

# Does Trade Reduce Infant Mortality? Evidence from Sub-Saharan Africa

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# Motivation

- Many developing countries have opened their economies in the hopes of spurring growth - But does this translate into development?
- Free trade can create access to a better variety of goods, increase women labor force participation, increase incomes and often leads to improvements in infrastructure investment (Dollar and Kraay, 2001; Broda and Weinstein, 2006; Wood, 1991; Storeygard, 2013)
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  - analyzes heterogeneous effects both at the macro and micro level
  - examines possible pathways

- Few empirical studies estimating the effect of trade on child health
- Empirically, it is difficult to identify causal effects due to endogeneity
  - Omitted Variables
  - Reverse Causality
- Identification in previous literature has come from using instrumental variables like predicting trade volumes as a ratio of GDP using geographic factors (Levine and Rothman (2006), Frankel and Romer (1999))
- Potential threats to validity as geographical trade share may be correlated with other factors that affect children's welfare

- Trade Policy
  - African Growth and Opportunity Act (AGOA): duty-free and largely quota-free access to US markets
  - Took effect in 2000 with 34 sub-Saharan African countries eligible for the trade benefits
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- Health

- Uses the best available pan-Africa Health Surveys on fertility and child health, Demographic and Health Surveys (DHS)
- Using retrospective birth histories from DHS, I develop a micro panel dataset that spans 30 sub-Saharan African countries, and about 686,000 children born to 212,000 mothers
- The effect of trade policy on infant mortality is gauged by studying the varying exposure between the children born to same mothers but exposed to the trade policy or not in both policy-affected and non-affected countries



# Preview of Findings

- AGOA reduces
  - Infant mortality in sub-Saharan Africa by 0.7 percentage points, 9% of the sample mean
  - Neonatal mortality by 4.4 death per 1000, 12% of sample mean
- AGOA benefits rural and poor mothers more
- Effect of AGOA on infant survival is stronger for countries that export large amounts of agricultural goods and mineral ores as compared to oil exporting countries
- Decrease in infant mortality is operating through:
  - change in household income/assets
  - change in female employment in labor force
  - changing health seeking behavior of mothers

# AGOA Timeline

2000

- Benin, Cameroon, Chad, Republic of Congo, **Ethiopia**, Ghana, Kenya, Lesotho, Malawi, **Mozambique**, Namibia, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Swaziland, Tanzania, Zambia
- Suspended: Guinea (2009), Madagascar (2009), Mali (2012), Niger (2009)

2002

- Sierra Leone

2003

- Angola, Democratic Republic of Congo, **Cote D'Ivoire**
- Suspended: Democratic Republic of Congo(2011), Cote D'Ivoire (2005)

2004-06

- 2004: Burkina Faso
- 2006: **Liberia**

Zimbabwe: Not AGOA Eligible

# Impact on Exports

- Frazer and Biesebroeck (2007), Condon and Stern (2011) and Collier and Venables (2007) find a positive and significant impact of AGOA on exports, without a decrease in trade share of European Union

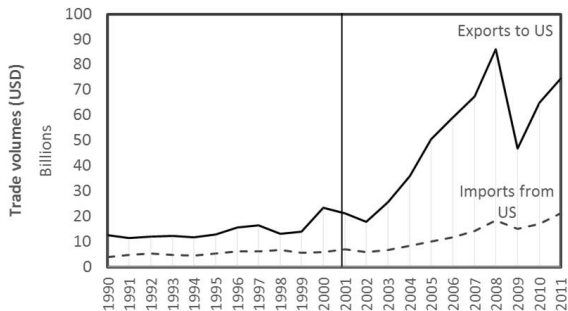








Figure: Total exports and imports between US and all the sub-Saharan African countries from 1990-2011

# Trade Linkages

	Mechanism	Trade	Infant Deaths
<b>Macro Channels</b>			
<b>GDP/Capita</b>	Increased Exports		
<b>Health Expenditure</b>	Tax Revenues	?	
<b>Inequality</b>		?	
<b>Pollution</b>	Urbanization		
<b>Micro Channels</b>			
<b>Employment</b>	Income Effect		
	Substitution Effect		
<b>Healthcare access</b>	Realignment of preferences		
<b>Bargaining Power</b>	Increased Income		
<b>Variety Gains</b>	Opening of markets		

- The micro level health data for the sub-Saharan African countries comes from the Demographic and Health Surveys (DHS)
- Women of reproductive age (15-49 years) are interviewed about the date of birth and death (if applicable) for up to 20 children they have had
- There are 36 DHS Surveys publically available
  - Central African Republic, Comoros, Gabon, South Africa, Sudan and Togo were all carried out before AGOA
  - 30 surveys are included in this analysis
- Datasets across 30 sub-Saharan African countries from DHS collated using the recall data to get a micro-dataset, which runs across the sub-Saharan African countries, with the time dimension being the child birth year

## Linear Probability Model, Specification 1

$$IMR_{imct} = \alpha_m + \beta_t + \theta T_{ct} + X_{imct}\delta + \mu_c \cdot t + \epsilon_{imct}$$

- IMR is a dummy which takes the value 1 if child  $i$  born to mother  $m$  in country  $c$  at time  $t$  dies before reaching the age of 1 year

## Linear Probability Model, Specification 2

$$IMR_{imbct} = \alpha_m + \beta_{bt} + \theta T_{ct} + X_{imbct}\delta + \mu_c \cdot t + \epsilon_{imbct}$$

- $b$ : Mother's birth cohort
- Standard errors clustered at the country level to take into account any correlation of the error across space and time within each country

- Residual contains no mother-specific time-varying shocks that might drive a correlation between mortality and AGOA

$$E(\epsilon_{imbct} | T_{ct}, \beta_{bt}, \alpha_m, \mu_{c \cdot t}, X_{imbct}) = 0$$

- To account for this, I include child birth year dummies interacted with mother's cohort to non-parametrically control for cohort-year fixed effects
- Also control for observable country specific time varying shocks (like GDP per capita, political regime, commodity prices etc.)

$$IMR_{imbct} = \alpha_m + \beta_{bt} + \theta T_{ct} + X_{imbct} \delta + \mu_{c \cdot t} + \lambda Z_{ct} + \epsilon_{imbct}$$

# Disentangling the Effects

- Difficulty of disentangling the effect of this policy from the prerequisites for being a signatory on the AGOA
  - Time-invariant heterogeneity regarding geography, history, culture, politics and attitudes etc. are taken care of by the mother fixed effects ( $\alpha_m$ )
  - The year fixed effects ( $\beta_t$ ) control for an aggregate time variation involving improvement of health technology and year shocks
  - ( $\beta_{bt}$ ) controls for changing time of mothers age at birth
  - Country-specific time trends ( $\mu_{c.t}$ ) also allow for differential states of development of the countries



# Event-Time Study

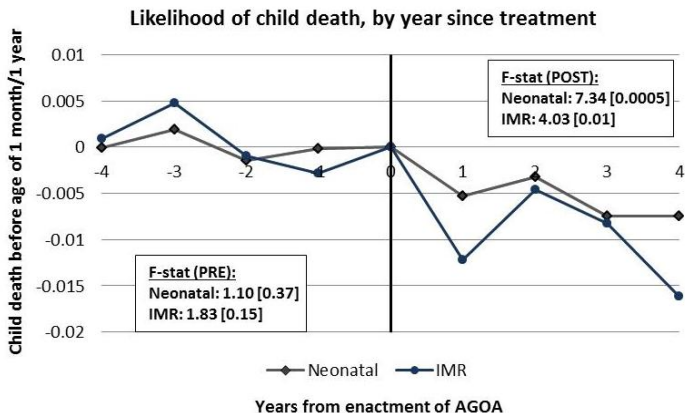


Figure: These are the  $\theta_j$  estimates plotted from estimating this equation:

$$Death_{imct} = \alpha_c + \beta_t + \sum_{j=-4}^4 \theta_j T_{c,t+j} + X_i \delta + \epsilon_{imct}$$

# Infant Mortality decreases after AGOA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Neonatal Mortality
<b>Treatment</b>	-0.0071 (0.0028)	-0.0081*** (0.0028)	-0.0071** (0.0028)	-0.0079*** (0.0019)	-0.0079*** (0.0028)	-0.00693** (0.0027)	-0.00456*** (0.0011)
<b>Explanatory Variables</b>	YES	YES	YES	YES	YES	YES	YES
<b>Country time trend</b>	NO	YES	YES	YES	YES	YES	YES
<b>Country FE</b>	YES	YES	NO	NO	YES	NO	NO
<b>Mother FE</b>	NO	NO	YES	NO	NO	YES	YES
<b>Cohort-year FE</b>	NO	NO	NO	YES	YES	YES	YES
<b>Number of countries</b>	30	30	30	30	30	30	30
<b>Number of mothers</b>	212738	212738	212738	212738	212738	212738	212738
<b>Observations</b>	686093	686093	686093	686093	686093	686093	686093

# Time-Variant Factors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality
<b>Treatment</b>	-0.0068** (0.0025)	-0.0076*** (0.0026)	-0.0082*** (0.0025)	-0.00697** (0.0026)	-0.0067* (0.0032)	-0.009*** (0.0025)	-0.0066** (0.0028)
<b>Log GDP per capita</b>	-0.0099* (0.0054)						-0.0175* (0.0094)
<b>Democracy</b>		-0.0041 (0.0029)					-0.0043 (0.0028)
<b>ODA</b>			0.00009 (0.0001)				-0.00003 (0.00007)
<b>Openness</b>				-0.00002 (0.00007)			0.00009 (0.00005)
<b>Female Education</b>					0.0029 (0.0053)		-0.001 (0.0048)
<b>Commodity Price Index</b>						0.0327*** (0.0067)	0.0311*** (0.0066)
<b>Number of countries</b>	30	30	29	30	21	29	21
<b>Number of mothers</b>	212738	209721	205420	212738	134952	206137	131959
<b>Observations</b>	686093	673646	655443	686093	410833	663838	394715

# Heterogeneity

- Trade policy helped boost exports in apparel and mining; which have been shown to be major employers of women in sub-Saharan Africa
- These sectors, along with agriculture, employ rural and poor women as they provide cheap labor
- I check for heterogeneity based on these characteristics of mother

# Micro Heterogeneity

	(1)	(2)	(3)	(4)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality
<b>Educated</b>	-0.0054* (0.0031)			
<b>Uneducated</b>	-0.0082*** (0.0029)			
<b>Rural</b>		-0.0085*** (0.0028)		
<b>Urban</b>		-0.0018 (0.0031)		
<b>Poor</b>			-0.0102*** (0.0028)	
<b>Non-Poor</b>			-0.0044 (0.0029)	
<b>Employed</b>				-0.0095*** (0.0028)
<b>Unemployed</b>				-0.0057 (0.0038)
<b>F-Stat</b>	0.83 (0.371)	5.71 (0.021)	7.82 (0.009)	2.25 (0.145)
<b>Number of Countries</b>	30	30	30	28
<b>Number of mothers</b>	212732	212738	212738	197632
<b>Observations</b>	686075	686093	686093	632951

# Employment

	Treat	Agriculture	Manual Labor	Managerial Services	Household and Services
<b>Infant Mortality</b>	0.0063 (0.0040)	-0.0185*** (0.0035)	-0.0155*** (0.0043)	-0.0081*** (0.0026)	-0.0022 (0.0061)
<b>F-Stat</b>	3.16 (0.041)				
<b>Number of Countries</b>	28				
<b>Number of mothers</b>	148006				
<b>Observations</b>	484754				

Note: Employment is categorized into four major sectors: (1) Agriculture - if the mother is working either as Agricultural self-employed or Agricultural employee, (2) Manual Labor - if the mother is employed as skilled manual or unskilled manual, (3) Managerial - if the mother is employed as Professional and managerial, clerical or sales, and (4) Household and services - if the mother is working in household or domestic services or the services sector. F-stat and corresponding p-value for equality of coefficients on employment categories is reported. Omitted category is the unemployed mothers.

\*\*\* Significant at 1% level, \*\* significant at 5% level, \* significant at 10% level.

▶ Macro Heterogeneity

▶ Time and Country

▶ Child Gender

- Assets/Income  
AGOA → Incomes increase → child health investment → infant mortality falls
- Health Care  
AGOA → Increased infrastructure → availability of health care interventions / Mothers health seeking behavior
- Employment  
AGOA → Change in type of employment → Increased bargaining power for women

# Data for Mechanism Analysis

- No data retrospectively for variables like possession of assets and employment
- Repeated cross-section sample of infants at each survey is created by collating data for various rounds of survey for each country
- Data on assets, employment and health care variables for 22 countries, where DHS survey has been carried out more than once
- Since mother fixed effects cannot be controlled for, I instead create 'mother-cohorts' defined by their year of birth, place of residence (country and urban/rural), and level of education (attended primary school or not)



	(1)	(2)	(3)	(4)
<b>Dependent Variable</b>	<b>Tetanus Toxoid</b>	<b>Delivery Assistance</b>	<b>Piped Water</b>	<b>Flush Toilets</b>
<b>Treatment</b>	0.132*** (0.044)	0.102*** (0.032)	-0.069** (0.025)	-0.008* (0.0048)
<b>Number of countries</b>	22	22	22	22
<b>Observations</b>	118784	121797	119705	119657

Note: These estimates are derived from a pooled sample of mothers in multiple surveys across 22 countries. The sample includes all babies, both living and dead, born within twelve months of survey date.

\*\*\* Significant at 1% level, \*\* significant at 5% level, \* significant at 10% level.

# Channels: Maternal Labor Force

	(1)	(2)	(3)	(4)	(5)
<b>Dependent Variable</b>	<b>Agriculture</b>	<b>Manual Labor</b>	<b>Managerial Services</b>	<b>Household and Services</b>	<b>Not Working</b>
<b>Treatment</b>	-0.149*** (0.015)	0.095** (0.037)	0.061* (0.034)	-0.009 (0.019)	-0.044 (0.039)
<b>Number of countries</b>	22	22	22	22	22
<b>Observations</b>	74478	74478	74478	74478	122053

Note: These estimates are derived from a pooled sample of mothers in multiple surveys across 22 countries. The sample includes all babies, both living and dead, born within twelve months of survey date.

\*\*\* Significant at 1% level, \*\* significant at 5% level, \* significant at 10% level.

# Channels: Ownership of Assets

	(1)	(2)	(3)	(4)	(5)
<b>Dependent Variable</b>	<b>Radio</b>	<b>Refrigerator</b>	<b>Bike</b>	<b> Scooter</b>	<b>Poor</b>
<b>Treatment</b>	0.078*** (0.017)	-0.024*** (0.007)	0.041* (0.019)	0.051*** (0.009)	-0.063*** (0.014)
<b>Number of countries</b>	22	22	22	22	22
<b>Observations</b>	119206	113511	119149	117921	119148

Note: These estimates are derived from a pooled sample of mothers in multiple surveys across 22 countries. The sample includes all babies, both living and dead, born within twelve months of survey date.

\*\*\* Significant at 1% level, \*\* significant at 5% level, \* significant at 10% level.

▶ Macro Pathways

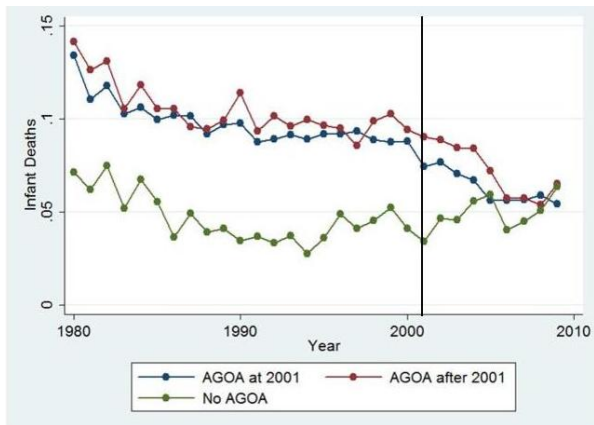
- Fertility Selection Effect: Mothers affected by AGOA in AGOA affected countries behave differently than mothers in non-AGOA countries, if they had been AGOA affected - possibly timing their birth [▶ Fertility](#)
- Fake AGOA Treatment [▶ Placebo Test](#)
- Dynamics of AGOA [▶ Dynamics](#)
- Early adopters vs. late adopters - Those who got AGOA in 2001 benefit more
- Different year of birth cutoffs
- Change in definition of "treatment" [▶ Robustness Table](#)
- Outliers - Dropping one country at a time [▶ Outliers](#)
- Country-specific birth order [▶ Birth Order](#)

# Conclusion

- Empirical study of the effect of trade on development has been limited, and in many cases confounding
- The reduced-form results indicate trade policy has a positive developmental effect on the population in terms of reducing probability of infant and neonatal deaths, by 9-12% of sample mean
- Mechanisms through which these effects take place are a shift of employment from agriculture to manual labor and managerial services and increased assets
- Analysis suggests that the income effect dominates the substitution effect of mother's opportunity cost of time

Thank You

# Infant Mortality Rates



**Figure:** Sample infant mortality rates for countries affected by AGOA by 2001, countries affected by AGOA after 2001 and never affected by AGOA countries, by year of child birth.

# Mother Characteristics

	(1)		(2)		(3)		(4)
	Full Sample		AGOA Countries All mothers		2+ Sample both before and after AGOA		T-test
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Mother's age at birth	25.72	6.44	25.72	6.42	26.03	6.39	-23.7
Mother's Education	0.501	0.499	0.503	0.499	0.478	0.499	24.78
Mother's wealth index	2.86	1.402	2.86	1.39	2.77	1.38	35.92
Mother's Residence (Rural)	0.73	0.444	0.73	0.442	0.77	0.422	-37.29
N	686093		594578		391425		
N (M.Educ)	686075		594560		391414		

Note: Sample means and standard deviations are reported for different samples of mothers. N refers to the number of observations in each sample. Column (1) gives the mean and standard deviation for different mother characteristics for the whole sample with AGOA affected and non-affected countries. Column (2) reports the same for all mothers in AGOA affected countries. Column (3) reports the sample mean and standard deviation for mothers with two or more children giving birth before and after AGOA. All variables are categorical variables except mothers age at birth. Column (4) provides a difference in means t-test between (2) and (3).



# Mean Infant and Neonatal Mortality for Sample of 2+ Mothers in AGOA Countries

	(1)		(2)	
	Both before and after AGOA		Only before or after AGOA	
	Mean	Std. Dev.	Mean	Std. Dev.
<b>Infant Mortality</b>				
Before AGOA	0.090	0.286	0.091	0.286
After AGOA	0.063	0.243	0.077	0.267
<b>Neonatal Mortality</b>				
Before AGOA	0.041	0.198	0.0436	0.202
After AGOA	0.029	0.168	0.0425	0.187
<b>N</b>	391425		165098	
Before AGOA	247784		117811	
After AGOA	143641		47287	

Note: Sample mean is reported in the top row and number of live birth observations for AGOA affected countries in the bottom row. Column (1) gives the sample mean and standard deviation for infant and neonatal mortality for the sample of mothers giving birth both before and after AGOA. Column (2) reports the sample mean and standard deviation for mothers with two or more children either only before AGOA or after AGOA. N represents the number of live births.

# Macro Pathways

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality
Treatment	-0.0067** (0.0025)	-0.0071** (0.0025)	-0.0086*** (0.0026)	-0.0087*** (0.0026)	-0.0066** (0.0027)	-0.0086*** (0.0029)
Log GDP per capita	-0.0099* (0.0054)					
Health expenditure per capita		0.00010** (0.00004)				
Paved Roads Access			-0.00043** (0.00016)			
Female LFPR				-0.00032 (0.0007)		
Inequality					0.000028 (0.00044)	
Fertility						-0.00017 (0.016)
Number of countries	30	29	29	29	27	29
Number of mothers	212738	194638	190014	206137	163946	206137
Observations	686093	519738	593076	663838	526782	663838

# Macro Heterogeneity

	(1)	(2)
<b>Dependent Variable</b>	<b>Infant Mortality</b>	<b>Infant Mortality</b>
<b>Apparel</b>	-0.00023 (0.0046)	
<b>Oil</b>	0.00142 (0.0034)	
<b>Agricultural Products</b>	-0.0132*** (0.0031)	
<b>Mineral and Ore</b>	-0.0109** (0.0048)	
<b>Others</b>	-0.00764 (0.0057)	
<b>East</b>		-0.0181*** (0.0031)
<b>West</b>		-0.0064 (0.0038)
<b>Central</b>		-0.0055 (0.0043)
<b>South</b>		0.0006 (0.0009)
<b>F-Stat</b>	4.40 (0.0066)	20.21 (0.00)
<b>Number of Countries</b>	30	30
<b>Number of Mothers</b>	212738	212738
<b>Observations</b>	686093	686093

# Time and Country Heterogeneity

## Time effects:

	2002	2003	2004	2005	2006	2007	2008	2009
<b>Infant Mortality</b>	-0.0059 (0.0042)	-0.0069** (0.0030)	-0.0118 (0.0073)	-0.0028 (0.0102)	0.0028 (0.0082)	-0.0084** (0.0034)	-0.014*** (0.0048)	-0.0104* (0.0061)
<b>Number of countries</b>	30							
<b>Number of mothers</b>	212738							
<b>Observations</b>	686093							

## Country effects:

Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality
	(1)Angola	(2)Benin	(3)Burkina Faso	(4)Burundi	(5)Cameroon	(6)Chad
<b>Treatment</b>	0.0043 (0.0026)	-0.0022 (0.0043)	-0.0068** (0.0027)	-0.0148*** (0.0024)	0.0029 (0.0044)	-0.0089* (0.0044)
	(7)Congo	(8)Congo, Dem.	(11)Ghana	(12)Guinea	(13)Kenya	(14)Lesotho
<b>Treatment</b>	-0.0154*** (0.0037)	-0.0019 (0.0033)	0.0175*** (0.0045)	-0.0157*** (0.0039)	-0.0217*** (0.0043)	0.0179*** (0.0044)
	(16)Madagascar	(17)Malawi	(18) Mali	(20)Namibia	(21)Niger	(22)Nigeria
<b>Treatment</b>	0.0026 (0.0044)	-0.00073 (0.0043)	-0.0209*** (0.0042)	-0.00668 (0.0044)	-0.0104** (0.0042)	0.00858* (0.0044)
	(23)Rwanda	(24)Sao Tome & Principe	(25)Senegal	(26)Sierra Leone	(27)Swaziland	(28)Tanzania
<b>Treatment</b>	-0.0223*** (0.0043)	0.0057 (0.0045)	-0.0037 (0.0044)	-0.0175*** (0.0030)	0.0072 (0.0043)	-0.0176*** (0.0044)
	(29)Zambia					
<b>Treatment</b>	-0.0186*** (0.0044)					

# Heterogeneity by Child's Gender

	(1)	(2)	(3)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality
AGOA	-0.0072** (0.0028)	-0.0062** (0.0026)	-0.0062** (0.0025)
AGOA*Son	-0.0017 (0.0012)	-0.0017 (0.0017)	-0.015 (0.0017)
Son	0.0138*** (0.0011)	0.014*** (0.0011)	0.014*** (0.0011)
Explanatory Variables	YES	YES	YES
Country time trend	YES	YES	YES
Country FE	YES	NO	NO
Mother FE	NO	YES	YES
Cohort-year FE	NO	NO	YES
Number of Countries	30	30	30
Number of mothers	212738	212738	212738
Observations	686093	686093	686093

# Robustness Table

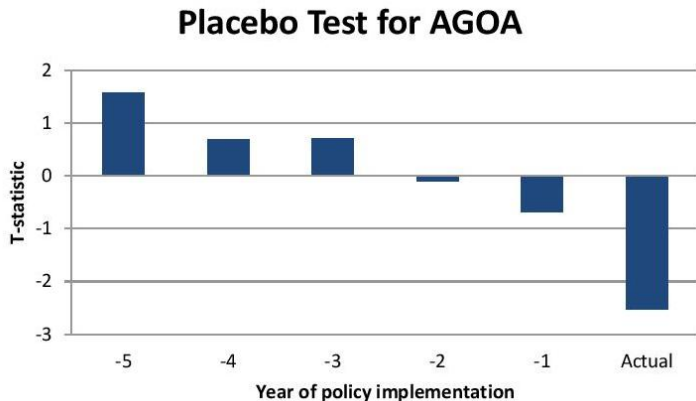
	(1)		(2)		(3)		(4)
Dependent Variable	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality	Infant Mortality
<b>Sample</b>	AGOA in 2001	AGOA after 2001	Year of birth cutoff = 1991	1993<Year of birth<2008	Percentage change in trade volumes	Intensity of treatment	Including death at 12 months
<b>Treatment</b>	-0.0163*** (0.0039)	-0.0029 (0.0065)	-0.0070** (0.0028)	-0.0082*** (0.0028)	-0.000014** (0.0027)	-0.0041** (0.0019)	-0.0085*** (0.0030)
<b>Explanatory Variables</b>	YES	YES	YES	YES	YES	YES	YES
<b>Country time trend</b>	YES	YES	YES	YES	YES	YES	YES
<b>Mother FE</b>	YES	YES	YES	YES	YES	YES	YES
<b>Cohort Year FE</b>	NO	NO	NO	NO	NO	NO	NO
<b>Number of countries</b>	25	10	30	30	30	30	30
<b>Number of mothers</b>	176295	69667	209970	197072	209970	212738	212738
<b>Observations</b>	559498	218110	635844	536137	635844	686093	686093

# Fertility

	(1)	(2)	(3)	(4)
	Fertility (All)	Fertility (Uneducated)	Fertility (Poor)	Fertility (Rural)
<b>AGOA</b>	-1.242 (1.07)	-0.567 (0.981)	-1.261 (1.07)	-1.252 (1.135)
<b>AGOA*Woman's type</b>		-0.265 (0.712)	0.338 (0.839)	-0.101 (1.04)
<b>F-stat</b>		0.39 [0.54]	0.5 [0.48]	1.18 [0.29]
<b>Number of Countries</b>	30	30	30	30
<b>Observations</b>	19250	38199	38290	38325

Note: The dependent variable is percentage of (type of) women giving birth. Woman's type is a dummy variable referring to if the woman is uneducated, poor or rural. For definitions of these, check notes in Table 1. (1) refers to all types of women, (2) to uneducated women, (3) to poor women and (4) to rural women. Standard errors clustered at the country level are reported in brackets. F-test reports F-statistics and its associated p-values in brackets for the null that the sum of coefficients on AGOA and on its interaction term with Woman's type is zero. All regressions control for country by woman's birth cohort fixed effects and year of giving birth by woman's birth cohort fixed effects which are also allowed to differ by woman's type.

\*\*\* Significant at 1% level, \*\* significant at 5% level, \* significant at 10% level.

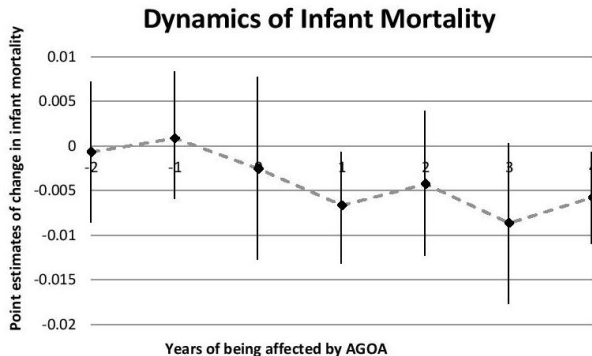


**Figure:** In each of the separate regressions, the effect of AGOA is estimated at false policy timings



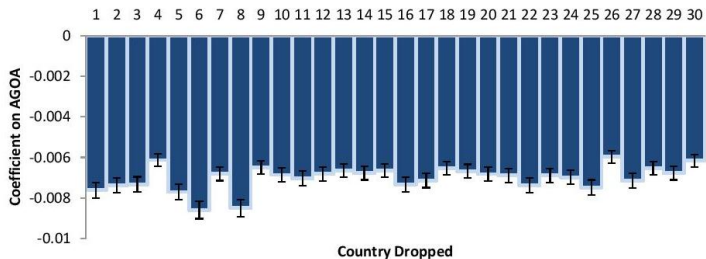
# Dynamics

- For the estimates to be unbiased, the error cannot be correlated with any of the covariates and outcomes, not only contemporaneously but also in leads and lags as the same mother gives birth
- Change in infant mortality compared to three years before



# Drop one country at a time

## Robustness to dropping one country at a time



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# Country-Specific Birth Order

	(1)	(2)
Dependent Variable	Infant Mortality	Infant Mortality
Specification	Country Specific Birth Order	Country Specific mother's age quadratic trends
Treatment	-0.00688** (0.0025)	-0.00681** (0.0026)
Explanatory Variables	YES	YES
Country time trend	YES	YES
Country Specific Birth Order Dummy	YES	YES
Country specific mother's age quadratic trend	NO	YES
Mother FE	YES	YES
Cohort-year FE	YES	YES
Number of countries	30	30
Number of mothers	212738	212738
Observations	686093	686093

# Dataset

Sub-Saharan Africa	AGOA Eligible	Year made AGOA Eligible	DHS used	Sample period
Angola	Y	December 30, 2003	2011	1990-2010
Benin	Y	October 2, 2000	2006	1990-2005
Burkina Faso	Y	December 10, 2004	2010	1990-2009
Burundi	Y	January 1, 2006	2010	1990-2010
Cameroon	Y	October 2, 2000	2011	1990-2010
Chad	Y	October 2, 2000	2004	1990-2003
Republic of the Congo	Y	October 2, 2000	2005	1990-2004
Democratic Republic of the Congo	Y	October 31, 2003 – Suspended 2011	2007	1990-2006
Cote d'Ivoire	Y	2003 – Suspended 2005; restored 2011	2005	1990-2003
Ethiopia	Y	October 2, 2000	2011	1990-2002
Ghana	Y	October 2, 2000	2008	1990-2007
Guinea	Y	2000- Suspended 2009; restored 2011	2005	1990-2004
Kenya	Y	October 2, 2000	2008-09	1990-2008
Lesotho	Y	October 2, 2000	2009	1990-2009
Liberia	Y	December 29, 2006	2007	1990-2006
Madagascar	Y	2000-Suspended 2009; restored 2014	2008-09	1990-2008
Malawi	Y	October 2, 2000	2010	1990-2009
Mali	Y	2000 – Suspended 2012; restored 2014	2006	1990-2005
Mozambique	Y	October 2, 2000	2003	1990-2002
Namibia	Y	October 2, 2000	2006-07	1990-2006
Niger	Y	2000-Suspended 2009; restored 2011	2006	1990-2005
Nigeria	Y	October 2, 2000	2010	1990-2009
Rwanda	Y	October 2, 2000	2010	1990-2009
Sao Tome and Principe	Y	October 2, 2000	2008-09	1990-2008
Senegal	Y	October 2, 2000	2010-11	1990-2010
Sierra Leone	Y	October 23, 2002	2008	1990-2007
Swaziland	Y	October 2, 2000	2006-07	1990-2006
Tanzania	Y	October 2, 2000	2010	1990-2009
Zambia	Y	October 2, 2000	2007	1990-2006
Zimbabwe	N	Non-AGOA	2010-11	1990-2009

- After dropping data for children born within twelve months of the survey, to ensure full exposure for every child in the sample and reduce measurement error, the sample includes 686,093 children born to 212,738 mothers
- Infant (Neonatal) mortality rate is the number of deaths of children before reaching the age of one year (month) per 1000 live births
- The sample average infant mortality rate is 8.15% of live births while the sample neonatal mortality rate is 3.8% of live births

▶ Infant Mortality Rates

# Summary Statistics - Child Variables

	(1)	(2)	(3)	(4)
	All	AGOA	Non-AGOA	t-test
<i>Child Variables</i>				
<b>Infant Mortality</b>	0.0815	0.0803	0.089	9.23
<i>Uneducated</i>	0.0939	0.0922	0.104	8.02
<i>N</i>	342382	295320	47062	
<i>Poor</i>	0.0902	0.0889	0.098	6.21
<i>N</i>	300418	258369	42049	
<i>Rural</i>	0.0866	0.0853	0.095	7.98
<i>N</i>	501284	436169	65115	
<b>Neonatal Mortality</b>	0.038	0.038	0.040	3.33
<b>Female</b>	0.492	0.492	0.492	-0.05
<b>Multiple Births</b>	0.035	0.035	0.033	-2.49
<b>Birth Order</b>	3.47	3.47	3.45	-1.93
<b>Month of birth</b>	6.15	6.16	6.07	-7.07
<b>Mother's age at birth</b>	25.68	25.69	25.65	-1.68
<b>N</b>	686093	594578	91515	

Country	AGOA Year	Mother	Birth History				
			1997	2000	2002	2005	2008
Angola	2003	M1	1	2	3		
Benin	2000	M2				1	2
Angola	2003	M3			1	2	3
Kenya	2000	M4	1			2	
Zimbabwe	NA	M5		1		2	
Liberia	2006	M6	1		2		

# Pathway Analysis Dataset

Sub-Saharan Africa	Year made AGOA Eligible	Infant mortality DHS used	Pathway Analysis DHS Used
Angola	2003	2011	No data for employment - dropped
Benin	2000	2006	1996, 2001, 2006
Burkina Faso	2004	2010	1993, 1998-99, 2003, 2010
Burundi	2006	2010	No employment data - dropped
Cameroon	2000	2011	1991, 1998, 2004, 2011
Chad	2000	2004	1996-97, 2004
Republic of the Congo	2000	2005	2005, 2011-12
Democratic Republic of the Congo	2003	2007	Two surveys not available - dropped
Cote d'Ivoire	2003 – Suspended 2005; restored 2011	2005	1994, 2011-12 (1998/2005 do not have data on toxoid injections)
Ethiopia	2000	2011	2000, 2005, 2011
Ghana	2000	2008	1993, 1998, 2003, 2008
Guinea	2000- Suspended 2009; restored 2011	2005	No employment data - dropped
Kenya	2000	2008-09	1993, 1998, 2003, 2008-09
Lesotho	2000	2009	2004, 2009
Liberia	2006	2007	No employment data for 2 rounds of survey - dropped
Madagascar	2000-Suspended 2009; restored 2014	2008-09	1992, 1997, 2003-04, 2008-09
Malawi	2000	2010	1992, 2000, 2004, 2010
Mali	2000 – Suspended 2012; restored 2014	2006	1995-96, 2001, 2006
Mozambique	2000	2003	1997, 2003, 2011
Namibia	2000	2006-07	1992, 2000, 2006-07
Niger	2000-Suspended 2009; restored 2011	2006	1992, 1998, 2006
Nigeria	2000	2010	1990, 1999, 2008 (2010 is MIS Data)
Rwanda	2000	2010	1992, 2000, 2005, 2010
Sao Tome and Principe	2000	2008-09	Two surveys not available - dropped
Senegal	2000	2010-11	1992-93, 1997, 2005, 2010-11
Sierra Leone	2002	2008	Two surveys not available - dropped
Swaziland	2000	2006-07	Two surveys not available - dropped
Tanzania	2000	2010	1991-92, 1996, 1999, 2010
Zambia	2000	2007	1992, 1996, 2001-02, 2007
Zimbabwe	Non-AGOA	2010-11	1994, 1999, 2005-06, 2010-11