A TEST OF THE NEW VARIANT FAMINE HYPOTHESIS: PANEL SURVEY EVIDENCE FROM ZAMBIA

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Outline

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- What is the 'new variant famine' (NVF) hypothesis?
- Why test the NVF hypothesis?
- Methods & data
- Results
- Conclusions
- Policy implications

The 'new variant famine' hypothesis (1)

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- Published by de Waal and Whiteside in 2003 during severe food crisis in southern Africa
- HIV prevalence rates highest in the world
- Agrarian communities not recovering from 2001-3 drought as well as they did from droughts in the early 1990s (before explosion of HIV/AIDS epidemic)
- **HIV/AIDS + drought + food crisis** could create **'new variant famine' (NVF)** in southern Africa (de Waal & Whiteside, 2003)

The 'new variant famine' hypothesis (2)

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- **Famines before AIDS epidemic** - expect communities to 'bounce back' after drought
- **New variant famines** - expect limited recovery after drought because HIV/AIDS:
  - Erodes the viability of agrarian livelihoods
  - Makes rural communities more sensitive and less resilient to drought and other shocks (de Waal & Tumushabe, 2003)
- **'Core' of the NVF hypothesis**: HIV/AIDS interacts with and exacerbates the effects of drought (de Waal, 2007)

Why test the NVF hypothesis?

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- High profile but controversial part of literature on HIV/AIDS and food crises (van Riet, 2007)
- Begun to influence HIV/AIDS mitigation and food security policies and programs (de Waal & Tumushabe, 2003)
- Evidence base thin; has not been directly tested empirically (de Waal, 2007)
- Strengthen the empirical foundation of HIV/AIDS mitigation and food security policies and programs

Our test of the NVF hypothesis

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- Use panel data from Zambia and econometric techniques to determine:

1. If HIV/AIDS is causing a decline in agricultural productivity (a key element of agrarian livelihoods)
2. If HIV/AIDS exacerbates the effects of drought on agricultural productivity

Outcome variables

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- District-level mean household area planted, crop output/ha, and crop output in 17 crops ("agricultural production indicators")
- Why district-level analysis?
  - NVF implications for HHs suffering AIDS-related illness/death ("afflicted" HHs) & broader communities
  - Burden of care in both afflicted & non-afflicted HHs rendering entire communities more vulnerable to shocks (de Waal and Whiteside, 2003)
  - EX) Asset pooling among HHs → even if only small percentage of HHs are directly afflicted, HIV/AIDS-effects would be transmitted more broadly through the community, so effects ought to be detectable at community level

Zambia as a test case of NVF

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- 72% of workforce in agriculture (2000 census)
- 15% HIV prevalence in 2007 - 7th highest in world
- Recurrent drought

Source: ILO

Empirical (supply response) models (1)

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(1) Area planted

$$\log AREA_{i,t} = \alpha + \gamma_1 \log P_{i,t-1}^{output} + \log \boldsymbol{p}_{i,t}^{\boldsymbol{inputs}} \boldsymbol{\gamma_2} + \boldsymbol{HIV}_{i,t}\boldsymbol{\delta_1} + \boldsymbol{HIV}_{i,t}^{2}\boldsymbol{\delta_2} + \boldsymbol{YEAR}_t\boldsymbol{\theta} + \lambda_i + \varepsilon_{i,t}$$

Lagged Divisia output price index; Input prices; Year dummies; Idiosyncratic error term; District; Year; Current & past HIV prev. rates (%); Unobserved time-invariant heterogeneity

(2) Crop output/ha

Index of crop output/ha; Same as Eq. (1)

$$\log Y_{i,t} = \alpha + \gamma_1 \log P_{i,t-1}^{output} + \log \boldsymbol{p}_{i,t}^{\boldsymbol{inputs}} \boldsymbol{\gamma_2} + \boldsymbol{HIV}_{i,t}\boldsymbol{\delta_1} + \boldsymbol{HIV}_{i,t}^{2}\boldsymbol{\delta_2} + \boldsymbol{YEAR}_t\boldsymbol{\theta} + \lambda_i + \varepsilon_{i,t}$$

$$+\omega_1 POS_{i,t} + \omega_2 POS_{i,t}^2 + \eta_1 NEG_{i,t} + \eta_2 NEG_{i,t}^2$$

Positive & negative rainfall shocks (% deviation from 16-year district mean)

$$+\boldsymbol{HIV}_{i,t} * POS_{i,t}\boldsymbol{\varphi_1} + \boldsymbol{HIV}_{it} * POS_{i,t}^2\boldsymbol{\varphi_2} + \boldsymbol{HIV}_{i,t} * NEG_{i,t}\boldsymbol{\phi_1} + \boldsymbol{HIV}_{i,t} * NEG_{i,t}^2\boldsymbol{\phi_2}$$

HIV prev.*rainfall shock interaction terms

Empirical (supply response) models (2)

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(3) Crop output = output/ha X area planted

- Deterministic relationship → use estimates from output/ha & area planted equations to recover effects of HIV, rainfall shocks, and interactions on crop output

Modeling HIV/AIDS dynamics

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- Lags between HIV+, illness, death, wider impact
- Current & past HIV/AIDS-related illness and death could be affecting agricultural production
- Use Almon lag to deal with multicollinearity

Data

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- Ag. production indicators, crop output prices, livestock prices: Zambia Post-Harvest Surveys
  - ~7,000 HHs/year, district-level panel (51 districts)
  - 14 years (1991-2004) X 51 districts = 714 obs.
- Fertilizer prices: Agricultural Marketing Info. Centre
- Wages, HIV prev. rates: Central Statistical Office
- Rainfall: rainfall stations in districts

Estimation

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- Allow for unobserved time invariant district-level heterogeneity (λ_i) to be correlated with explanatory variables → fixed effects estimator
- Evidence of serial correlation & heteroskedasticity→ robust standard errors

Models estimated

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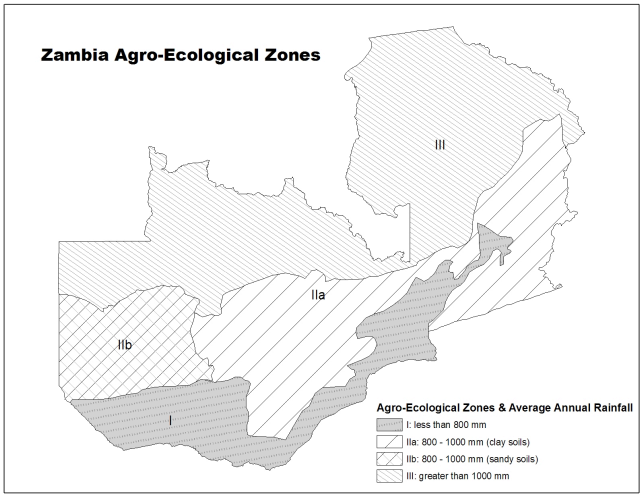
- **All districts**
- **Rainfall level:**
  - Low (≤1,000 mm)
  - High (>1,000 mm)
- **Land:labor ratio**
  - Low (≤1 ha/adult)
  - High (>1 ha/adult)



Results: Effects of HIV on ag. production (1)

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$$(4)\ \boxed{\partial \log AREA / \partial \boldsymbol{HIV}} = f(\boldsymbol{HIV};\ parameters)$$

$$(5)\ \boxed{\partial \log Y / \partial \boldsymbol{HIV}} = g(\boldsymbol{HIV},\ POS,\ NEG;\ parameters)$$

$$(6)\ \boxed{\frac{\partial \log OUTPUT}{\partial \boldsymbol{HIV}}} = [(1 + \frac{\partial \log Y}{\partial \boldsymbol{HIV}}) * (1 + \frac{\partial \log AREA}{\partial \boldsymbol{HIV}})] - 1$$

- Evaluate at:
  - Mean and high (90th percentile) HIV prevalence
  - Average rainfall (set *POS, NEG* = 0 in Eq. 5)
- Negative, stat. sig. effect ➔ HIV/AIDS having negative impact on ag. production indicator (as predicted by NVF)

Results: Effects of HIV on ag. production (2)

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		% change in ag. production indicator given a 1-percentage point increase in HIV prevalence	
Districts	**Ag. production indicator**	**Mean HIV prev.**	**High HIV prev.**
All districts	Crop output/ha	***-3.36 (p=0.10)***	***-4.69 (p=0.08)***
	Area planted	***4.34 (p=0.01)***	-2.18 (p=0.30)
	Crop output	0.83 (p=0.72)	***-6.77 (p=0.05)***

Significant at p≤0.10 level

Also find negative, stat. sig. effects of HIV/AIDS on:
- Area planted (high rainfall districts)
- Crop output/ha & crop output (low & high land-to-labor districts)

Results: Effects of HIV on impact of drought (1)

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$$(7)\quad \frac{\partial\left(\left|\frac{\partial \log Y}{\partial NEG}\right|\right)}{\partial \boldsymbol{HIV}} = l(NEG; parameters)$$

- Evaluate at mean, 75th pctl., & 90th pctl. of *NEG* ("moderate", "severe", & "extreme" drought)
- Negative, stat. sig. effect ➔ HIV/AIDS exacerbates the effect of drought on crop output/ha (as predicted by NVF)

Results: Effects of HIV on impact of drought (2)

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Districts (# of districts)	Percentage point change in drought (*NEG*) effect on crop output/ha given a 1-percentage point increase in HIV prevalence		
	Moderate drought	Severe drought	Extreme drought
All (N=51)	-0.11 (p=0.15)	-0.07 (p=0.17)	0.03 (p=0.71)
Low rainfall (N=25)	***-0.15 (p=0.07)***	0.02 (p=0.58)	***0.25 (p<0.01)***
High rainfall (N=26)	-0.04 (p=0.68)	-0.01 (p=0.91)	0.09 (p=0.34)
Low land-to-labor (N=32)	0.01 (p=0.88)	0.03 (p=0.51)	0.07 (p=0.44)
High land-to-labor (N=19)	-0.10 (p=0.35)	***-0.11 (p=0.09)***	***-0.15 (p=0.02)***

Significant at p≤0.10 level

- Could be due to relief/development activities in drought-prone areas/ during drought years → often target highly HIV/AIDS-affected areas (e.g., WFP) ➔ could decrease sensitivity to extreme drought shocks

Results: Effects of HIV on impact of drought (3)

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- How large in magnitude is the exacerbating effect?
  - EX) Moderate drought shock (10% *NEG*) in low rainfall districts

HIV prevalence	% change in output/ha given a 1-percentage point increase in the moderate drought shock
14% (mean)	-0.45%
15%	-0.60%
22% (90th percentile)	-1.72%

Conclusions

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1. In several models, a 1-percentage point increase in HIV prev. → 3-7% reduction in output/ha, crop output, and/or area planted
   - Consistent with NVF prediction that HIV/AIDS is eroding agrarian livelihoods
2. Evidence that HIV/AIDS exacerbates the effects of drought on crop output/ha, as predicted by NVF
   - "NVF-effects" only detected in **low rainfall** and **high land:labor** ratio districts

Policy implications

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- In period of analysis (1991-2004), **NVF**-type outcomes most likely in **high HIV prevalence**, **low rainfall**, and **high land:labor** ratio areas in Zambia
  - ➔ If this holds during future droughts, then drought relief interventions and programs/policies to reduce sensitivity to drought may be particularly needed there
- Even where no HIV/AIDS-drought interactions (i.e., high rainfall and low land:labor ratio areas), epidemic still negatively affecting agricultural production
  - ➔ HIV/AIDS prevention & mitigation policies and programs needed even in non-drought years and throughout the country

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Thank you. Questions?

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Hypothesized NVF pathways

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1. HIV/AIDS morbidity and mortality adversely affect dependency ratios and could result in labor shortages at the household level
2. Increased adult mortality disrupts the intergenerational transfer of skills and knowledge regarding effective livelihood coping strategies
3. Family and social networks are being stretched thin by the increased number of orphans and sick adults; essential assets are being sold to cover the costs of medicine, funerals, and caring for orphans
4. HIV/AIDS exacerbates malnutrition and vice versa (de Waal & Whiteside, 2003).

➔ HIV/AIDS makes high resilience famine coping strategies less available or even dangerous, and causes affected groups to resort to low resilience strategies that reduce the likelihood of recovery after shocks (de Waal and Tumushabe, 2003; de Waal and Whiteside, 2003; de Waal, 2007).

Trajectory of livelihood coping strategies

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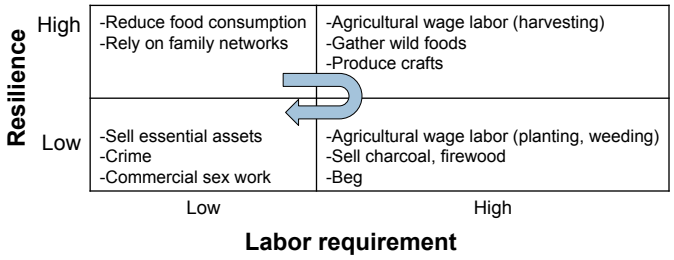

Source: de Waal & Tumushabe, 2003

Agrarian community responses to drought

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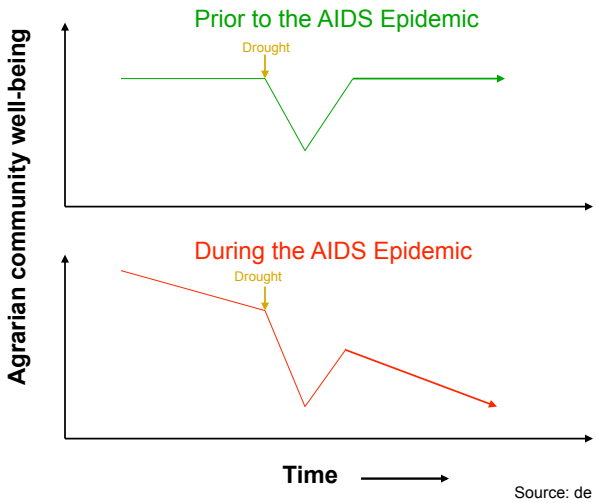

Source: de Waal & Tumushabe, 2003

Areas for further research (1)

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- Evaluate relative importance of four hypothesized pathways of NVF
- Impacts of HIV/AIDS, drought, and interactions on other measures of agrarian welfare, e.g., consumption or expenditure, off-farm income, or health and nutrition related outcomes.
- ART first publicly available in 2002; 7% coverage by 2004 but not available in vast majority of districts ➔ ART not widely available during period of analysis (1991-2004). As data become available, will be important to test for NVF effects when ART widely available.

Areas for further research (2)

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- Test for interactions between HIV/AIDS and "other shocks" e.g., has HIV/AIDS exacerbated the effects of the recent financial/economic crises?
- Is HIV/AIDS increasingly the variability/inequality of agricultural production outcomes and/or other indicators of agrarian welfare?