

Resource Reallocation and Zombie Lending in Japan's 1990s

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Introduction

- The collapse of Japan's bubble economy in the early 1990s was followed by a decade of economic stagnation and financial crisis.
- Banks continued to provide subsidized credit to otherwise insolvent firms (Zombie Lending).
 - Peek and Rosengren (2005) and Caballero et al. (2008)

Question

- How efficiently were resources reallocated during the 1990s relative to the 1980s?
- How much did zombie lending distort the efficiency of the resource reallocation?

Approach

- Use the measure of Aggregate Productivity Growth (APG) provided by Petrin and Levinsohn (2008).
 - Estimate reallocation effect (RE) on APG.
- Develop a model with plant-level heterogeneity to measure the distortion due to zombie lending.
 - Calibrate the model using the results of plant-level estimation.
 - Conduct a counterfactual exercise with no-zombie lending.
 - Compare REs in the cases with and without zombie lending.

Main Results

1. RE was lower in the 90s than in the 80s.
2. RE was negative, especially during the 90s.
3. Distortion of zombie lending accounted for 37% of the negative RE during the 90s.

Contribution

- Provide new evidence that RE was less efficient during the 90s.
 - Fukao et al. (2006) reported that RE was more efficient during the 90s, using the APG measure by Bailey et al. (1992).
 - The PL-APG is more precise in measuring RE in a sense that RE is measured based on marginal product.
- Provide a quantitative measure of the zombie distortion on RE.

Production Function

- Gross output production function of plant i :

$$Y_i = A_i L_i^{\beta_L} K_i^{\beta_K} M_i^{\beta_M},$$

- Y_i : Real gross output
- A_i : Level of technical efficiency
- L_i : Labor-hour input
- K_i : Real capital stock
- M_i : Real intermediate material

Definition of PL-APG

- PL-APG (PL^{level}) is defined by:

$$dPL^{level} := \sum_i P_i dY_i - \sum_i \sum_j W_{ij} dX_{ij}$$

- dY_i : Change in output
 - W_{ij} : Price of input $j \in \{L, K, M\}$
 - dX_{ij} : Change in input $j \in \{L, K, M\}$
- PL-APG captures aggregate change in output holding input use unchanged.

Decomposition of PL-APG

- Convert PL^{level} into the growth rate version (PL).
- Obtain the decomposition:

$$dPL = dTE + dRE + dNE,$$

- dTE : Contribution of technical efficiency among existing plants
- dRE : Contribution of input reallocation among existing plants
- dNE : Contribution of net-entry of plants

Reallocation Effect

- The contribution of input reallocation among existing plants (RE) is

$$dRE := \sum_j dRE_j,$$

- Input-specific RE term for $j \in \{L, K, M\}$ is

$$dRE_j := \sum_{i \in S} D_i (\varepsilon_{ij} - s_{ij}) d \ln X_{ij}.$$

- S : Set of indexes of existing plants
- D_i : Dornier weight
- ε_{ij} : Elasticity of output w.r.t. input j .
- s_{ij} : Ratio of cost to output for input j .

Production Function Estimation

- Need estimates of ε_{ij} ($= \beta_{ij}$) for $j \in \{L, K, M\}$.
- Estimation equation is

$$\ln Y_{it} = \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_M \ln M_{it} + \ln A_{it}.$$

for each 2-digit SIC code.

- Use the Wooldridge-Levinsohn-Petrin (WLP) estimator.

Data

- Plant-level panel data from 1981 to 2000.
 - Census of Manufactures (METI).
 - Compiled by RIETI as a panel data set.
 - Annual data on shipments, number of employees, book value of tangible fixed assets, materials, etc.
 - 3,321,149 plant-year observations in our sample.

Measured RE

Table 1: Reallocation Effect and Its Components

year	Reallocation	Decomposition		
		Labor	Capital	Materials
1980s Average	-0.18	0.02	-0.20	0.00
1990s Average	-0.85	-0.66	-0.14	-0.05

Note: Results are based on the Wooldridge-Levinsohn-Petrin estimator.

- RE was negative on average during the two decades.
- RE was lower in the 90s (-0.18 vs -0.85).
- Negative RE during the 90s was mainly due to labor RE.

Why was RE Negative?

- Investigate the effect of zombie lending as a possible cause.
- How much of the negative RE can be explained by subsidized credit to zombie plants?

Model

- Develop a version of the model provided by Restuccia and Rogerson (2008).
 - Decreasing Returns to Scale.
 - Heterogeneous Plant-level TFP.
- Zombie lending is captured by effective tax/subsidy rates in the model.

Zombie Lending in the Model

- Problem of an existing plant- i is defined by

$$\max_{l, k \geq 0} \left\{ A_i k_i^{\beta_k} l_i^{\beta_l} - (1 + \tau_i^l) w_t l_i - (1 + \tau_i^k) r_t k_i \right\},$$
$$\beta_k, \beta_l \in (0, 1), \quad 0 < \beta_k + \beta_l < 1$$

- Zombie lending is subsidy (low τ) for low TFP plants.

Calibration of Tax/Subsidy Rates

- Calibrate τ^j using
 1. FOC of the existing plants:

$$\varepsilon_j - s_j = \beta_j \left(1 - \frac{1}{(1 + \tau^j)} \right), \quad \text{for } j = k, \text{ and } l,$$

2. Average of estimated wedges across plants and time:

$$\overline{\varepsilon_j - s_j}$$

Zombie Plants in the Data

- For $(\tau_{80}^l, \tau_{80}^k)$, use the 80s' average of estimated wedges $\overline{\varepsilon_j - s_j}$.
- For $\{(\tau_{90,Z}^l, \tau_{90,Z}^k), (\tau_{90,NZ}^l, \tau_{90,NZ}^k)\}$, use
 - the 90s' average wedge among zombie plants
 - the 90s' average wedge among non-zombie plants
- Zombie plants in the data:

A plant that has been below the 20th percentile of the TFP distribution for 5 consecutive years.

Calibrated Tax/Subsidy Schedule

Table 2: Calibrated Tax/Subsidy Rates.

Calibrated Taxes	1980s	1990s	
		Zombie	Non-Zombie
τ^l	0.62	-0.29	0.68
τ^k	-0.28	-0.42	-0.32

Note: We estimate ε_{ij} ($j = l, k$) assuming the common value-added production function for all plants in the manufacturing sector.

- Calibrated τ was lower for zombie plants.
- Zombie plants actually received subsidies (negative τ).

Counter-factual Exercise

- Consider Two Steady States:
 - Initial Steady State in 1989, with high growth in aggregate TFP.
 - Final Steady State in 1999, with low growth in aggregate TFP.
- Consider the Cases With and Without Zombie Lending.
 - Zombie Case: Use $\{(\tau_{90,Z}^l, \tau_{90,Z}^k), (\tau_{90,NZ}^l, \tau_{90,NZ}^k)\}$ in 1999.
 - No-Zombie Case: Use $(\tau_{80}^l, \tau_{80}^k)$ in 1999.
- In each case, calculate PL-APG and its components from 1989 to 1999 in the same way as in the data.

Distortion of Zombie Lending

Table 3: Distortion of Zombie Lending

	Reallocation Effect	
	Labor	Capital
Data	-3.96	-0.50
Zombie Case	-0.62	-1.63
No-Zombie Case	0.87	-1.44
Distortion of Zombies	1.48	0.18
As % of Data	37%	36%

Note: Table shows the 10 year growth rate from 1989 to 1999.

- RE of labor and capital are both lower in the zombie case.
- Size of the distortion of zombie lending on labor RE was 37%.

Conclusion

- Resource reallocation was less efficient during the 90s.
- Resources (especially labor) were reallocated in a way that decreased output during the 90s.
- Zombie lending had a sizable impact on resource reallocation.
 - Zombie lending accounted for 37% of the negative RE of labor.