

Measuring Welfare Dynamics in Africa and Middle East Regions

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UNDESA Expert Group Meeting
New York, September 2018

Outline of Presentation

- Introduction/ Motivation
- Synthetic panel techniques
- Welfare dynamics in Africa & MENA regions
 - 21 African countries, accounting for two-thirds of Sub-Saharan African population
 - Both objective and subjective wellbeing data for MENA
 - objective data before 2010: 6 countries
 - subjective data span Arab Spring: 16 countries
 - Offer comparable cross-country analysis

Main Findings/ Africa

- The region saw
 - a 9 percent (a five-percentage points) reduction in poverty and a 28 per cent increase in the size of the middle class
 - the vulnerable category also grows by 12 per cent.
- Countries with pro-poor growth
 - Mauritania, Ethiopia, Togo, Swaziland, Malawi, Chad, Botswana, Ghana, Uganda, Congo DRC, Mozambique, Rwanda, Tanzania, and Sierra Leone
- Post-secondary education strongly associated with higher upward mobility and less downward mobility
 - holds true to some extent for female-headed and urban households
- Indicative evidence for more upward than downward mobility in most resource-rich and middle-income countries

Main Findings/ MENA

- Analysis based on expenditure data do not always align with that based on subjective data
 - Yemen and Egypt: rising poverty & unhappiness
 - Syria and Tunisia: decreasing poverty but increasing unhappiness
- Mobility for expenditure is mixed pre-2010
 - Upward mobility: Palestine, Tunisia, and Syria
 - Downward mobility: Yemen, Egypt, and Jordan
- Mobility for life satisfaction is not good during 2009-12
 - Downward mobility for most countries
 - Morocco is exception, with the unhappy population declining by more than a quarter.

I. Introduction/ Motivation (1)

- Panel data
 - often unavailable for developing countries, esp. low-income countries
 - Beegle et al. (2016) on Africa
 - if available, affected with various issues, incl. representativeness, attrition, measurement error
 - [example](#)
- Very few regional studies on welfare dynamics for Africa & MENA

I. Introduction/ Motivation (2)

- Synthetic panels
 - builds on pseudo-panel literature
 - recent statistical techniques to construct “panel” data from *two* (or more) rounds of repeated cross sections
 - absent panel data, provide estimates for poverty mobility and vulnerability dynamics
- Limitation: don’t allow causal analysis.

I. Introduction/ Background (3)

- Previous literature
 - seminal work by Deaton (1985, JoE) constructs pseudo-panels
 - subsequent work by Bourguignon et al. (2004), Güell and Hu (2006, JoE)
- Dang et al. (2014, JDE), Dang and Lanjouw (2013, 2018)
- Recent validations/ applications
 - Bosnia-Herzegovina, Indonesia, Lao PDR, Peru, the US and Vietnam Indonesia (IFLS) and Vietnam (VHLSS) (**Dang and Lanjouw, 2013 & 2018**)
 - EAP: Martinez et al (2013), Garbero (2014, JoDef), **Dang & Lanjouw (2017, RIW), Dang, Jolliffe & Carletto (2017), Urzanqui (2017)**
 - ECA: Bierbaum and Gassmann, (2012); Davalos and Sanchez-Paramo (2014); Cancho et al. (2015)
 - LAC: Ferreira et al. (2013); Cruces et al. (2015, JoEI); **Vakis et al. (2016), Perez (2016), Bourguignon, Moreno, and Dang (2018)*, Balcazar et al. (2018)**
 - SAS-MENA: **Dang & Ianchovichina (forthcoming, RIW); Dang & Lanjouw (in press, EDCC; 2018b)** for India
 - SSA: **Dang, Lanjouw & Swinkels (2017, chapter in OUP book); Dang & Dabalen (in press, JDS)**
 - and others, including **ADB, OECD, UNDP.....**

II. Synthetic Panels / Model (1)

Let x_{ij} be a vector of time-invariant household characteristics (e.g, ethnicity, religion, language) observed in both survey round j , $j= 1, 2$; $i= 1, \dots, N$.

Assume

$$y_{i1} = \beta_1' x_{i1} + \varepsilon_{i1} \quad (7)$$

$$y_{i2} = \beta_2' x_{i2} + \varepsilon_{i2} \quad (8)$$

Model assumptions:

[Examples](#)

1. Underlying populations (ie, x_i 's) being sampled in survey rounds 1 and 2 are the same.
2. ε_{i1} and ε_{i2} have a bivariate normal distribution with non-negative (partial) correlation coefficient ρ and standard deviations σ_{ε_1} and σ_{ε_2} respectively.

II. Synthetic Panels/ Model (2)

Let z_j be the poverty line in period j . We are interested in knowing such quantities as

$$P(y_{i1} < z_1 \text{ and } y_{i2} > z_2) \quad (9)$$

This can be estimated as

$$P(y_{i1} < z_1 \text{ and } y_{i2} > z_2) = \Phi_2 \left(\frac{z_1 - \beta_1' x_{i2}}{\sigma_{\varepsilon_1}}, -\frac{z_2 - \beta_2' x_{i2}}{\sigma_{\varepsilon_2}}, -\rho \right) \quad (10)$$

Given a vulnerability line v_j , we can analyze the dynamics for three income groups: poor, vulnerable, and middle class.

$$P(y_{i1} < z_1 \text{ and } z_2 < y_{i2} < v_2) = \Phi_2 \left(\frac{z_1 - \beta_1' x_{i2}}{\sigma_{\varepsilon_1}}, \frac{v_2 - \beta_2' x_{i2}}{\sigma_{\varepsilon_2}}, \rho \right) - \Phi_2 \left(\frac{z_1 - \beta_1' x_{i2}}{\sigma_{\varepsilon_1}}, \frac{z_2 - \beta_2' x_{i2}}{\sigma_{\varepsilon_2}}, \rho \right) \quad (11)$$

[Validation](#)

[Implementation](#)

[Extension](#)

II. Synthetic Panels/ Decomposition (3)

unconditional versions of poverty mobility

$$P(y_{i1} < z_1 \text{ and } y_{i2} < z_2) + P(y_{i1} < z_1 \text{ and } y_{i2} > z_2) = P(y_{i1} < z_1) \quad (2a)$$

$$P(y_{i1} < z_1 \text{ and } y_{i2} < z_2) + P(y_{i1} > z_1 \text{ and } y_{i2} < z_2) = P(y_{i2} < z_2) \quad (2b)$$

conditional versions of these equalities, conditional on household poverty status in *either* period

$$P(y_{i1} < z_1 \text{ and } y_{i2} < z_2 \mid y_{i1} < z_1) + P(y_{i1} < z_1 \text{ and } y_{i2} > z_2 \mid y_{i1} < z_1) = 1 \quad (3a)$$

$$P(y_{i1} < z_1 \text{ and } y_{i2} < z_2 \mid y_{i2} < z_2) + P(y_{i1} > z_1 \text{ and } y_{i2} < z_2 \mid y_{i2} < z_2) = 1 \quad (3b)$$

another conditional version, conditional on household poverty status in *both* periods

$$P(y_{i1} < z_1 \text{ and } y_{i2} < z_2 \mid y_{i1} < z_1 \text{ or } y_{i2} < z_2) + P(y_{i1} < z_1 \text{ and } y_{i2} > z_2 \mid y_{i1} < z_1 \text{ or } y_{i2} < z_2) + \\ + P(y_{i1} > z_1 \text{ and } y_{i2} < z_2 \mid y_{i1} < z_1 \text{ or } y_{i2} < z_2) = 1 \quad (4)$$

II. Vulnerability & Shared Prosp.

- Vulnerability to poverty approach consisting of three groups: poor, vulnerable, and middle class
 - [example](#)
 - [definition](#)
 - [estimating vulnerability line](#)
- Typology of pro-poor growth
 - [definition](#)

III. Estimation Results/ Africa

Table 3: Net and Gross Changes in Poverty over Time for Each Country (percentage)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No	Country	Headcount poverty in 1st period	Headcount poverty in 2nd period			Upward mobile	Net change
			Total	Decomposition			
				Chronic poverty	Downward mobile		
1	Mauritania	14.6	10.5	6.5	4.0	8.1	-4.0
2	Botswana	25.1	17.6	8.9	8.7	16.2	-7.5
3	Nigeria	19.8	21.5	11.7	9.8	8.1	1.7
4	Ghana	33.1	26.1	20.4	5.7	12.7	-7.0
5	Cote d'Ivoire	23.5	28.5	17.3	11.2	6.2	5.0
6	Cameroon	21.5	29.6	13.9	15.7	7.6	8.1
7	Ethiopia	38.8	37.2	28.6	8.6	10.2	-1.6
8	Senegal	37.2	39.0	29.5	9.5	7.7	1.8
9	Chad	64.2	40.7	24.8	15.9	39.4	-23.4
10	Swaziland	44.2	43.0	18.0	25.0	26.2	-1.3
11	Uganda	54.5	43.4	32.4	11.0	22.1	-11.1
12	Tanzania	54.1	48.8	27.6	21.2	26.5	-5.3
13	Togo	54.3	53.4	41.1	12.3	13.2	-0.9
14	Sierra Leone	58.4	53.5	37.8	15.7	20.6	-4.9
15	Burkina Faso	54.6	56.9	47.6	9.3	7.0	2.3
16	Rwanda	68.9	62.0	50.8	11.2	18.1	-6.9
17	Zambia	58.7	63.5	45.1	18.4	13.6	4.9
18	Mozambique	80.8	69.9	51.1	18.8	29.7	-11.0
19	Malawi	73.5	72.5	54.1	18.4	19.4	-1.1
20	Congo, DRC	91.7	78.0	72.8	5.2	18.9	-13.7
21	Madagascar	74.3	82.3	59.9	22.4	14.4	8.0
	Regional average	49.8	46.6	33.3	13.2	16.5	-3.2

Note: Authors' calculation based on household survey data. Household heads' age is between 25 and 5

Figure 1: Decomposition of Unconditional Poverty Mobility

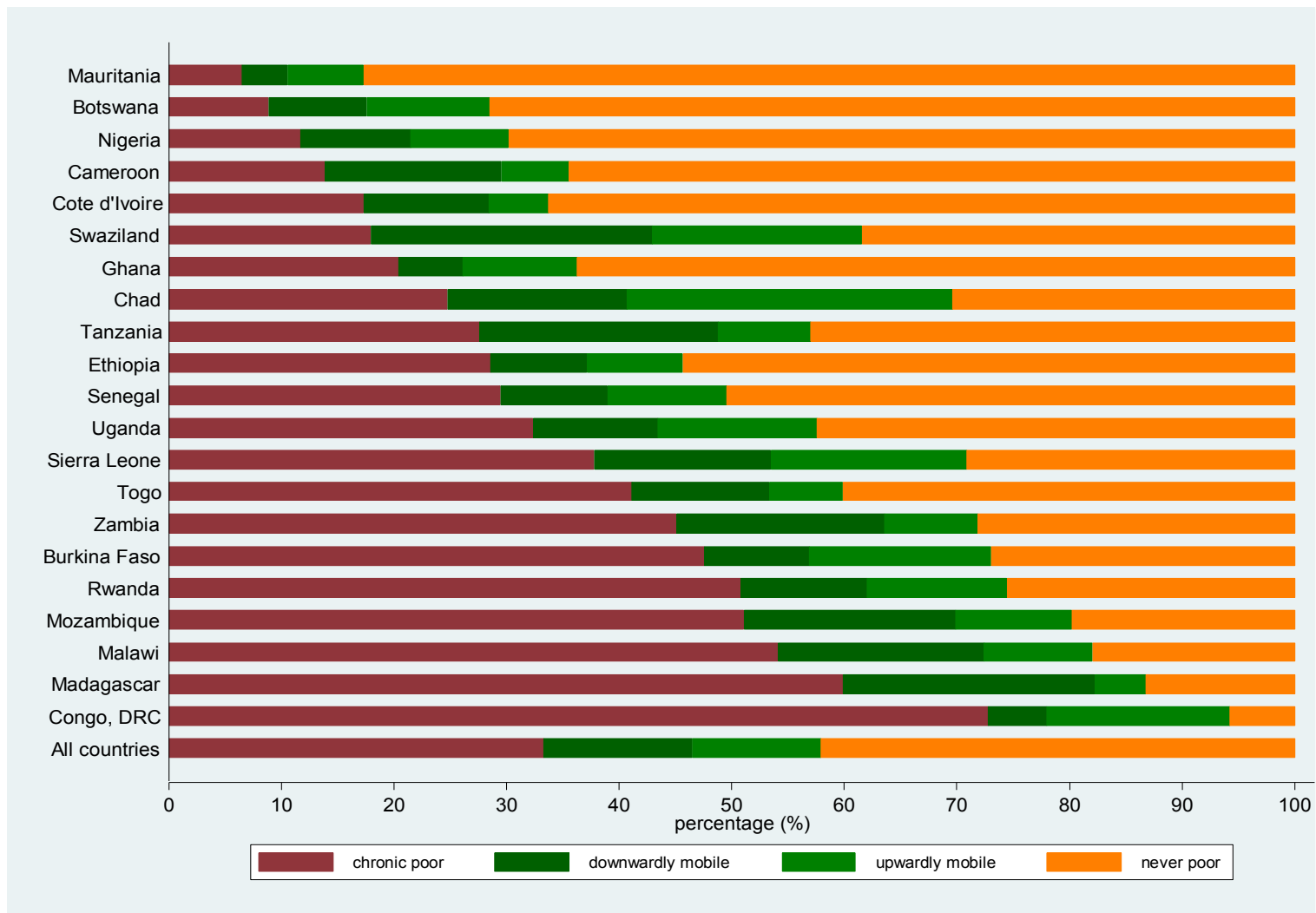


Figure 2: Proportions of Chronic Poverty, Downward Mobility, and Upward Mobility out of Those Who Were Ever Poor (percentage)

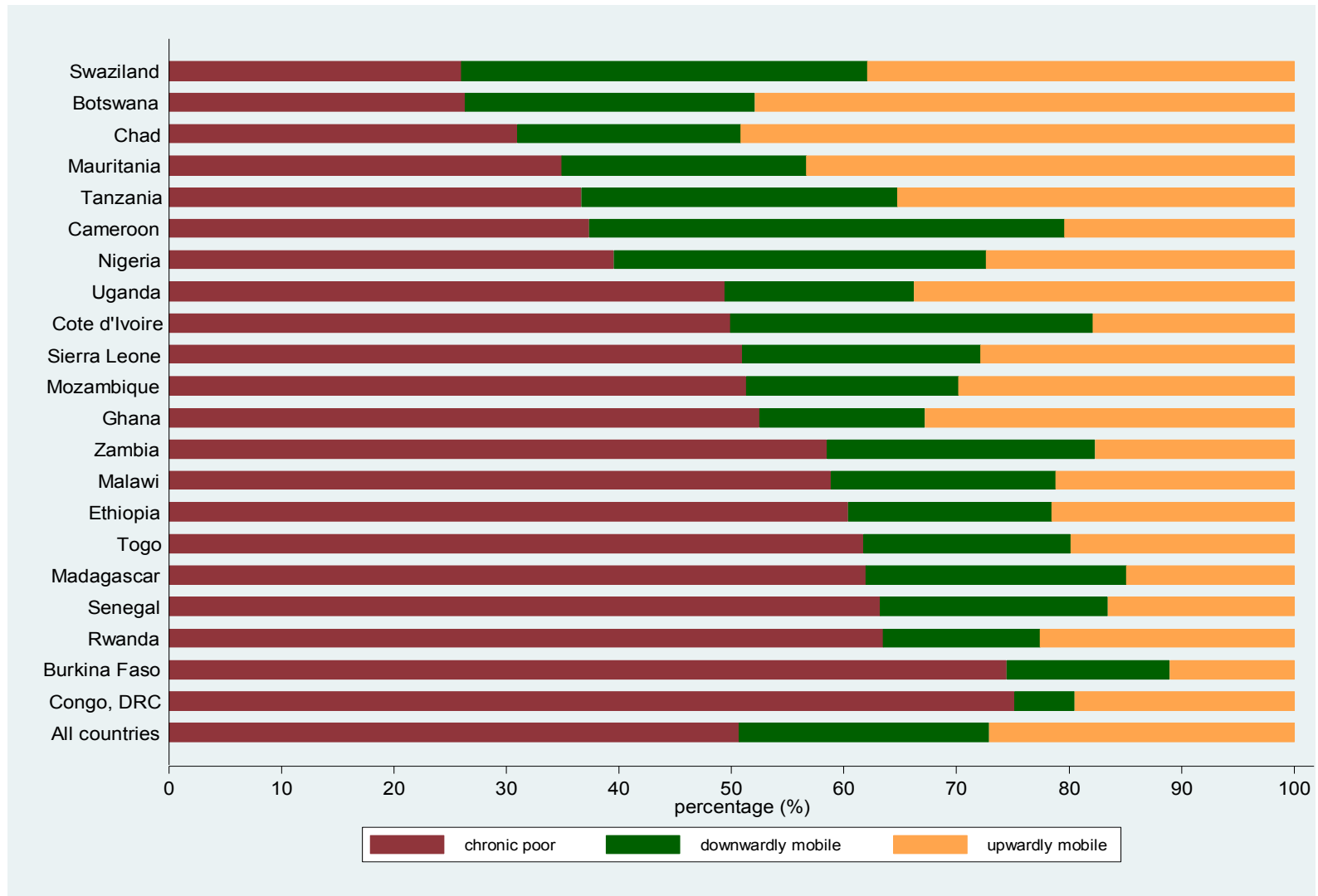


Table 4: Change in Poverty and Shared Prosperity for Each Country (percentage)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
No	Country	Growth in the population share of each welfare category			Pro-poor growth scenario	Growth in mean consumption for bottom 40% in each year
		Poor	Vulnerable	Middle class		
1	Mauritania	-27.7	-18.8	34.7	***	13.2
2	Ethiopia	-3.9	-1.2	26.7	***	-4.0
3	Togo	-1.4	-4.5	14.9	***	-7.8
4	Swaziland	-1.3	-1.3	4.0	***	-7.4
5	Malawi	-1.0	-3.8	28.4	***	-8.1
6	Chad	-36.1	42.6	192.1	**	35.3
7	Botswana	-28.7	6.6	12.5	**	28.9
8	Ghana	-20.7	4.4	21.7	**	14.9
9	Uganda	-19.1	26.3	24.9	**	21.3
10	Congo, DRC	-13.5	149.7	249.4	**	75.0
11	Mozambique	-12.6	70.0	30.9	**	20.9
12	Rwanda	-8.7	19.3	24.4	**	27.0
13	Tanzania	-6.7	10.5	3.6	**	14.6
14	Sierra Leone	-6.5	16.6	-6.7	*	14.9
15	Burkina Faso	6.3	-4.4	-18.0	--	7.6
16	Zambia	7.8	-12.0	-12.1	--	3.7
17	Madagascar	9.5	-32.5	-23.6	--	-5.6
18	Cote d'Ivoire	15.1	-5.3	-5.6	--	-3.4
19	Cameroon	34.5	-12.3	-8.9	--	-5.7
20	Senegal	0.9	3.3	-7.9	---	-3.1
21	Nigeria	5.5	1.4	-6.4	---	-1.7
	Regional average	-5.2	12.1	27.6	**	11.0

Note: Authors' calculation based on household survey data. Household heads' age is between 25 and 55

Table 5: Transition Dynamics among the Three Welfare Groups, All Countries (percentage)

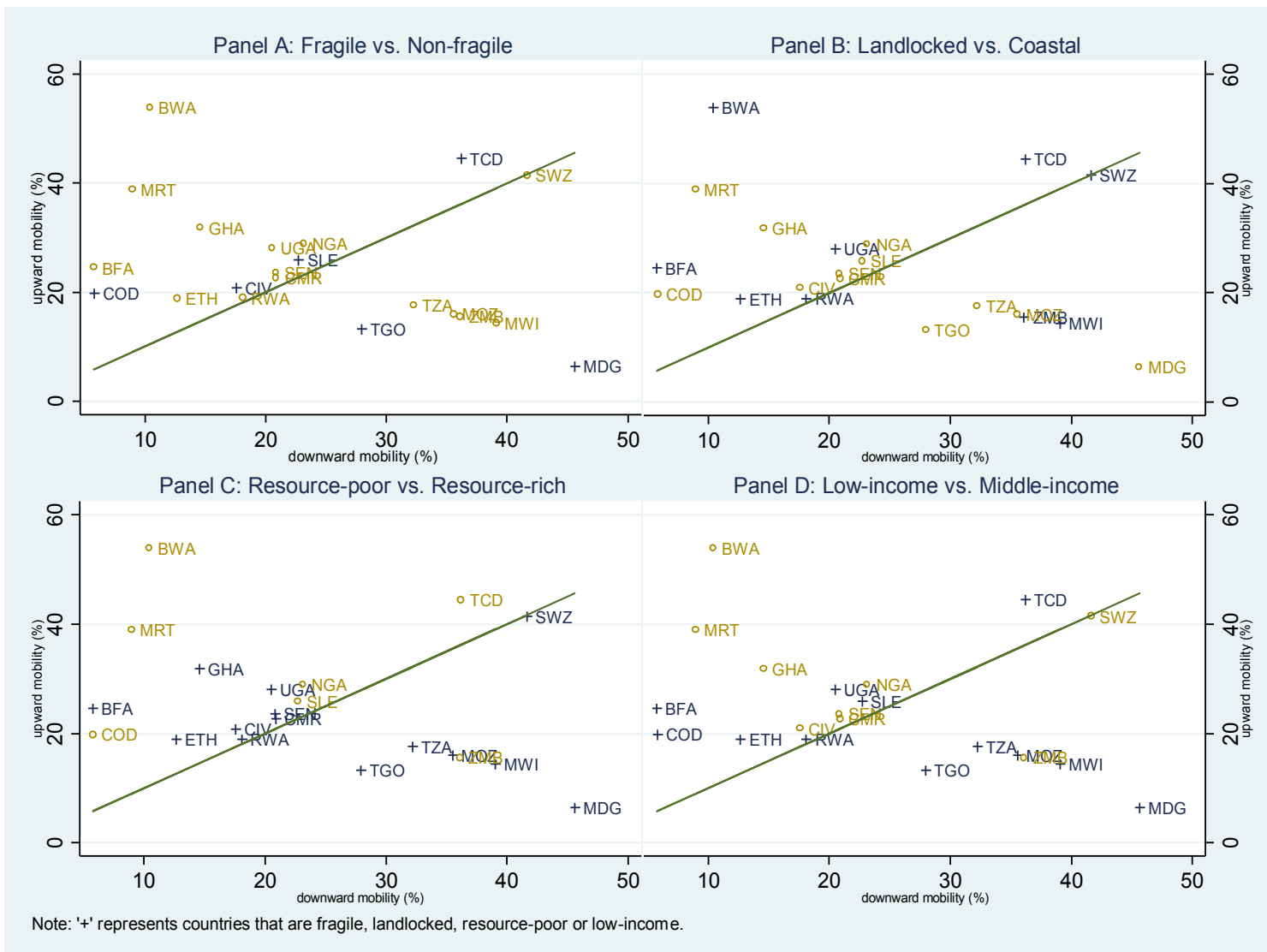
		Second year			
		Poor	Vulnerable	Middle class	Total
First year	Poor	35.9	8.0	0.1	44.0
		(0.1)	(0.0)	(0.0)	(0.1)
	Vulnerable	5.2	22.3	5.7	33.2
		(0.0)	(0.0)	(0.0)	(0.0)
	Middle class	0.1	4.3	18.4	22.8
		(0.0)	(0.0)	(0.1)	(0.1)
	Total	41.2	34.6	24.2	100
	(0.1)	(0.0)	(0.1)		

Note: Authors' calculation based on household survey data. Bootstrap standard errors in parentheses are estimated with 1,000 bootstraps. Household heads' age is between 25 and 55 in the first survey round and adjusted accordingly for the second survey round. The poverty line and vulnerability line are respectively set at \$1.9/day and \$4.3/day in 2011 PPP dollars for both periods, with the latter corresponding to a vulnerability index of 0.15. Estimates are obtained with synthetic panel data and weighted with population weights where the second survey round is used as the base year. Estimation sample size of the base year is 149,820 households.

Table 2.3: Transition Dynamics among the Three Welfare Groups for Each Country (percentage)

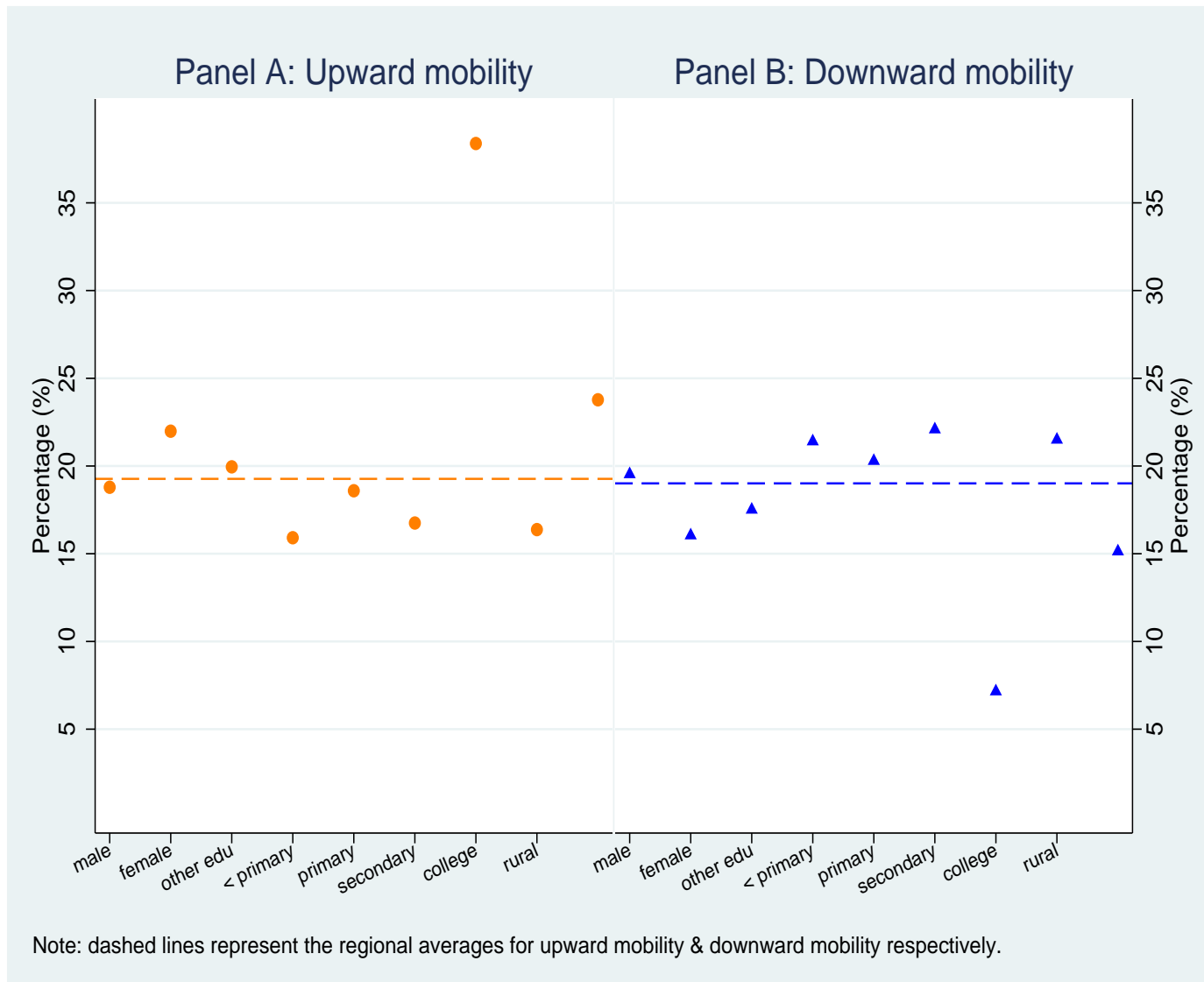
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No	Country	Proportion of the vulnerable		Proportion of the middle class		Overall downward mobility	Overall upward mobility
		remained in vulnerability	moved to middle class	fell to vulnerability	remained in middle class		
1	Botswana	37.1	53.1	9.8	89.3	10.4	53.9
2	Chad	41.5	29.3	36.8	46.7	36.2	44.5
3	Swaziland	34.6	30.8	29.8	51.1	41.6	41.5
4	Mauritania	59.2	34.6	10.9	89.0	8.9	38.9
5	Ghana	55.4	30.8	15.1	84.5	14.6	31.8
6	Nigeria	60.0	22.7	28.9	69.5	23.1	28.9
7	Uganda	56.3	25.0	22.6	76.0	20.5	28.1
8	Sierra Leone	64.5	17.0	36.8	61.7	22.7	25.8
9	Burkina Faso	72.4	22.6	8.1	91.9	5.7	24.5
10	Senegal	60.4	20.7	23.9	75.3	20.8	23.5
11	Cameroon	62.9	18.9	22.8	76.4	20.9	22.6
12	Cote d'Ivoire	63.7	19.3	17.7	81.9	17.6	20.9
13	Congo, DRC	61.0	33.7	10.1	89.9	5.8	19.8
14	Rwanda	66.3	17.0	20.7	78.9	18.1	19.0
15	Ethiopia	73.7	15.7	18.4	81.6	12.7	18.9
16	Tanzania	60.4	12.4	37.4	60.1	32.2	17.6
17	Mozambique	52.4	14.0	35.3	59.9	35.5	16.1
18	Zambia	47.3	15.9	29.5	64.9	36.1	15.6
19	Malawi	47.7	13.0	33.0	61.7	39.1	14.4
20	Togo	60.5	12.6	28.7	70.1	27.9	13.2
21	Madagascar	50.6	5.2	48.0	47.7	45.6	6.4
	Regional average	56.6	22.1	25.0	71.8	23.6	25.0

Figure 3: Upward Mobility and Downward Mobility by Country Groupings



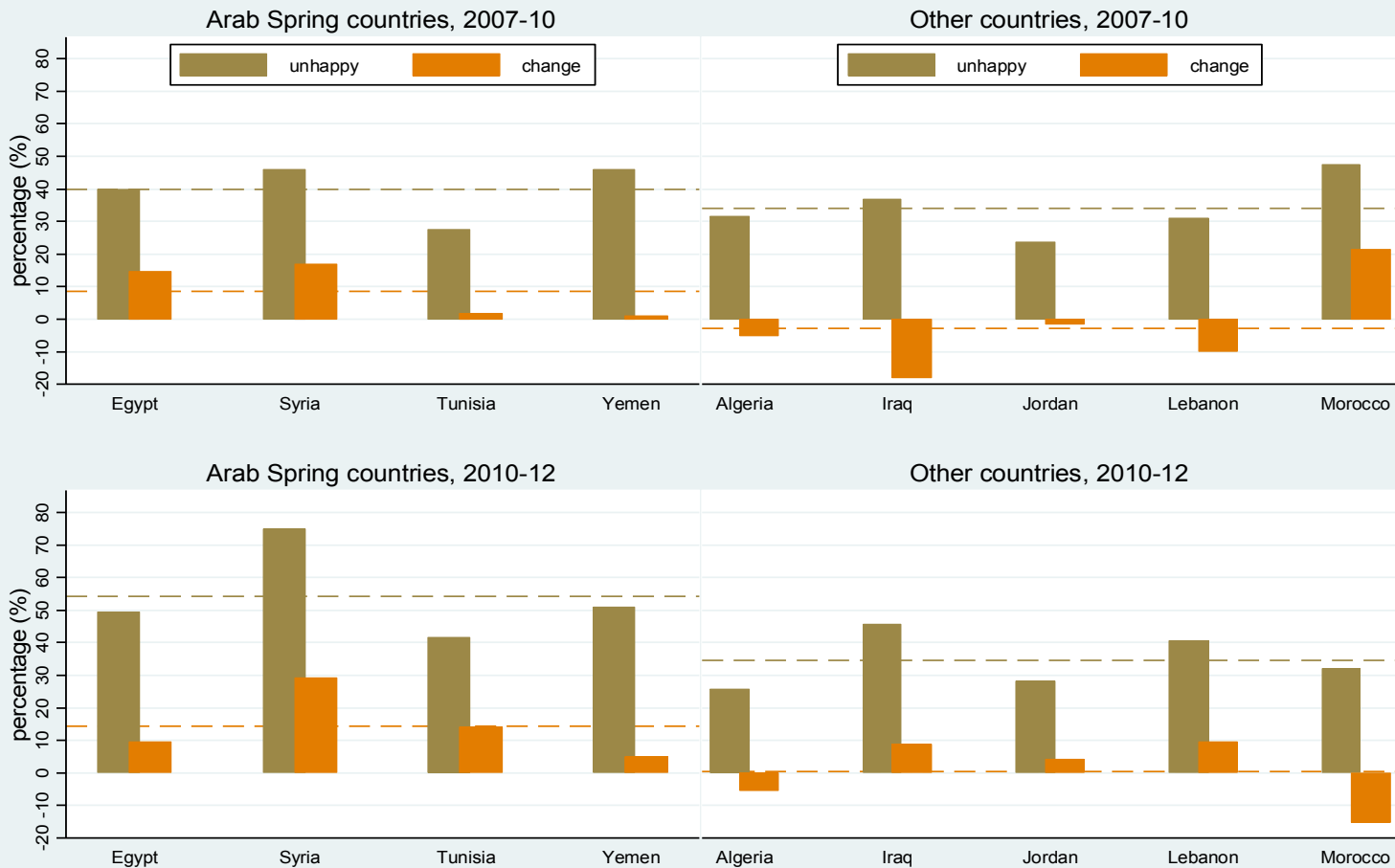
Grouping

Figure 4: Upward Mobility and Downward Mobility by Population Groups



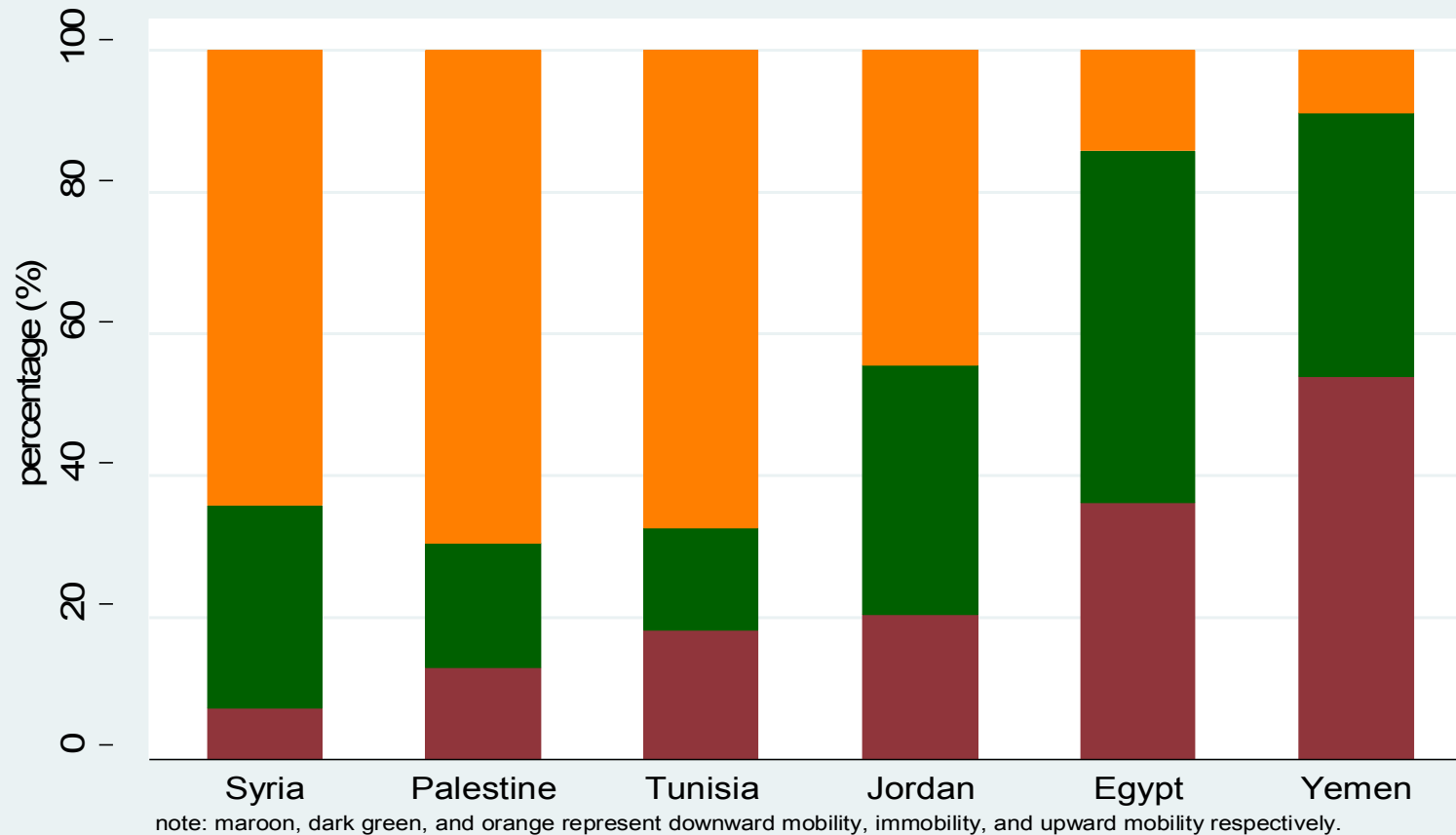
IV. Estimation Results/ MENA

Dissatisfaction Rates Increased in the Arab Spring countries prior to 2010 (%)

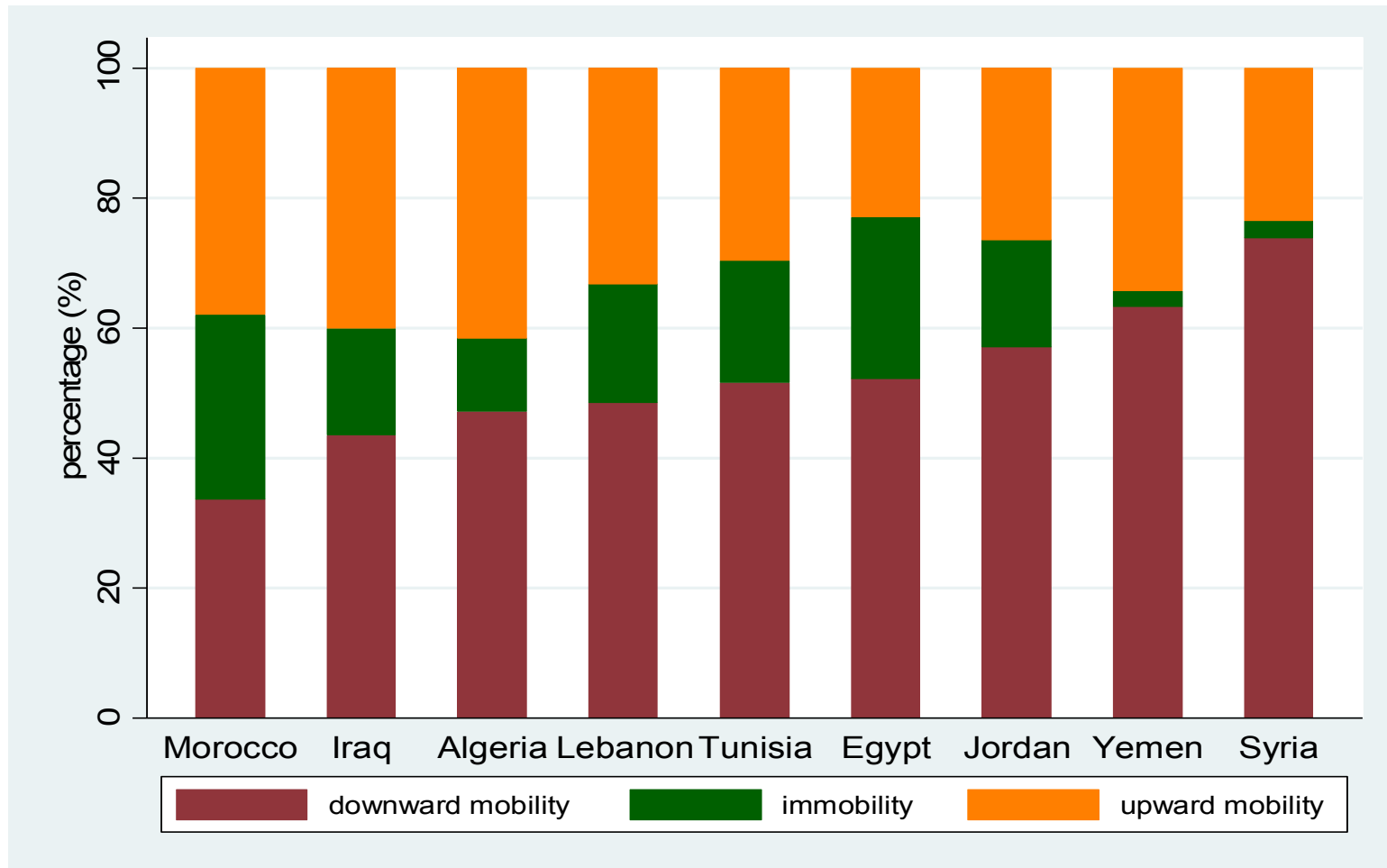


Note: dashed lines in dark brown and orange represent mean unhappiness rate and mean change respectively.

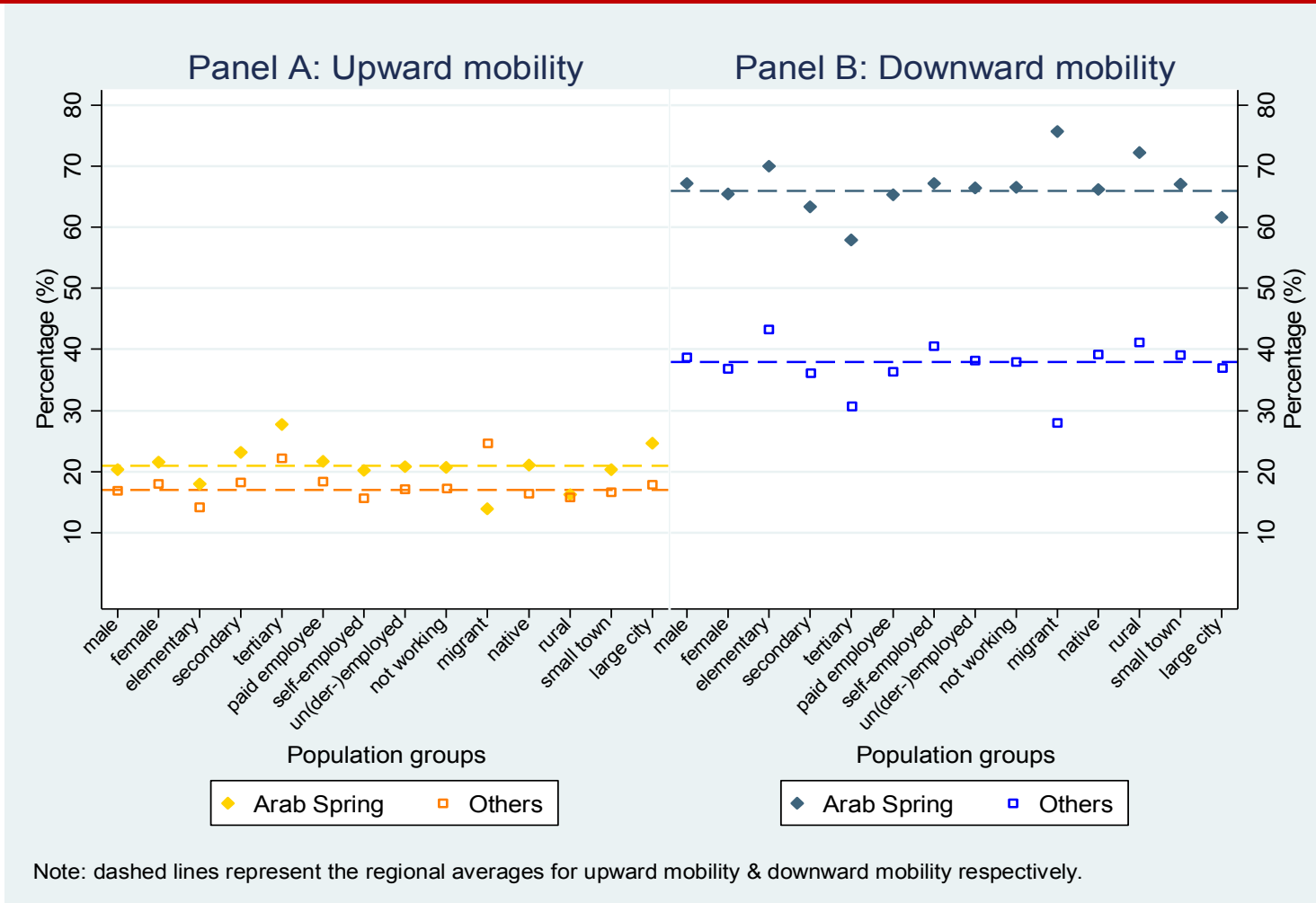
Welfare Dynamics Using Monetary Measures, Pre -2010



Subjective Well-being Dynamics, 2009-12



Subjective Well-being Dynamics by Type of Country and Population Group, 2007-2012



IV. Conclusion

-
- Promising results for tracking poverty mobility based on cross sections.
 - Africa shows good performance with mobility, even though chronic poverty remains high.
 - MENA
 - objective & subjective data can indicate different trends (e.g., Yemen and Egypt: rising poverty & unhappiness; Syria and Tunisia: decreasing poverty but increasing unhappiness)
 - Downward mobility with life satis. for most countries, with Morocco an exception
 - Policies can protect the poor and minimize downward mobility (eg. safety nets, investment in early childhood, health services).

Thank you

4. Population Share of Each Welfare Category (percentage)

Figure 2.1: Proportions of the Poor, the Vulnerable, and the Middle Class in Most Recent Year



5. Country Classifications

No	Country Name	Country code	Fragile Situations	Landlocked	Income grouping	Resource-poor
1	Botswana	BWA	No	Yes	Middle Income	No
2	Burkina Faso	BFA	No	Yes	Low Income	Yes
3	Cameroon	CMR	No	No	Middle Income	Yes
4	Chad	TCD	Yes	Yes	Low Income	No
5	Congo, Dem. Rep.	ZAR	Yes	No	Low Income	No
6	Cote d'Ivoire	CIV	Yes	No	Middle Income	Yes
7	Ethiopia	ETH	No	Yes	Low Income	Yes
8	Ghana	GHA	No	No	Middle Income	Yes
9	Madagascar	MDG	Yes	No	Low Income	Yes
10	Malawi	MWI	No	Yes	Low Income	Yes
11	Mauritania	MRT	No	No	Middle Income	No
12	Mozambique	MOZ	No	No	Low Income	Yes
13	Nigeria	NGA	No	No	Middle Income	No
14	Rwanda	RWA	No	Yes	Low Income	Yes
15	Senegal	SEN	No	No	Middle Income	Yes
16	Sierra Leone	SLE	Yes	No	Low Income	No
17	Swaziland	SWZ	No	Yes	Middle Income	Yes
18	Tanzania	TZA	No	No	Low Income	Yes
19	Togo	TGO	Yes	No	Low Income	Yes
20	Uganda	UGA	No	Yes	Low Income	Yes
21	Zambia	ZMB	No	Yes	Middle Income	No

[Back](#)

6. Sample Household Consumption Models

	Country											
	Cote d'Ivoire		Mozambique		Malawi		Senegal		Togo		Zambia	
	2002	2008	2002	2008	2004	2010	2005	2011	2006	2011	2006	2010
Head is female	0.054** (0.024)	0.029 (0.022)	0.097*** (0.023)	0.099*** (0.021)	0.024 (0.018)	0.096*** (0.020)	0.099*** (0.017)	0.263*** (0.025)	0.196*** (0.022)	0.157*** (0.029)	0.066*** (0.016)	0.123*** (0.016)
Head's age	-0.011*** (0.001)	-0.008*** (0.001)	0.002 (0.001)	0.005*** (0.001)	-0.005*** (0.001)	0.007*** (0.001)	-0.010*** (0.001)	-0.003** (0.001)	-0.007*** (0.001)	0.001 (0.001)	-0.010*** (0.001)	-0.004*** (0.001)
Head has less than primary school	0.147*** (0.032)	0.154* (0.083)	0.288*** (0.024)	0.090*** (0.024)	0.142*** (0.018)	0.253*** (0.022)	0.060*** (0.021)	0.077** (0.036)	0.137*** (0.025)	0.255*** (0.034)	0.169*** (0.026)	-0.000 (0.028)
Head completes primary school	0.184*** (0.023)	0.188*** (0.022)	0.693*** (0.047)	0.368*** (0.035)	0.232*** (0.023)	0.362*** (0.027)	0.141*** (0.022)	0.226*** (0.034)	0.216*** (0.029)	0.354*** (0.039)	0.327*** (0.043)	0.150*** (0.042)
Head completes secondary school	0.399*** (0.025)	0.428*** (0.022)	1.231*** (0.052)	0.879*** (0.042)	0.570*** (0.023)	0.715*** (0.028)	0.423*** (0.025)	0.444*** (0.039)	0.403*** (0.022)	0.520*** (0.030)	0.688*** (0.027)	0.472*** (0.028)
Head completes college	0.977*** (0.035)	0.896*** (0.044)	2.068*** (0.078)	1.742*** (0.064)	1.414*** (0.050)	1.448*** (0.046)	0.753*** (0.031)	0.909*** (0.053)	0.897*** (0.042)	1.179*** (0.055)	1.585*** (0.031)	1.421*** (0.030)
Urban	0.375*** (0.018)	0.451*** (0.018)	0.408*** (0.022)	0.366*** (0.020)	0.514*** (0.020)	0.707*** (0.023)	0.561*** (0.015)	0.482*** (0.023)	0.760*** (0.019)	0.617*** (0.024)	0.729*** (0.015)	0.655*** (0.015)
Constant	7.344*** (0.044)	7.161*** (0.048)	5.749*** (0.047)	5.811*** (0.056)	6.209*** (0.035)	5.478*** (0.047)	6.906*** (0.037)	6.573*** (0.062)	6.386*** (0.044)	5.932*** (0.063)	6.116*** (0.039)	5.991*** (0.042)
σ	0.77	0.78	0.75	0.77	0.59	0.67	0.62	0.670	0.61	0.69	0.78	0.77
Adjusted R2	0.20	0.18	0.29	0.24	0.28	0.35	0.28	0.26	0.43	0.34	0.47	0.46
ρ	0.87		0.75		0.66		0.78		0.82		0.69	
N	7976	8417	6171	6735	7627	6870	8811	4076	5431	3845	14360	13837
Estimates for chronic poverty using synthetic panels	17.3 (0.1)		51.1 (0.2)		54.1 (0.3)		29.5 (0.3)		41.1 (0.4)		45.1 (0.2)	

Note: *p<0.1, **p<0.05, ***p<0.01. Standard errors are in parentheses. Household heads' ages are restricted to between 25 and 55 for the first survey round and adjusted accordingly for the second survey round.

11. Est. Framework/ Shared Prosp.

- Vulnerability approach (Dang and Lanjouw, in press)
define $P = P(y_1 \leq Z_1 | Z_0 < y_0 < V_0)$
- Solve empirically for V_0 , given a set value for P (eg, 20%)

13. Est. Framework/ Shared Prosp.

- Typology of growth based on Dang and Lanjouw (2016)

Scenario	Pro-poor Growth	Welfare Category			Notes
		1st group	2nd group	3rd group	
		Lowest income	Middle income	Top income	
1	Strongest/ Most positive	-	-	+	first and second group reduce, and third group expands
2	More positive	-	+	+	first group reduces, and second and third group expand
3	Positive	-	+	-	first and third group reduce, and second group expands
4	Negative	+	-	+	first and third group expand, and second group reduces
5	More negative	+	-	-	first group expands, and second and third group reduce
6	Weakest/ Most negative	+	+	-	first and second group expand, and third group reduces

Note: The signs (-) and (+) respectively stand for decrease and increase. Pro-poor growth is defined as the dynamics that are most beneficial to the different categories in this order: Lowest Income, Middle Income, and Top Income. This typology is modified based on Dang and Lanjouw (2016).

14. Est. Framework/ Shared Prosp.

Table 1: Vulnerability Lines at Given Vulnerability Indexes for All Countries

No	Vulnerability index (%)	Vulnerability line (\$PPP)	Increase (%)	Pop. share with consumption above poverty line but less than V-line (%)
1	33	2.10	11	5
2	32	2.18	15	7
3	31	2.26	19	8
4	30	2.32	22	10
5	29	2.40	26	11
6	28	2.48	31	12
7	27	2.58	36	14
8	26	2.64	39	15
9	25	2.74	44	17
10	24	2.84	49	18
11	23	2.92	54	19
12	22	3.02	59	21
13	21	3.16	66	22
14	20	3.28	73	24
15	19	3.44	81	26
16	18	3.62	91	28
17	17	3.78	99	29
18	16	4.06	114	32
19	15	4.30	126	34
20	14	4.74	149	37
21	13	5.20	174	39
22	12	5.88	209	42
23	11	7.00	268	46
24	10	9.30	389	51

Note: Vulnerability lines are in 2011 PPP dollars per capita per day. The relative increases of the

Validation for other countries

Poverty Status	Bosnia- Herzegovina		Lao PDR		Peru		United States		Vietnam	
First Period--> Second Period	2001- 2004		2002/03- 2007/08		2005-06		2007-09		2006-08	
	Actual panel	Synthetic panel	Actual panel	Synthetic panel	Actual panel	Synthetic panel	Actual panel	Synthetic panel	Actual panel	Synthetic panel
Poor--> Poor	45.0 (4.6)	39.4 (1.2)	49.0 (3.0)	50.0 (1.6)	72.0 (1.9)	71.5 (1.0)	61.2 (2.2)	65.5 (2.0)	62.8 (2.8)	66.0 (1.5)
Poor--> Nonpoor	55.0 (4.6)	60.6 (1.7)	51.0 (3.0)	50.0 (1.1)	28.0 (1.9)	28.5 (0.3)	38.8 (2.2)	34.5 (0.9)	37.2 (2.8)	34.0 (0.6)
Nonpoor--> Poor	13.6 (1.8)	15.3 (0.2)	15.2 (1.3)	15.5 (0.3)	15.1 (1.3)	17.6 (0.2)	5.0 (0.4)	4.4 (0.1)	5.9 (0.6)	5.9 (0.1)
Nonpoor--> Nonpoor	86.4 (1.8)	84.7 (0.7)	84.8 (1.3)	84.5 (0.8)	84.9 (1.3)	82.4 (0.7)	95.0 (0.4)	95.6 (0.3)	94.1 (0.6)	94.1 (0.3)
<i>Goodness-of-fit Tests</i>										
Within 95% CI	4/4		4/4		4/4		2/4		4/4	
Within 1 standard error	2/4		4/4		2/4		0/4		2/4	
Mean coverage (percent)	100		100		79.5		66.6		96.8	
Coverage of 100%	4/4		4/4		2/4		2/4		3/4	
N	1342	1342	1989	3215	2250	9084	3368	3368	2723	3701

Source: Dang and Lanjouw (2013 & 2018a)

Validation using India's IHDS

Table 8: Welfare Transition Dynamics Based on Synthetic Panel Data, India 2004/05- 2011/12 (percentage)					
Panel A: Vulnerability line equals twice poverty line, IHDS actual panels		2011			
		Poor	Vulnerable	Middle class	Total
2004	Poor	13.0 (0.6)	19.3 (0.6)	6.1 (0.3)	38.4 (0.8)
	Vulnerable	6.7 (0.4)	20.3 (0.6)	16.0 (0.5)	43.0 (0.7)
	Middle class	1.2 (0.1)	5.6 (0.3)	11.9 (0.5)	18.7 (0.6)
	Total	20.9 (0.7)	45.2 (0.7)	33.9 (0.8)	100
Panel B: Vulnerability line equals twice poverty line, IHDS synthetic panels		2011			
		Poor	Vulnerable	Middle class	Total
2004	Poor	15.1 (0.2)	16.7 (0.2)	5.9* (0.1)	37.7* (0.4)
	Vulnerable	7.1* (0.0)	19.3 (0.1)	15.9* (0.1)	42.3* (0.2)
	Middle class	1.1* (0.0)	6.1 (0.1)	12.9 (0.2)	20.0 (0.3)
	Total	23.3 (0.2)	42.1 (0.1)	34.6 (0.3)	100
Note: Bold font indicates the estimate falls within the 95% CI of the actual estimate; a start ("*") indicates the estimate falls within one standard error of the actual estimate.					

Source: Dang and Lanjouw (2018b)

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Implementation/ Roadmap

Step 1: Estimate equations (1) and (2) and obtain the predicted coefficients $\hat{\beta}_1'$, $\hat{\beta}_2'$, the predicted standard error $\hat{\sigma}_{\varepsilon_1}$ and $\hat{\sigma}_{\varepsilon_2}$ using survey round 1 and 2 respectively.

Step 2: Estimate the cohort-level simple correlation coefficient $\hat{\rho}_{y_{i1}y_{i2}}$, then calculate $\hat{\rho}$ using Proposition 2.

Step 3: Calculate absolute quantities of poverty mobility as

$\Phi_2 \left(d_1 \frac{z_1 - \hat{\beta}_1' x_{ij}}{\hat{\sigma}_{\varepsilon_1}}, d_2 \frac{z_2 - \hat{\beta}_2' x_{ij}}{\hat{\sigma}_{\varepsilon_2}}, \hat{\rho}_d \right)$, where d_j is an indicator function that equals 1 if the

household is poor and equals -1 if the household is non-poor in period j , $j= 1, 2$, and

$\hat{\rho}_d = d_1 d_2 \hat{\rho}$. Calculate the standard errors using Proposition 3.

Step 4: (If relevant) Calculate the relative quantities of poverty mobility for period j as

$\frac{\hat{\Phi}_2 \left(d_1 \frac{z_1 - \hat{\beta}_1' x_{ij}}{\hat{\sigma}_{\varepsilon_1}}, d_2 \frac{z_2 - \hat{\beta}_2' x_{ij}}{\hat{\sigma}_{\varepsilon_2}}, \hat{\rho}_d \right)}{\hat{P}}$. Calculate the standard errors using Corollary 3.1. [Back](#)

Table 1: Examples of Recent Household Consumption Surveys

No	Country	Survey	Panel Data	Main Data Source for Poverty	Survey Years	Main Host Agency
1	China					
1.1		China Household Income Project (CHIP)	No	Yes	2002, 2007, 2013	Beijing Normal University
1.2		Chinese Family Panel Studies (CFPS)	Yes	No	2010, 2012, 2014, 2016	Peking University
2	Ethiopia					
2.1		Household Consumption Expenditure Survey (HCE)	No	Yes	2000, 2004, 2011, 2016	Central Statistical Agency
2.2		Ethiopia Socioeconomic Survey (ERSS)	Yes	No	2011/12*, 2013/14, 2015/16	World Bank's Survey Unit & Central Statistical Agency
3	India					
3.1		National Sample Survey (NSS)	No	Yes	2004/05, 2009/10, 2011/12	National Sample Organization
3.2		India Human Development Survey (IHDS)	Yes	No	2004/05, 2011/12	University of Maryland
4	Indonesia					
4.1		National Socio-Economic Survey (SUSENAS)	No	Yes	2000-2017 (annually)	Directorate of Social Welfare and Education Statistics
4.2		Indonesian Family Life Survey (IFLS)	Yes	No	2000*, 2007/08*, 2014/15*	Rand Corporation
5	Vietnam	Vietnam Household Living Standards Survey (VHLS)	Yes	Yes	2002-present (biennially)	General Statistical Office

Note: Dang and Carletto (2018). A star "*" sign on the survey year indicates that the data for that year are not nationally representative. We restrict the sample to surveys that were implemented in 2000 or later and that are publicly available.

Further extensions to kxk transition matrix

Proposition 5- Asymptotic results for point estimates for mobility between different groups for two periods

Given the same assumptions in Proposition 3, let P^{lm} represent household i 's ($i=1, \dots, N$) probability of moving from consumption group l in period 1 to consumption group m in period 2, that is $P^{lm} = P(z_1^{l-1} < y_{i1} < z_1^l \text{ and } z_2^{m-1} < y_{i2} < z_2^m)$, where $l, m= 1, \dots, k$, and the z_j are the thresholds that separate the different consumption groups, with $z_j^0 = -\infty$ and $z_j^k = \infty$, for period $j, j= 1, 2$. Defining

$F^{l,m}$ as $\Phi_2\left(\frac{z_1^l - \beta_1' x_{ij}}{\sigma_{\varepsilon_1}}, \frac{z_2^m - \beta_2' x_{ij}}{\sigma_{\varepsilon_2}}, \rho\right)$, and the $(\hat{\cdot})$ sign represent the estimate, our point estimates are

distributed as

$$\sqrt{n}\left[P^{lm} - (\hat{F}^{l,m} - \hat{F}^{l,(m-1)} - \hat{F}^{(l-1),m} + \hat{F}^{(l-1),(m-1)})\right] \sim N(0, V)$$

Sample Household Consumption Models

	Country											
	Cote d'Ivoire		Mozambique		Malawi		Senegal		Togo		Zambia	
	2002	2008	2002	2008	2004	2010	2005	2011	2006	2011	2006	2010
Head is female	0.054**	0.029	0.097***	0.099***	0.024	0.096***	0.099***	0.263***	0.196***	0.157***	0.066***	0.123***
	(0.024)	(0.022)	(0.023)	(0.021)	(0.018)	(0.020)	(0.017)	(0.025)	(0.022)	(0.029)	(0.016)	(0.016)
Head's age	-0.011***	-0.008***	0.002	0.005***	-0.005***	0.007***	-0.010***	-0.003**	-0.007***	0.001	-0.010***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Head has less than primary school	0.147***	0.154*	0.288***	0.090***	0.142***	0.253***	0.060***	0.077**	0.137***	0.255***	0.169***	-0.000
	(0.032)	(0.083)	(0.024)	(0.024)	(0.018)	(0.022)	(0.021)	(0.036)	(0.025)	(0.034)	(0.026)	(0.028)
Head completes primary school	0.184***	0.188***	0.693***	0.368***	0.232***	0.362***	0.141***	0.226***	0.216***	0.354***	0.327***	0.150***
	(0.023)	(0.022)	(0.047)	(0.035)	(0.023)	(0.027)	(0.022)	(0.034)	(0.029)	(0.039)	(0.043)	(0.042)
Head completes secondary school	0.399***	0.428***	1.231***	0.879***	0.570***	0.715***	0.423***	0.444***	0.403***	0.520***	0.688***	0.472***
	(0.025)	(0.022)	(0.052)	(0.042)	(0.023)	(0.028)	(0.025)	(0.039)	(0.022)	(0.030)	(0.027)	(0.028)
Head completes college	0.977***	0.896***	2.068***	1.742***	1.414***	1.448***	0.753***	0.909***	0.897***	1.179***	1.585***	1.421***
	(0.035)	(0.044)	(0.078)	(0.064)	(0.050)	(0.046)	(0.031)	(0.053)	(0.042)	(0.055)	(0.031)	(0.030)
Urban	0.375***	0.451***	0.408***	0.366***	0.514***	0.707***	0.561***	0.482***	0.760***	0.617***	0.729***	0.655***
	(0.018)	(0.018)	(0.022)	(0.020)	(0.020)	(0.023)	(0.015)	(0.023)	(0.019)	(0.024)	(0.015)	(0.015)
Constant	7.344***	7.161***	5.749***	5.811***	6.209***	5.478***	6.906***	6.573***	6.386***	5.932***	6.116***	5.991***
	(0.044)	(0.048)	(0.047)	(0.056)	(0.035)	(0.047)	(0.037)	(0.062)	(0.044)	(0.063)	(0.039)	(0.042)
σ	0.77	0.78	0.75	0.77	0.59	0.67	0.62	0.670	0.61	0.69	0.78	0.77
Adjusted R2	0.20	0.18	0.29	0.24	0.28	0.35	0.28	0.26	0.43	0.34	0.47	0.46
ρ	0.87		0.75		0.66		0.78		0.82		0.69	
N	7976	8417	6171	6735	7627	6870	8811	4076	5431	3845	14360	13837
Estimates for chronic poverty using synthetic panels	17.3		51.1		54.1		29.5		41.1		45.1	
	(0.1)		(0.2)		(0.3)		(0.3)		(0.4)		(0.2)	

Note: *p<0.1, **p<0.05, ***p<0.01. Standard errors are in parentheses. Household heads' ages are restricted to between 25 and 55 for the first survey round and adjusted accordingly for the second survey round.

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