Paper

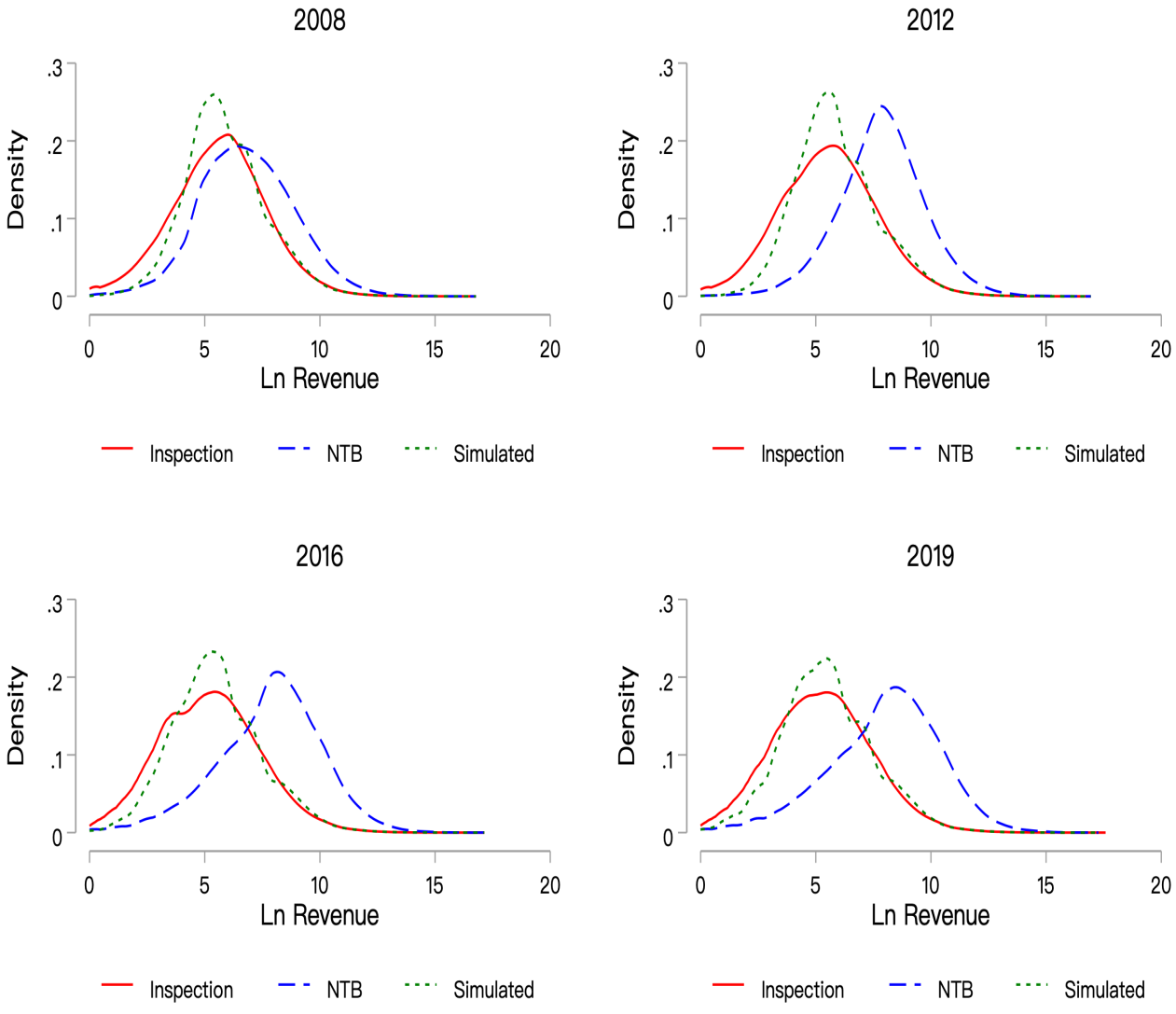
- Build representative data set for Chinese manufacturing through 2019
- Study productivity growth and factor-saving bias
- Use firm-level data for bottom-up view:
  1. Identify labor augmenting vs Hicks-neutral growth
  2. Novel growth decomposition: efficiency vs misallocation
  3. Study role of size and churn (reallocation, entry and exit)
  4. Study group decomposition: Industry, region, size
- Build dynamic Hopenhayn model

Challenge: Data Availability

- National accounts are probably exaggerated
- Need representative firm-level data to calculate TFP
- Alternative firm-level data sets for Chinese mfg: NBS; Tax data (NTB); Inspection Data
  - **NBS data** have problems after 2007 and end in 2013
  - **NTB** high quality, but not representative; frequent rotation
  - **Inspection data** covers the universe of firms, but few variables
- **Solution:** Use the Inspection Data to adjust sampling weights for NTB (Hellerstein and Imbens, 2009; Brandt et al., 2026). Obtain representative firm-level data up to 2019

Weighting Strategy

Distributions of (ln) Revenue



Next Steps

- Analyze growth in aggregate productivity (Solow residual)
- Quantify efficient growth vs misallocation improvement
- Identify drivers of growth - forensic exploration of churn, size, industries, etc.

Theory: CES Production Function

Assume:

- CES production function (allows varying labor-income share)
- Decreasing returns to scale, $\eta < 1$
- Common labor-augmenting technical change, λ_t

$$y_{it} = z_{it} \cdot \left[\left((k_{it})^{\frac{\rho-1}{\rho}} + (\lambda_t n_{it})^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \right]^{\eta}$$

Decreasing returns to scale: define aggregate TFP as

$$Z_t = \frac{Y_t}{(M_t)^{1-\eta}[X_t(K_t, N_t)]^{\eta}}$$

where:

$$X(k, n) = \left(k^{\frac{\rho-1}{\rho}} + (\lambda n)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

Misallocation

Firms face output and capital frictions (τ_i, τ_{ik})

Distorted Optimization Problem

$$\max_{k_i, n_i} \{(1 - \tau_i) y_i - w n_i - (1 + \tau_{ik})(r + \delta) k_i\}$$

Efficient Allocation and Aggregate TFP

Analyze efficient TFP to assess role of distortions. Efficient allocation is defined as $y_{it}^* = (z_{it})^{1/(1-\eta)} \cdot \overline{y}_t^*$ where:

$$\overline{y}_t^* = \left[(K_t)^{\frac{\rho-1}{\rho}} + (\lambda_t N_t)^{\frac{\rho-1}{\rho}} \right]^{\frac{\eta\rho}{\rho-1}} \left(\int (z_i)^{\frac{1}{1-\eta}} dF_t(i) \right)^{-\eta}$$

Aggregate efficient TFP (same formula setup as for aggregate TFP):

$$\begin{aligned} Z_t^* &= \frac{\int y_i^* dF_t(i)}{(M_t)^{1-\eta} \left[\left((K_t)^{\frac{\rho-1}{\rho}} + (\lambda_t N_t)^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \right]^{\eta}} \\ &= \left(\frac{1}{M_t} \int (z_i)^{\frac{1}{1-\eta}} dF_t(i) \right)^{1-\eta}. \end{aligned}$$

Realized Growth vs Efficient Growth

$$\underbrace{\ln\left(\frac{Z_t}{Z_{t-1}}\right)}_{\text{realized growth}} = \underbrace{\ln\left(\frac{Z_t^*}{Z_{t-1}^*}\right)}_{\text{efficient growth}} + \underbrace{\left[\ln\left(\frac{Y_t}{Y_{t-1}}\right) - \ln\left(\frac{Y_t^*}{Y_{t-1}^*}\right)\right]}_{\text{improvement in misallocation}}$$

(Shapley) Decomposition of TFP Growth from Churn

$$\ln\left(\frac{Z_t}{Z_{t-1}}\right) \approx \underbrace{\bar{\omega}_{Ct}\frac{\Delta Z_{C,t}}{\bar{Z}_t}}_{\text{Incumbent growth}} + \underbrace{\left(\frac{\bar{Z}_{Ct}}{\bar{Z}_t}-1\right)\Delta\omega_{C,t}}_{\text{Reallocation to incumbents}}$$
$$+ \underbrace{\omega_{Nt}\left(\frac{Z_{N,t}}{\bar{Z}_t}-1\right)}_{\text{Entry}} + \underbrace{\omega_{X,t-1}\left(1-\frac{Z_{X,t-1}}{\bar{Z}_t}\right)}_{\text{Exit}}$$

where

$$\Delta Z_{Ct} \equiv Z_{C,t}-Z_{C,t-1} \qquad \Delta\omega_{Ct} \equiv \omega_{Ct}-\omega_{C,t-1}$$
$$\bar{Z}_{Ct} \equiv \frac{Z_{C,t}+Z_{C,t-1}}{2} \qquad \bar{\omega}_{Ct} \equiv \frac{\omega_{Ct}+\omega_{C,t-1}}{2}$$

TFP Growth: Efficient vs. Misallocation

- Incumbent Growth

$$\bar{\omega}_{Ct}\frac{\Delta Z_{Ct}}{\bar{Z}_t} = \underbrace{\bar{\omega}^*_{Ct}\frac{\Delta Z^*_{C,t}}{\bar{Z}^*_t}}_{\text{efficient growth}} + \underbrace{\bar{\omega}_{Ct}\frac{\Delta Z_{Ct}}{\bar{Z}_t} - \bar{\omega}^*_{Ct}\frac{\Delta Z^*_{Ct}}{\bar{Z}^*_t}}_{\text{reduction in misallocation}}$$

- Reallocation to Incumbents

$$\left(\frac{\bar{Z}_{Ct}}{\bar{Z}_t} - 1\right)\Delta\omega_{Ct} = \underbrace{\left(\frac{\bar{Z}^*_{Ct}}{\bar{Z}^*_t} - 1\right)\Delta\omega^*_{Ct}}_{\text{efficient growth}}$$

$$+ \underbrace{\left(\frac{\bar{Z}_{Ct}}{\bar{Z}_t} - 1\right)\Delta\omega_{Ct} - \left(\frac{\bar{Z}^*_{Ct}}{\bar{Z}^*_t} - 1\right)\Delta\omega^*_{Ct}}_{\text{reduction in misallocation}}$$

TFP Growth: Efficient vs. Misallocation

- Entry

$$\omega_{N,t}\left(\frac{Z_{N,t}}{\bar{Z}_t}-1\right)=\underbrace{\omega^*_{Nt}\left(\frac{Z^*_{Nt}}{\bar{Z}^*_t}-1\right)}_{\text{efficient growth}}+\underbrace{\omega_{Nt}\left(\frac{Z_{Nt}}{\bar{Z}_t}-1\right)-\omega^*_{Nt}\left(\frac{Z^*_{Nt}}{\bar{Z}^*_t}-1\right)}_{\text{reduction in misallocation}}$$

- Exit

$$\begin{aligned}\omega_{X,t-1}\left(1-\frac{Z_{X,t-1}}{\bar{Z}_t}\right) &= \underbrace{\omega^*_{X,t-1}\left(1-\frac{Z^*_{X,t-1}}{\bar{Z}^*_t}\right)}_{\text{efficient growth}}\\ &+ \underbrace{\omega_{X,t-1}\left(1-\frac{Z_{X,t-1}}{\bar{Z}_t}\right)-\omega^*_{X,t-1}\left(1-\frac{Z^*_{X,t-1}}{\bar{Z}^*_t}\right)}_{\text{reduction in misallocation}}\end{aligned}$$

Estimating λ_t and Hicks-neutral TFP

- Calibrate $\rho = 0.6$ (Yang-Zhang 2024) and $\eta = 2/3$ (Hsieh-Klenow 2009)
- Problem measuring in λ_t - in the presence of wedges, aggregate data no longer identifies the sequence $\{\lambda_t\}_{t=1}^{T}$
- Solution - make two assumptions about output wedges
  1. In the initial period, capital and output wedges have zero contribution to the aggregate labor-income share (normalization of λ_1).
  2. Output wedges are constant for firms between age 7 and 9
- Measure firm-level TFP z_{it} by inverting production function

$$z_{it} = y_{it} \cdot \left(\left((k_{it})^{\frac{\rho-1}{\rho}} + (\lambda_t n_{it})^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \right)^{-\eta}.$$

Annualized Growth Rates

	Year	Y	λ_g	Z_g	M	K	N
NBS							
	1998-2007	19.1	17.5	5.6	11.6	10.4	4.9
NTB							
	2007-19	6.6	9.0	1.1	4.7	4.5	-1.5
	2007-10	10.7	5.3	4.6	5.4	7.3	0.2
	2010-19	5.3	10.2	0.0	4.5	3.5	-2.1

Growth Accounting

	Year	Z_g	λ_g	M_g	K_g	N_g
NBS						
	1998-2007	29.2	21.1	20.2	23.8	5.9
NTB						
	2007-19	17.3	44.2	23.8	23.0	-7.6
	2007-10	43.5	16.7	16.7	22.5	0.6
	2010-19	-0.4	62.5	28.6	23.0	-12.9

Hicks-neutral Growth: Efficient vs Misallocation

	Year	total Hicks Z_g	efficient growth Z_g^*	misallocation improvement $Z_g - Z_g^*$
NBS	1998-2007	5.6	5.4	0.2
NTB	2007-19	1.1	3.5	-2.4
	2007-10	4.6	6.7	-2.3
	2010-19	0.0	2.4	-2.4

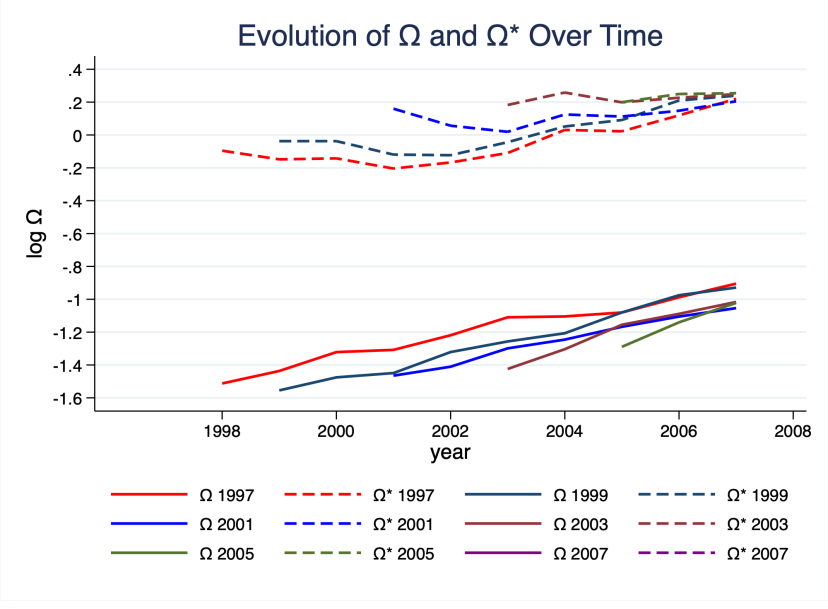
Decomp of TFP Growth: Incumbents, Entry and Exit

Year	0 Total	1 Incumb.	2 Realloc.	3 Entry	4 Exit
1998-2007	0.056	0.069	-0.002	-0.024	0.021
2007-2019	0.011	0.028	0.000	-0.013	0.002
2007-2010	0.046	0.066	-0.001	-0.015	0.003
2010-2019	0.000	0.016	0.000	-0.012	0.002

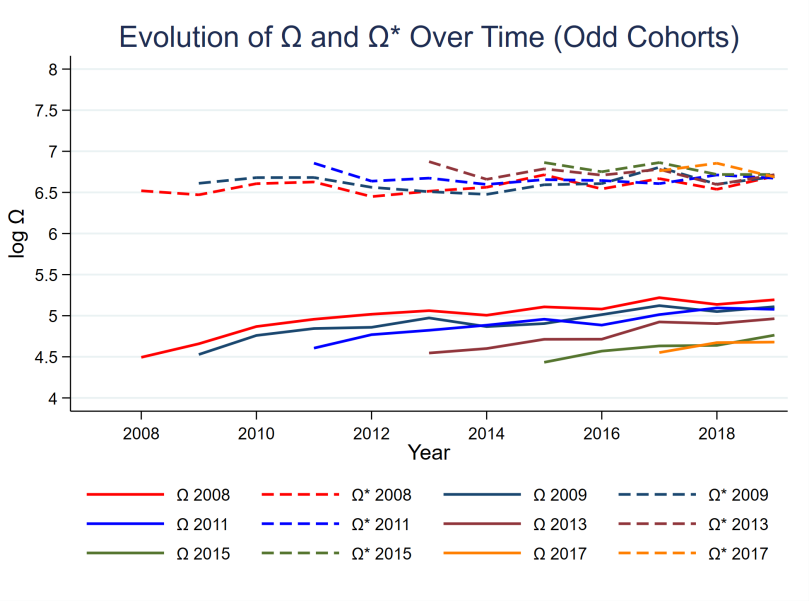
Decomposition of TFP Growth Channels

	Incumbent		Reallocation		Entry		Exit	
Year	Eff.	Misall.	Eff.	Misall.	Eff.	Misall.	Eff.	Misall.
1998-07	2.1	4.9	0.4	-0.7	4.2	-6.6	-1.0	3.1
2007-19	1.8	1.0	0.1	-0.1	16.0	-17.3	-7.5	7.8
2007-10	4.4	2.1	0.1	-0.1	17.4	-19.0	-6.8	7.1
2010-19	0.9	0.6	0.1	-0.1	15.6	-16.8	-7.8	8.0

Z and Z^*, by Cohort

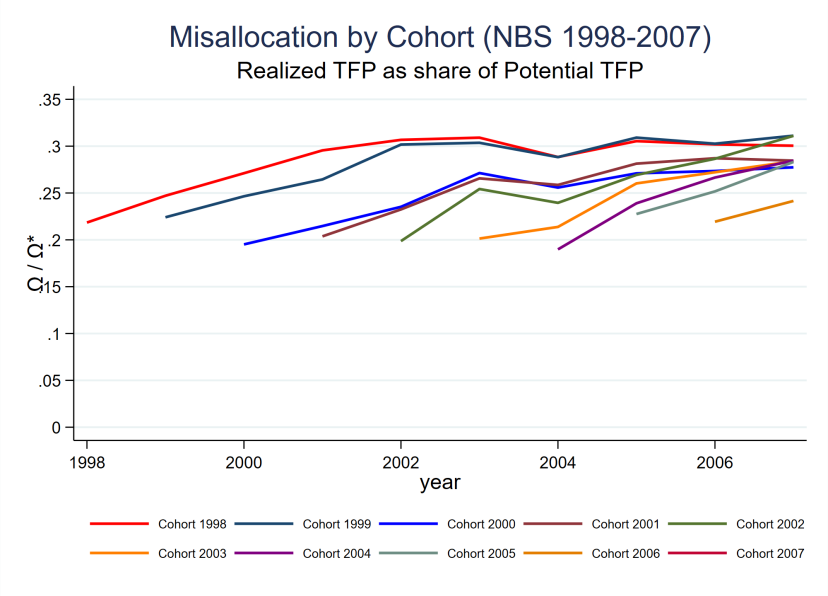


(a) NBS: 1998–2007

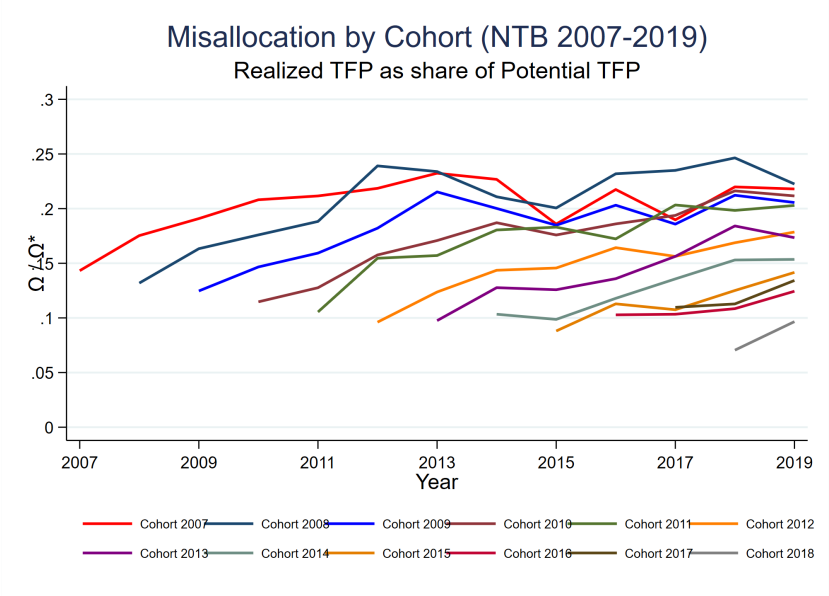


(b) NTB: 2007–2019

Misallocation over the Life Cycle Z/Z^*



(a) NBS: 1998–2007. Measured TFP as share of potential TFP



(b) NTB: 2007–2019. Measured TFP as share of potential TFP

Decomposition of TFP Growth, by Regions

		Z^*	Z	TFP		Misallocation	
				within	between	within	between
NBS: 1998–07		5.4	5.6	5.4	0.0	0.0	0.2
	C	0.5	0.5	0.6	-0.1	0.2	-0.2
	E	3.4	3.1	2.7	0.7	-0.2	-0.1
	N	0.4	0.5	0.8	-0.4	0.1	0.1
Region	NE	0.5	0.4	0.3	0.2	0.1	-0.2
	NW	0.1	0.1	0.1	0.0	0.0	0.0
	S	0.1	0.7	0.6	-0.5	0.0	0.6
	SW	0.6	0.3	0.4	0.2	0.0	-0.3
NTB: 2007–19		3.5	1.1	3.4	0.1	-3.6	1.3
	C	-0.4	0.0	0.2	-0.6	0.0	0.5
	E	1.3	0.7	1.6	-0.3	-0.8	0.3
	N	0.2	0.0	0.4	-0.2	-0.2	0.1
Region	NE	0.7	0.0	0.3	0.4	-0.4	-0.3
	NW	0.1	0.1	0.1	0.0	-0.1	0.0
	S	1.4	0.2	0.7	0.7	-0.6	-0.6
	SW	0.4	0.1	0.2	0.2	-0.2	-0.1

Summary of Micro Facts

- New firms have lower measured TFP than incumbents ... but higher efficient TFP
- **Before 2007:**
  - Misallocation falls over the life cycle
  - New firms catch up with incumbents' measured TFP
  - Incumbents catch up with new firms' efficient TFP
  - High incumbent growth due to rapid reduction in misallocation for young incumbent firms
- **After 2007:**
  - New firms' misallocation lingers over the life cycle

Next steps: Model Setup

- Dynamic Hopenhayn model (endogenous entry/exit)
- Age-dependent distortions (dispersion falling with age)
- Account for new firms being more selected (higher firm level TFP) but lower aggregate TFP (more distorted)
- High incumbent growth due to reduction in misallocation (for young firms) and exit (for older and more misallocated firms)
- Model elements: general TFP growth, entry costs, distribution of new firms relative to existing firms, financial constraints, and size-dependent policies
- Estimate model using documented facts as moments

Weighting Strategy (Hellerstein and Imbens, 1999)

- Sort Inspection Data firms into bins on year, size, age, & industry
- Estimate true density in each "cell" from Inspection Data
- For each cell, generate weights for observations in NTB survey that are representative of their weight in the target population (Inspection Data, the universe)
- Problematic to separately estimate two densities and (non-parametrically) take ratio
- Instead: estimate density ratio by Least Square Importance Fitting

Return