Roads to Structural Transformation in Ethiopia

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Introduction

Research questions

- We ask whether improvements in connectivity affect the process of structural transformation (ST) in Ethiopia

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- We look at two key dimensions of ST:

  1. The shift of workers across industries;
  2. Improvements in workforce's educational attainments.

- We try to disentangle some of the underlying mechanisms, including:

  1. Migration;
  2. Higher (and more qualified) demand.

The context

Ethiopia is an excellent case to analyse:

- Structural transformation is high in the political agenda (Ali, 2019)

- High transport costs pose high barriers to labour supply (Franklin, 2018) and hinder mkt opportunities (Atkin and Donaldson, 2015)

- The Road Sector Development Programme (RSDP) was launched in 1997 to improve connectivity and support economic growth

Contribution

- Contribute to a growing body of evidence on the causes of ST in developing countries (Bustos et al., 2016, 2017; Barrett et al., 2017)

  - We show that improvements in connectivity supports ST and education (as in Asher and Novosad, 2018; Adukia et al., forthcoming, though we also look at improvements in existing roads and urban areas as well)

  - We show that infrastructures push ST by stimulating economic activities at destination (as in Hjort and Poulsen, 2019)

- Contribute to literature on the effects of transport infrastructures on economic development in developing countries (Donaldson, 2018; Storeygard, 2016)

Data

The RSDP and the quality of road infrastructure

- Data on Ethiopian roads targeted by the RSDP: **type of surface** and **condition**

- ERA's assessment of avg speed in km/h

Surface	Condition	
	Not rehabilitated	Rehabilitated or new
Asphalt	50	70
Major gravel	35	50
Minor gravel	25	45
Earth	20	30

RSDP road network in 1996 by surface type

Legend

Cities
▲ capital
• town

Road surface
══ asphalt
── major gravel
── gravel
── earth
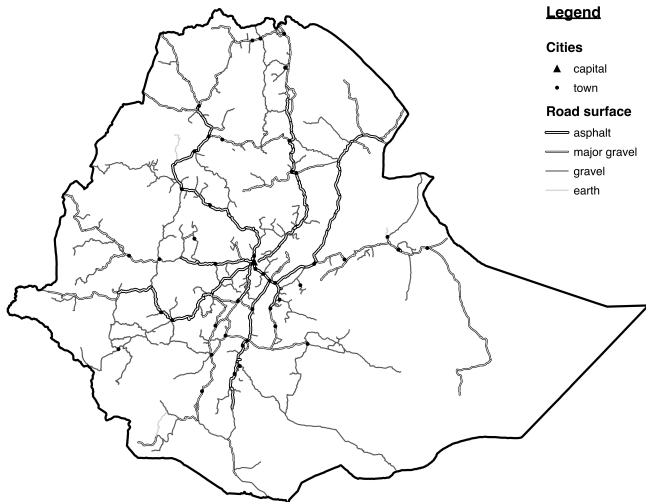
Upgraded and new roads from the 1996 RSDP road network

Legend

▲ Addis Ababa

RSDP treatment

— new or upgraded by 2014
— same as in 1996
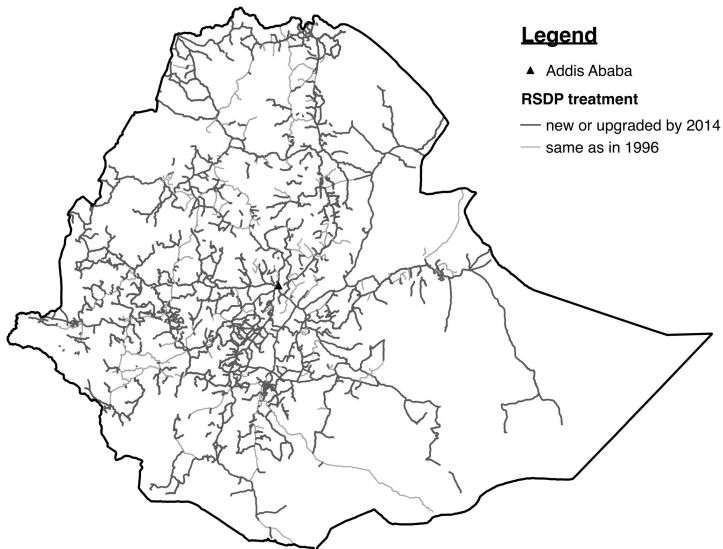
A measure of quality of road infrastructure

- Market access à la Harris (1954) for district r at time t

$$\text{Roads}_{rt} = \log \Big(\sum_{z \neq r} D_{rz,t}^{-1} L_z \Big)$$

- $D_{rz,t}$: (Dijkstra) minimum distance in hours travel between r and z given road network in place at t

- L_z: indicator of economic activity based on night light intensity

Individual Data

- We merge 1999, 2005 and 2013 National Labour Force (NLF) surveys with 1994 National Census data;

- Data cover the demographic characteristics of individuals, as well their education and working conditions;

- Include information on the previous place of residence of individuals, allowing to recover their migration status;

- We use district (wereda), the third admin division of Ethiopia, as our unit of analysis.

Individual Data: sector composition of employment

Year	Agriculture	Manufacturing	Services
1994	89.37%	1.78%	8.56%
1999	79.85%	4.45%	14.78%
2005	82.51%	4.35%	11.88%
2013	73.62%	4.07%	20.56%

Individual Data: Educational attainments

Year	Grade 1-8	Grade 9-12	Diploma	Degree
1994	15.95%	3.91%	0.17%	0.10%
1999	22.83%	3.91%	0.31%	0.11%
2005	31.86%	4.40%	0.50%	0.15%
2013	46.74%	7.19%	1.89%	1.04%

Identification

$$y_{it} = \beta_1 \text{ Roads}_{it} + \theta_i + \phi_{rt} + \epsilon_{it} \tag{1}$$

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- **Endogeneity**: We exploit the fact that variation in each district's market access is determined by improvements to the whole road network in the country (as in Donaldson and Hornbeck, 2016);

- We partial out the changes in **local** roads, which are the key source of the endogeneity concerns.
    - District level infrastructures measured as a weighted sum of the distance covered by each road segment within the district area, with weights equal to the speed allowed by the type of surface and the road's condition.

Results

Prima Facie Evidence

Employment:	Total	Agriculture	Manufacturing	Services
	(1)	(2)	(3)	(4)
Roads	0.0208*	-0.0467**	0.0122**	0.0310**
	(0.0114)	(0.0182)	(0.00512)	(0.0145)
Constant	0.438***	1.030***	-0.0227	-0.00130
	(0.0556)	(0.0882)	(0.0249)	(0.0706)
Observations	1,690	1,690	1,690	1,690
R-squared	0.278	0.351	0.155	0.319
Region FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of employed persons on total population (Total); the share of agricultural workers on total (Agriculture); the share of manufacturing workers on total (Manufacturing); the share of services workers on total (Services). The regressor of interest (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results (1) - Roads and Structural Change

Employment:	Total	Agriculture	Manufacturing	Services
	(1)	(2)	(3)	(4)
Roads	0.0745*	-0.163**	0.0142	0.140**
	(0.0429)	(0.0742)	(0.0200)	(0.0634)
Constant	0.192	1.589***	-0.0355	-0.518*
	(0.205)	(0.352)	(0.0940)	(0.302)
Observations	1,573	1,573	1,573	1,573
R-squared	0.601	0.661	0.509	0.634
District FE	YES	YES	YES	YES
Region Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of employed persons on total population (Total); the share of agricultural workers on total (Agriculture); the share of manufacturing workers on total (Manufacturing); the share of services workers on total (Services). The regressor of interest (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results (2) - Roads and Education

VARIABLES	Grade 1-8	Grade 9-12	Diploma	Degree
	(1)	(2)	(3)	(4)
Roads	0.00397	0.00967*	0.0128**	0.00985**
	(0.00977)	(0.00560)	(0.00604)	(0.00419)
Constant	-0.00232	-0.0361	-0.0558**	-0.0444**
	(0.0467)	(0.0268)	(0.0284)	(0.0197)
Observations	1,573	1,573	1,573	1,573
R-squared	0.660	0.799	0.617	0.643
Controls	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Region Year FE	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of individuals with completed grades 1-8 (Grade 1-8), 9-12 (Grade 9-12), diploma (Diploma) and degree (Degree) on the total number of individuals aged 10 and above. The main control (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results (3) - Structural Transformation by Gender

Employment:	Total	Agriculture	Manufacturing	Services
	(1)	(2)	(3)	(4)
Panel A: females				
Roads	0.0299	-0.0806*	0.00343	0.105**
	(0.0317)	(0.0469)	(0.0149)	(0.0438)
Constant	0.297*	0.710***	0.00620	-0.408*
	(0.151)	(0.223)	(0.0701)	(0.208)
Observations	1,573	1,573	1,573	1,573
R-squared	0.471	0.590	0.448	0.604
Panel B: males				
Roads	-0.0299	-0.0823*	0.0107	0.0432
	(0.0317)	(0.0491)	(0.0115)	(0.0302)
Constant	0.703***	0.879***	-0.0417	-0.146
	(0.151)	(0.234)	(0.0535)	(0.143)
Observations	1,573	1,573	1,573	1,573
R-squared	0.471	0.639	0.569	0.662
Controls	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Region Year FE	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of employed persons on total population (Total); the share of agricultural workers on total (Agriculture); the share of manufacturing workers on total (Manufacturing); the share of services workers on Total (Services). The main control (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results (3) - Education by Gender

VARIABLES	Grade 1-8	Grade 9-12	Diploma	Degree
	(1)	(2)	(3)	(4)
Panel A: females				
Roads	0.00108	0.000823	0.00449**	0.000996*
	(0.00333)	(0.00206)	(0.00203)	(0.000597)
Constant	-0.000880	-0.00122	-0.0200**	-0.00430
	(0.0159)	(0.00982)	(0.00953)	(0.00283)
Observations	1,573	1,573	1,573	1,573
R-squared	0.673	0.818	0.664	0.719
Panel B: males				
Roads	0.00281	0.00583**	0.00436	0.00591**
	(0.00474)	(0.00264)	(0.00271)	(0.00269)
Constant	-0.00559	-0.0228*	-0.0184	-0.0267**
	(0.0226)	(0.0126)	(0.0128)	(0.0126)
Observations	1,573	1,573	1,573	1,573
R-squared	0.609	0.787	0.586	0.632
Controls	YES	YES	YES	YES
District FE	YES	YES	YES	YES
Region Year FE	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of individuals with completed grades 1-8 (Grade 1-8), 9-12 (Grade 9-12), diploma (Diploma) and degree (Degree) on the total number of individuals aged 10 and above. The main control (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Mechanisms

Mechanisms (1) - Migration

VARIABLES	Migrant	Urban_migrant	Rural_migrant
	(1)	(2)	(3)
Roads	0.0122	0.0141***	-0.00128
	(0.0119)	(0.00413)	(0.00971)
Constant	0.0363	-0.0451**	0.0734
	(0.0582)	(0.0196)	(0.0477)
Observations	1,690	1,690	1,690
R-squared	0.183	0.177	0.195
Region FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: The dependent variables measure, respectively, the share of total, urban and rural migrants on the total population. The main control (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Mechanisms (2) - Demand (Manufacturing)

VARIABLES	Entry	Foreign_entry	Productivity	Sales	Exporter	Importer	Size	Non-prod workers	Wage	Wage non-prod	Wage prod.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Roads	0.00775	0.00266*	0.160***	0.191**	0.00201	0.0411***	0.0166	0.0565*	0.00948	0.0806*	0.00832
	(0.0155)	(0.00155)	(0.0577)	(0.0944)	(0.00644)	(0.0138)	(0.0318)	(0.0333)	(0.0329)	(0.0453)	(0.0299)
Constant	-0.321	0.0914	10.28***	14.23***	-0.0339	0.308	4.064***	-1.954***	7.806***	7.749***	7.460***
	(0.559)	(0.0595)	(1.041)	(1.528)	(0.131)	(0.233)	(0.510)	(0.537)	(0.497)	(0.729)	(0.491)
Observations	604	604	8,478	8,681	10,414	10,414	10,130	8,758	10,120	9,198	9,566
R-squared	0.537	0.406	0.697	0.847	0.689	0.613	0.906	0.632	0.790	0.737	0.686
Firm FE	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Town FE	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
Region Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the entry rate, measured as the share of new firms at t on the total number of firms at $t-1$ in each town (Entry); the entry rate of foreign owned firms (Foreign_entry); firms' labour productivity, measured as value added on employment (Productivity); firms' (log of) sales; firms' (log of) total employment (Size); Firms' (log of) total number of non-production workers (Non-prod workers); the (log of) per capita wages for all employees (Wage), and for production (Wage prod.) and non-production workers (Wage non-prod.). The main control (Roads) measures the log of market access. Standard errors are clustered at the town level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Mechanisms (2) - Demand (Services)

VARIABLES	Size	Wage	Productivity	Capital intensity
	(1)	(2)	(3)	(4)
Roads	3.056*	11.44*	0.672	-5.302***
	(1.669)	(6.462)	(7.841)	(0.976)
Constant	-5.946	45.58	-13.05	-41.98***
	(14.88)	(51.17)	(47.47)	(13.45)
Observations	1,488	865	1,481	694
R-squared	0.268	0.449	0.474	0.283
District FE	YES	YES	YES	YES
Region Year FE	YES	YES	YES	YES

Notes: The dependent variables measure, respectively, the (log) number of employees (Size); the (log of) wage per capita; the (log of) sales of employees (Productivity); the (log of) assets on employees. All variables have been deflated using the GDP deflator from the IMF. The main control (Roads) measures the log of market access. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Conclusions

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- Empirical assessment of the role of road infrastructure in shaping structural transformation in Ethiopia;

- Improvements in road infrastructures create jobs and structural transformation (still not significantly so in the manufacturing);

- Improving connectivity can affect the incentives to invest in education

- Reducing migration costs and fostering economic activities among the key mechanisms to explain the story.

Thank You.

Ethiopia Road Sector Development Programme

Indicators	1997	2010
Proportion of Asphalt roads in Good Condition	17%	73%
Proportion of Gravel roads in Good Condition	25%	53%
Proportion of Earth-surfaced roads in Good Condition	21%	53%
Proportion of Total Road network in Good Condition	22%	56%

Notes: Raw data sourced from RSDP 13 Years Performance and Phase IV: January 2011.