Can the Service Sector Lead Structural Transformation in Africa? Evidence from Côte d'Ivoire

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How we think economic growth & structural change happens

- Stage 1: An agrarian society with low productivity
- Stage 2: **Industrialization!** higher productivity manufacturing takes off, higher productivity agriculture allows workers to move to urban manufacturing (Lewis model)
- Stage 3: Industrial economy matures, maybe export led growth driven by manufacturing (E. Asian miracle)
- Stage 4: Service economy takes over and dominates the economy (US and Europe)

Motivation: Are African countries doing development "wrong"?

- There is a special structural transformation pattern in Africa: Agriculture Sector $\rightarrow$ Service Sector
- But what we "know" about development is that:
  - Services have low productivity and slow productivity growth
  - Manufacturing has fast productivity growth and converges to world productivity levels (Rodrik)
  - Higher productivity means higher wages, more employment growth: i.e. development
  - $\rightarrow$ service sector-led growth is a path to low and slow development
- Research question:
  Can the service sector be the engine of growth and structural transformation in Africa?

Overview

- **Productivity Estimation**: Can we estimate productivity in the service sector using proxy variable productivity techniques?
- **Productivity Level**: What is the relative difference in productivity across sectors?
- **Productivity Heterogeneity**: Is the productivity heterogeneity larger in the service sector?
- **Efficiency in Structural Transformation**: Do workers reallocate to the sector of the highest productivity? How about skilled workers and unskilled workers?

Productivity Estimation Method

- When analyzing the Structural Transformation, people usually use value added per worker to estimate the service sector productivity.
- We **innovate by introducing proxy techniques** into service sector productivity estimation.
- Issues in estimating service sector productivity:
  1. Service sector outputs are highly heterogeneous. Heteorgeneity
  2. Heterogeneity in inputs could be large in Services. Heteorgeneity
     e.g. Finance and Insurance $\rightarrow$ Skilled Workers, Retail $\rightarrow$ Unskilled Workers
- Solution:
  1. We estimate productivity separately by individual sub-sectors.
  2. In the African context, the input heterogeneity in the service sector is no larger than that in manufacturing.
  3. More importantly, we use the MrEst Method to estimate productivity.

Estimation Method: MrEst Method

The advantages

1. Input Heterogeneity:
   (1) The model is more flexible by using three inputs (capital, skilled workers, and unskilled workers).
   (2) The model allows the contributions of inputs in sub-sectors to be different.
2. Output Heterogeneity: Heterogeneity passes through the price of the outputs, and monetary outputs in the model capture the difference across sub-sectors.
3. Data: The method deals with the "large N, small T" data set we have.

Estimation Method: MrEst Method

- We use the MrEst Method to estimate TFP in the service, agricultural, and manufacturing sectors.
- h_{it}: skilled worker in firm i at time t
  l_{it}: unskilled worker in firm i at time t
  k_{it}: capital in firm i at time t
  m_{it}: intermediate material in firm i at time t
- The MrEst estimation functions are

$$y_{it} = \beta_0 + \beta_1 h_{it} + \beta_2 l_{it} + \beta_3 k_{it} + h(k_{it}, m_{it}) + v_{it} \quad (1)$$

$$y_{it} = \beta_0 + \beta_1 h_{it} + \beta_2 l_{it} + \beta_3 k_{it} + f[h(k_{it-1}, m_{it-1})] + \eta_{it} \quad (2)$$

where $\eta_{it} = \xi_{it} + v_{it}$

Data

- Data: Firm-level data from Côte d'Ivoire Descriptive Statistics
  1. 28,810 registered firms from the agricultural, manufacturing, and service sectors
     - Manufacturing: Chemicals, Wood, Plastic, Construction, etc.
     - Services: Finance, Legal, Transport, Commerce, etc.
     - Agriculture: only plantation ag in coffee, cocoa, palm oil
  2. More than 50% firms with less than 5 workers
  3. From 2003 to 2014
  4. Panel data with 91,630 firm-year observations
  5. NOTE: No data on the informal sector, which may be a large part of the service sector in CIV. GDP Comparison

Regression Outcomes: Service Sector

- Skilled-labor-intensive sub-sectors and unskilled-labor-intensive sub-sectors

Table 1: Estimates of Production Function Parameters (Service Sector)

	(1) Finance and Insurance	(2) Transport	(3) Building Management	(4) Personal Beauty	(5) Restaurant	(6) Training & Legal Service	(7) Commerce
log(Value-added)							
log(Skilled)	0.403***	0.300***	0.316***	0.451***	0.449***	0.519***	0.327***
	(4.63)	(7.11)	(4.10)	(5.85)	(7.43)	(18.30)	(12.08)
log(Unskilled)	0.285***	0.254***	0.164**	0.285***	0.351***	0.265***	0.534***
	(3.84)	(8.65)	(2.73)	(5.44)	(7.48)	(15.16)	(24.47)
log(Capital)	0.466*	0.146**	0.303**	0.0828	0.0327	0.117***	0.106***
	(2.20)	(2.94)	(2.79)	(0.69)	(0.39)	(4.99)	(5.74)
N	1011	3843	1256	223	1453	10531	25646

Distribution of Productivity Across Sectors

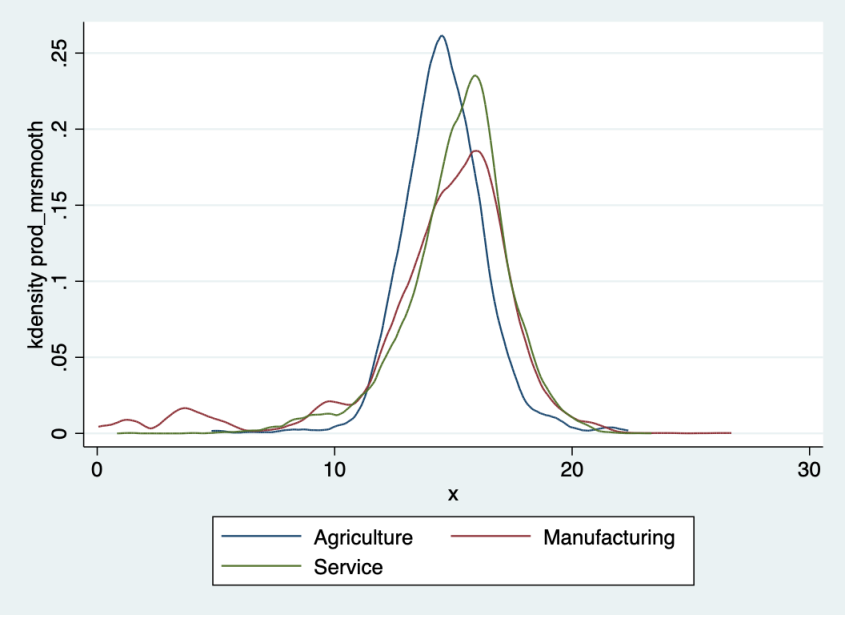
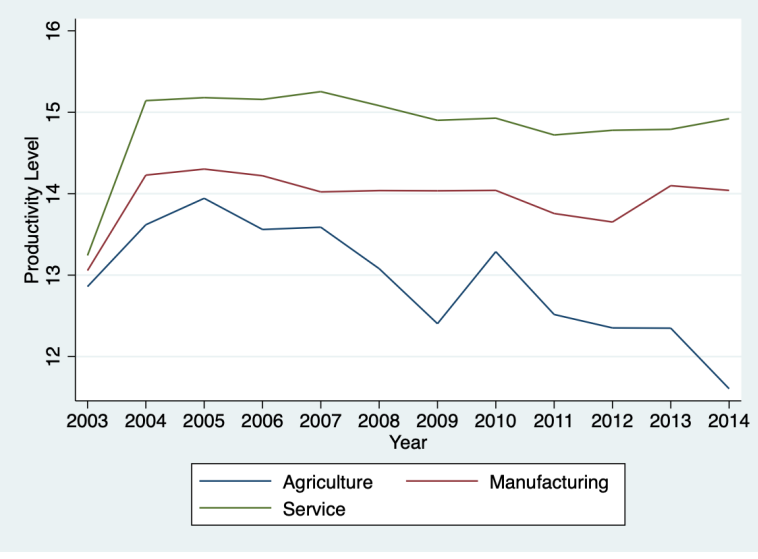


Figure 1: Productivity Distribution Other Methods

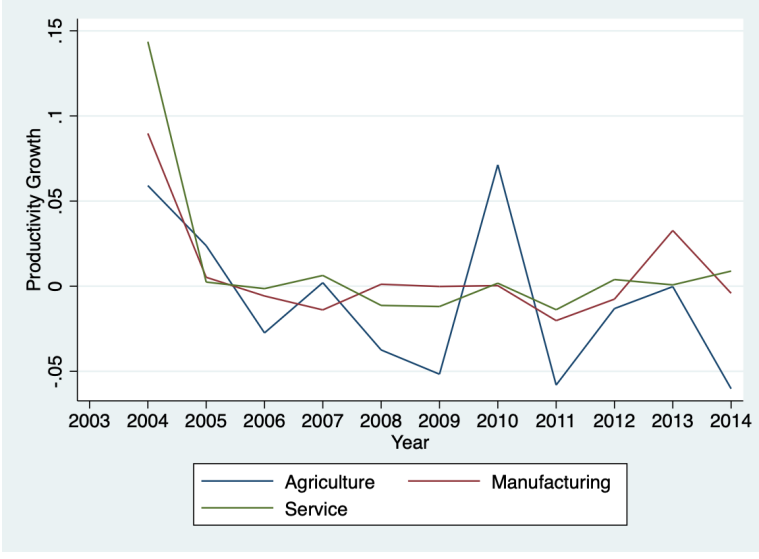
Table 2: Summary of TFP

	Agriculture	Manufacturing	Service
Mean	12.811	13.943	**14.844**
Std. dev.	5.333	4.338	**3.204**

Productivity Comparison Across Sectors



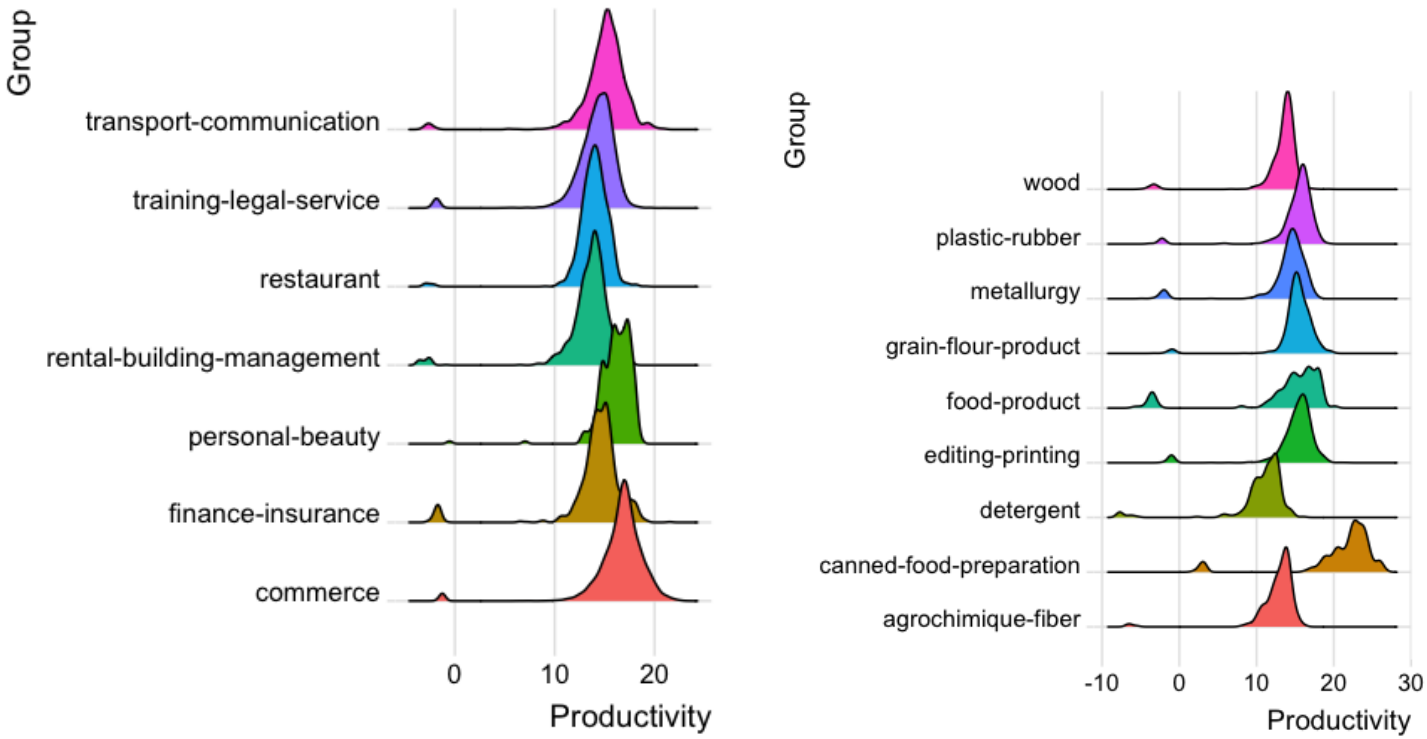
(a) Productivity Level



(b) Productivity Growth Rate

Figure 2: Productivity Comparison

Heterogeneity: Distribution Across Sub-sectors in Each Sector



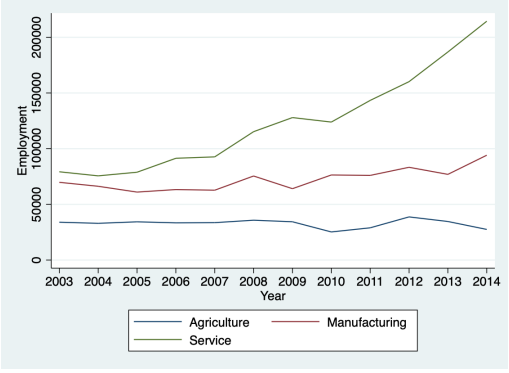
(a) Service Sub-sectors (b) Manufacturing Sub-sectors

Figure 3: Ridge Distribution of Industry

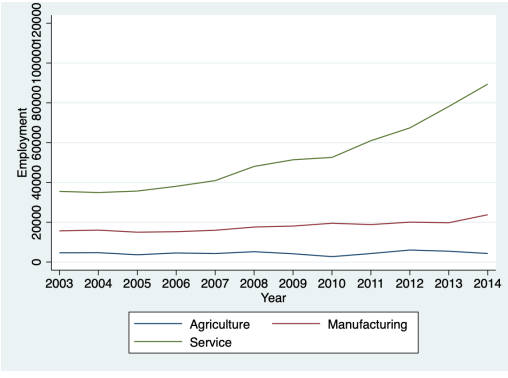
Structural Transformation and Efficiency

- The structural transformation is efficient if the labor moves from low-productivity activities to high-productivity activities.
- Sector Level
  1. The Service sector has higher productivity.
  2. We expect to see more labor reallocation to the service sector.
- Until now, we assume the sectors are hiring workers.
- Moving to a higher productivity sector does not mean the structural transformation is efficient if the workers all go to low-productivity firms.
- Firm Level: We expect to see more labor reallocation to the high-productivity firms.

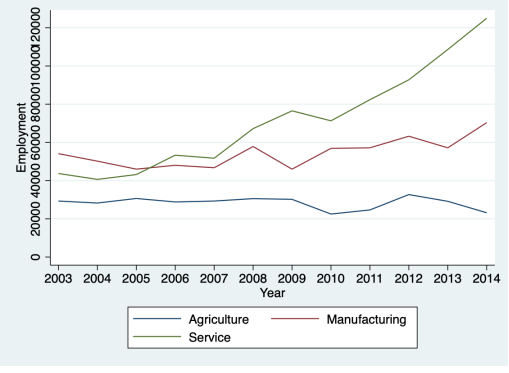
Employment Across Sectors



(a) Labor



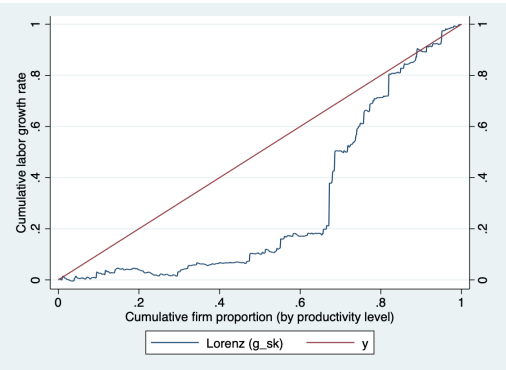
(b) Skilled Labor



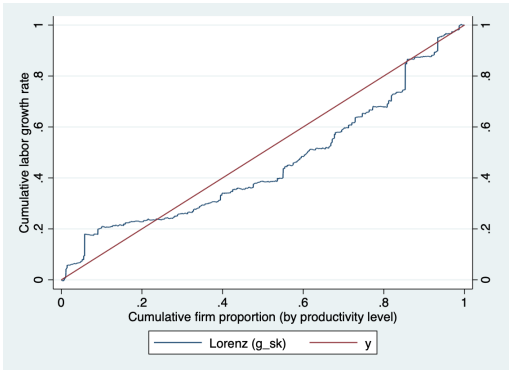
(c) Unskilled Labor

Figure 4: Labor Hired Over Time

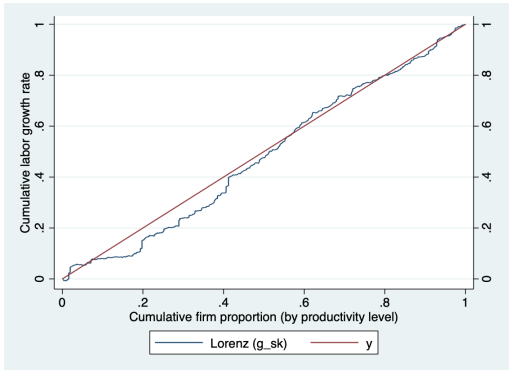
Skilled Worker Employment Across Firms



(a) Agriculture



(b) Manufacturing

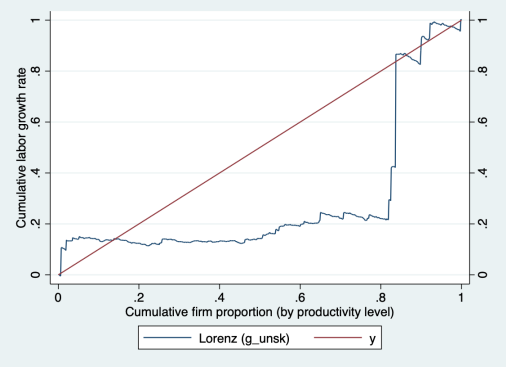


(c) Service

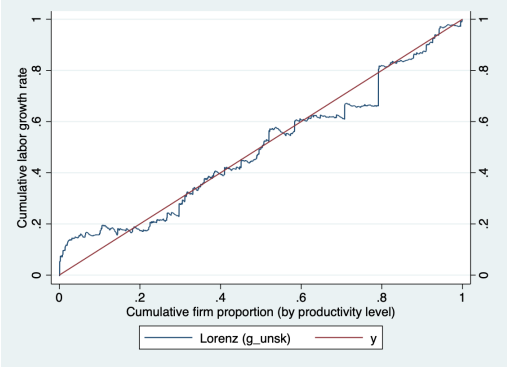
Figure 5: Firm-level Skilled Labor Reallocation

Consistency

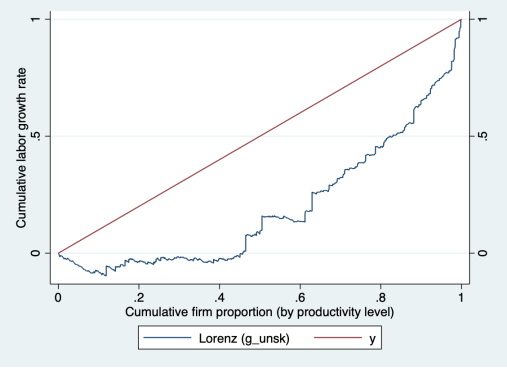
Unskilled Workers Employment Across Firms



(a) Agriculture



(b) Manufacturing



(c) Service

Figure 6: Firm-level Unskilled Labor Reallocation

Conclusion

- With high quality micro data you can estimate service sector productivity using proxy variable techniques.
  - Results more robust than value added per worker
- The Service sector is 7% more productive than manufacturing firms.
- Employment, especially low-skill, grows faster in the most productive firms in the service sector.
- The service sector can be an engine of structural transformation in African countries. Might even be a better one than manufacturing.

Policy implications and next steps in this work

- Policy implications/questions:
  - Do we need to rethink manufacturing subsidies?
  - Would service sector subsidies work better?
  - Does this mean we should formalize more of the service sector?
- Next steps in the research
  - Explaining the high productivity level in the service sector in the model.
    $\Rightarrow$ Span of Control Effect is stronger in the service sector.
  - Testing these findings across more African countries
  - How does the informal market affect the outcomes?

Appendix

Service Sector Outputs are Highly Heterogeneous

- Heterogeneity:
  1. Outputs are customized and intangible. (Tether & Hipp(2002))
  2. The value of the outputs is often decided by the consumers. (Karmarkar & Pitbladdo (1995), Ojasalo (2003))
  3. Potentially large differences between sub-sectors within services.
- We solve this by
  1. estimating TFP separately by individual sub-sectors.

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Heterogeneity in Inputs Could be Large in Services

- The input heterogeneity in the service sector is no larger than the input heterogeneity in the manufacturing sector.

Table 3: Inputs Comparison Across Sectors

Sector	Inputs	Obs	Mean	Std. dev.
Manufacturing	Skilled worker	9,586	0.101	0.140
	Unskilled worker	9,586	0.076	0.120
	Capital	9,586	0.242	0.255
Service	Skilled worker	68,801	0.162	0.201
	Unskilled worker	68,801	0.112	0.180
	Capital	68,801	0.240	0.271

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Descriptive Statistics

Table 4: Descriptive Statistics

Variable	Observation	Mean	Std.dev	Min	Max
Value-added	91,630	8.99e+08	7.10e+09	-3.75e+10	3.08e+11
Skilled Worker	91,630	10.57786	61.36005	0	3419
Unskilled Worker	91,630	21.19307	212.3427	0	16288
Capital	91,630	3.79e+08	5.10e+09	0	3.86e+11
Material	91,630	3.42e+08	1.09e+10	0	1.26e+12
External Service	91,630	1.55e+08	1.91e+09	0	2.15e+11

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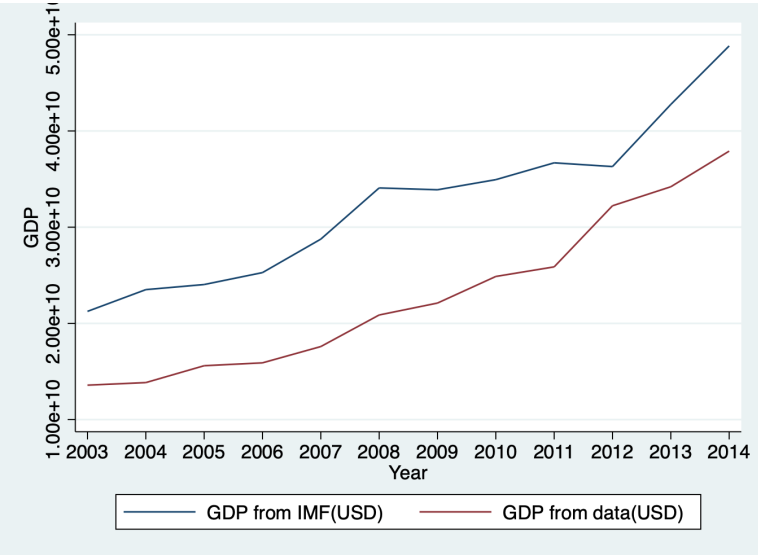
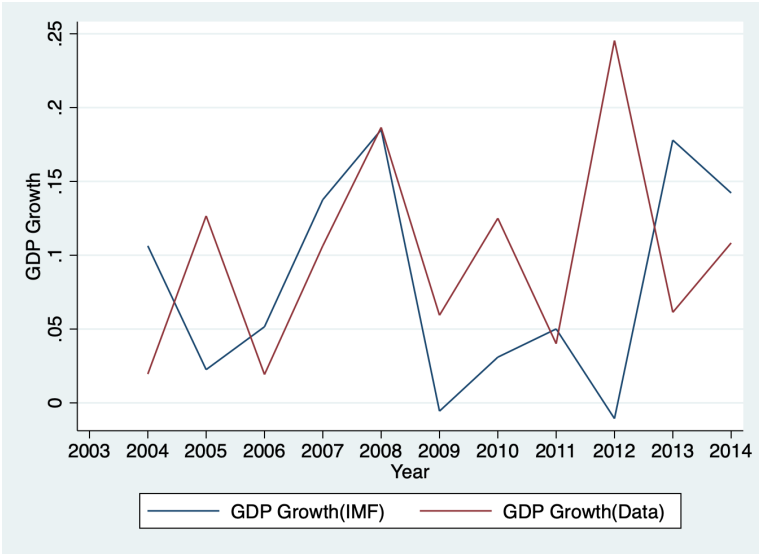
GDP Comparison



(a) GDP Comparison



(b) GDP Growth Comparison

Figure 7: GDP in CIV

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Service Sector Inputs Literature Review

Table 1 Literature Review

Industry	Paper	Input and Output
Banking	Sealey & Lindley (1977), Berger & Humphrey (1992, 1997), Wheelock & Wilson (1999), Drake & Hall(2003), Isik & Hassan (2003), Casu et al.(2004)	Inputs are labor and capital. Output can be deposits, net revenue, or value-added.
Banking	Grifell-Tatjé & Lovell (1997)	Inputs are the number of employees, non-labor operating expense, and a capital cost input.
Banking	Johnes et al. (2014)	Fixed assets as represent capital input. General and administration expenses as a proxy for labor input.
Transport	Gordon(1992)	Output is value-added. Inputs are labor and capital.
		Output is an aggregate output quantity index.

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Service Sector Inputs Literature Review

Railway	Oum et al.(1999)	Output is an aggregate output quantity index. Inputs are capital (physical quantity) and labor.
Port	Gonzalez & Trujillo (2009)	Outputs are cargo or income. Inputs are labor and capital
Telephone Service	Sichel (2001)	Bills from telephone service as output. Capital especially the equipment, and labor as inputs.
Telecommunication	Li & Xu (2004)	Value-added as an output. Labor and capital employed as inputs.
Telecommunication	Oniki et al. (1994), Yoon (1999), Rushdi (2000), Lam & Lam (2005)	Revenues as an output. Capital and labor as inputs.
Restaurant & Hotel	Smeral(2009)	The growth in the value-added comes from the labor input and capital service.
Restaurant & Hotel	Campos-Soria et al.(2005), Smeral (2009)	Human capital factor has a positive influence on the service quality and productivity.

Service Sector Inputs Literature Review

Tourism	Borooah (1999), King & McVey (2006), Parilla et al (2007)	Physica capital investment increase the growth in tourist sector.
Commerce	Ortiz-Buonafina (1992), Dubelaar et al (2002)	Sales or value added as outputs. capital and labor as inputs
Commerce	Leadbeater (2001), Scarbrough & Swan (2001), Higón et al. (2010)	Skilled workers are determinants of retail industry
Commerce	Higón et al. (2010))	Capital is important

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Share of Productivity Values Estimated

Table 5: Share of Productivity Values Estimated in Each Sector

Sector	Number of Productivity Values	Share of Total Sector
Agriculture	1,166	0.865(1,348)
Manufacturing	7,189	0.744(9,668)
Service	48,264	0.694(69,577)

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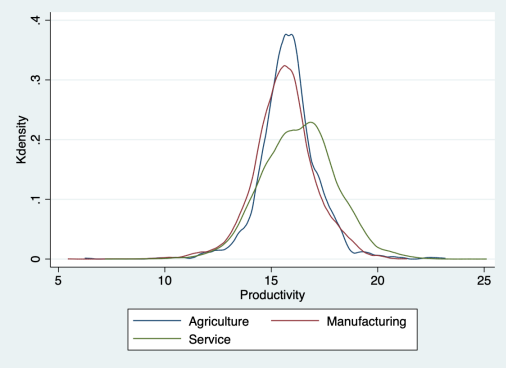
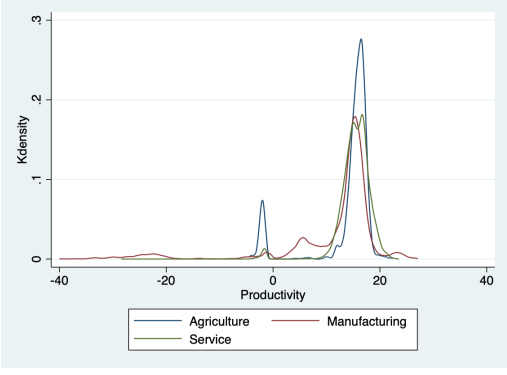
Productivity Distribution of Other Methods

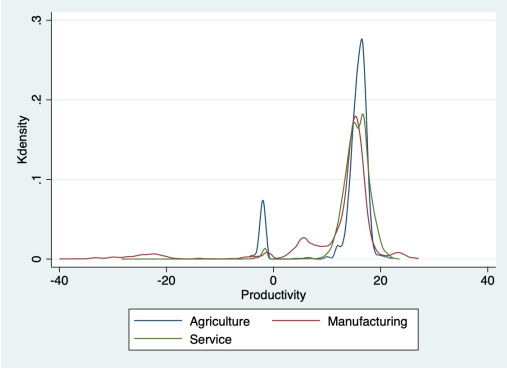
Figure 8: Productivity Distribution of Other Methods



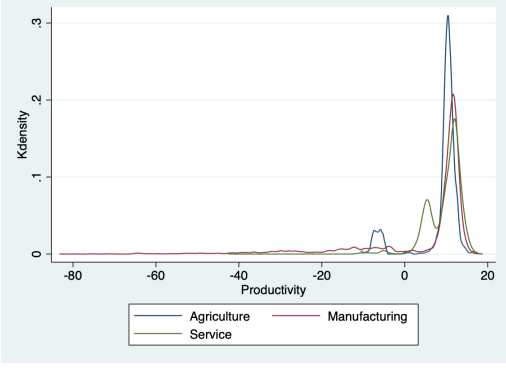
(a) Labor Prod



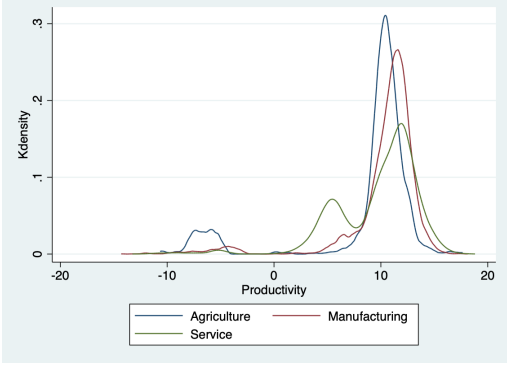
(b) OP Method



(c) LP Method



(d) OP+ACF Method



(e) LP+ACF Method

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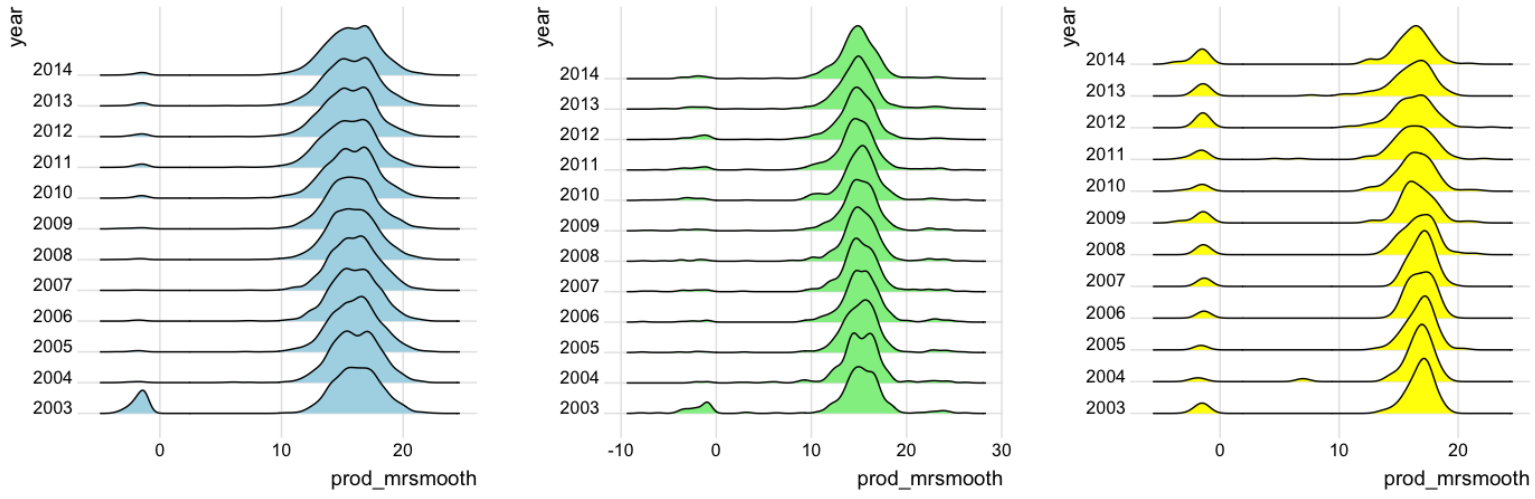
Ridge Distribution by Year



(a) Service (b) Manufacturing (c) Agriculture

Figure 9: Ridge Distribution by Year

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Consistency in Ranking Firms

Table 6: Correlation of Firm Ranks at the Sector Level

	MrEst	OP	LP	Lab-Prod	ACF-OP	ACF-LP
MrEst	1.0000					
OP	0.9367*	1.0000				
LP	0.9430*	0.9815*	1.0000			
Lab-Prod	0.9129*	0.9068*	0.9249*	1.0000		
ACF-OP	0.8983*	0.9688*	0.9739*	0.8846*	1.0000	
ACF-LP	0.8858*	0.9439*	0.9544*	0.8559*	0.9724*	1.0000

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Structural Model

The Bellman equation for an incumbent firm is

$$V_t(\omega_t, k_t) = \max\{\phi, \sup_{m_t \geq 0} \pi_t(\omega_t, k_t) - c(m_t) + \beta E[V_{t+1}(\omega_{t+1}, k_{t+1})|\mathcal{F}_t]\}$$

where ϕ is a sell-off value if the firm exits, $\pi_t(\cdot)$ is the restricted profit function giving current period profits as a function of the vector of state variables, $c(m_t)$ is the cost of current intermediate materials m_t, β is the firm's discount factor, and $\mathcal{F}_t$ represents the information available at time t.

The material demand equation is:

$$m_t = f_t(\omega_t, k_t)$$

We can get the productivity equation from the demand equation:

$$\omega_t = f_t^{-1}(m_t, k_t)$$

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Regression Outcomes: Manufacturing Sector

Table 7: Estimates of Production Function Parameters (Manufacturing Sector)

	(1) Editing and Printing	(2) Food Products	(3) Wood Products	(4) Detergents	(5) Plastic and Rubber	(6) Metallurgy	(7) Agrochemical and Fiber
Skilled	0.645***	0.747***	0.571***	0.461*	0.431***	0.915***	0.185
	(6.69)	(4.99)	(6.72)	(2.12)	(3.89)	(5.49)	(0.95)
Unskilled	0.350***	0.561***	0.548***	0.0772	0.162*	0.370***	0.204
	(4.08)	(4.68)	(5.33)	(0.82)	(2.40)	(4.27)	(1.69)
Capital	0.129*	-0.0736	-0.00500	0.749	0.136	0.169	0.483**
	(2.28)	(-0.67)	(-0.03)	(1.73)	(0.80)	(1.76)	(2.94)
N	1377	1851	826	278	651	874	223

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Regression Outcomes: Manufacturing Sector

Table 8: Estimates of Production Function Parameters (Agriculture Sector)

	Agriculture Plantation
Skilled	0.939***
	(4.31)
Unskilled	0.623***
	(4.82)
Capital	0.0402
	(0.10)
N	1115

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