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The changing balance between formal and informal old-age care in Spain. Results from a mixed microsimulation and agent-based model.

Jeroen Spijker, Daniel Devolder, Pilar Zueras*

Centre for Demographic Studies, Barcelona, Spain

*Twitter: @popageing

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Context: General

Population ageing: ↑ longevity and the size of cohorts that reach old age are factors that shape **care demand** as it increases the overall prevalence of disability, its severity and the probability of help being required to carry out activities of daily living (ADLs).

Reduction in family size: The decline in the number of children that women have and the increasing proportion of women who remain childless may put the current system of **care supply** at risk.

The increase in female labor force participation (while they provide 75% of informal care for older people in the case of Spain).

Policy: Ageing in Place (general); right to request **flexible work arrangements** (NZ); A change in the **System for Autonomy and Attention to Dependency** via the Dependency Act of 2006 (Spain).



Context: SPAIN

- **Life expectancy increase at older ages**
(LE65 in 1908 ♂ 10 yrs/ ♀ 11 yrs; 1958 13/15 yrs; 2018 19/23 yrs)
and persistent below replacement fertility
(since 1981 TFR below 2.1 and is currently 1.3)
accelerating population ageing
 - last 30 years number 65+ has doubled
 - increasing demand for health and social care
- **Elderly care is still mainly a family affair**
 - but family structures are changing due to fewer offspring and increasing divorce rates & ♀ LFP has rapidly increased.
(In 1996 36% of women aged 20-64 were employed vs 58% in 2016)



Research objectives and questions

▶ **Objective:** To study the changing balance between formal and informal old-age care in Spain

▶ **Method:** We do this by using a mixed micro simulation-agent-based model

▶ **Research questions:**

- ▶ what are the **determinants** of **informal** (family) **care supply**?
 - Effect of demographic change on elderly kinship networks
 - How have family care dynamics changed?
- ▶ what is the **share** of **informal** care in the **total demand of care hours needed** by elderly people



The 2008 Survey on Disabilities, Personal Autonomy and Situations of Dependency (EDAD)

- To obtain age-, sex- and education-specific levels of dependency and transition probabilities to higher states of dependency (4 CARE DEMAND)
- To estimate hours of care

Spanish Labour Force Survey

- To obtain age-, sex- and education-specific levels of labour force participation and transition from one employment status to another (4 CARE SUPPLY)



DEMOCARE

- **Mixed model**
 - a classical **microsimulation of kinship** is used to create a population of kin
 - an **Agent-Based-Model (ABM)** determines the needs of hours of care by elderly people and the amount that can be supplied by their kin
- Seven different Spanish birth cohorts are compared (1908, 1918, ..., 1968)
- Employment activity and health conditions are for the year 2008



Method: Step 1

A Microsimulation Model of Kinship creates an initial set of Agents (1)

- Our Microsimulation Model of Kinship, developed in Object Pascal by Devolder (2002), is similar to CAMSIM (Cambridge Simulator), which in turn is derived from Le Bras' (1982) BACKFOR. In fact, it is so close to Le Bras' model, that we name it **BACKFOR2**.
- **BACKFOR2** is used to create a group of persons from the same birth cohort named 'egos'
 - Each ego has a complete network of living kin (partner, siblings, children and their partners, grandchildren) who are all possible **care providers** and who age with egos
 - We follow the egos and their kin as they age from 50 until death

Devolder, D. 2002. "Effects of the European late marriage pattern on kinship. A study using a microsimulation model." In *When dad died. Individuals and Families Coping with Family Stress in Past Societies*, edited by R Derosas and M Oris, 325-350. Bern: Peter Lang.

Le Bras, H. (1982) "Evolution des liens de famille au cours de l'existence", in INED (ed.), *Les âges de la vie. Actes du colloque national de démographie*, volume 1, Paris, INED - Presses Universitaires de France: 27-45.



Method: Step 1

A Microsimulation Model of Kinship creates an initial set of Agents (2)

Demographic indicators of 7 Spanish birth cohorts

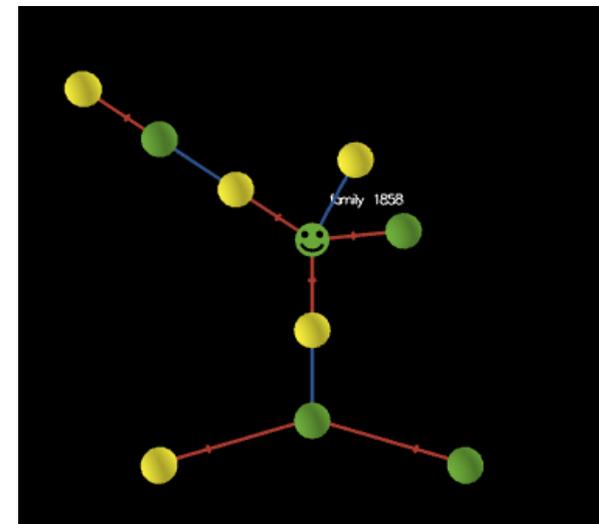
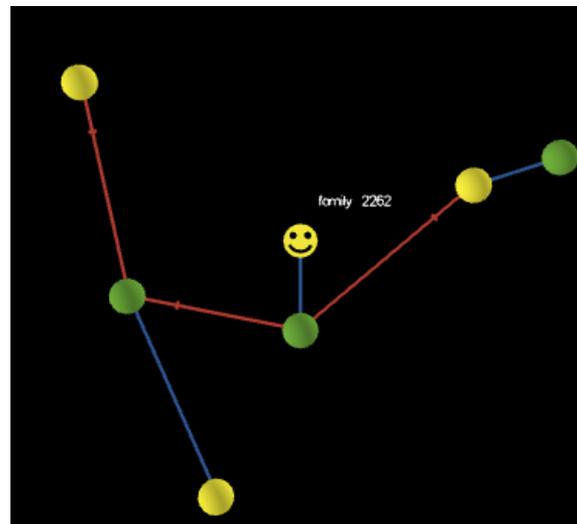
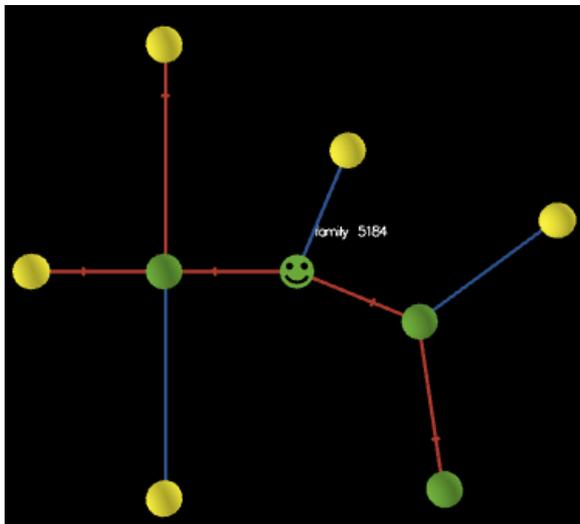
Cohort	Total Fertility Rate	Age at first marriage	Parity progression ratios			Life Expectancy at birth	
			First child	Second child	Third and + child	Women	Men
1908	2.74	26.5	0.75	0.87	0.67	52	49
1918	2.54	27.0	0.78	0.83	0.62	55	51
1928	2.52	26.5	0.82	0.85	0.59	60	55
1938	2.60	25.8	0.86	0.89	0.56	65	61
1948	2.27	25.5	0.87	0.88	0.45	72	69
1958	1.82	27.0	0.85	0.80	0.31	78	76
1968	1.53	29.0	0.79	0.73	0.22	85	83



Method: Step 1

A Microsimulation Model of Kinship creates an initial set of Agents (3)

Around 10 000 agents are created (**egos**), each one with a network of close kin (for a total population of around 60 000 persons)



women



men



marriage



offspring



Method: Step 2

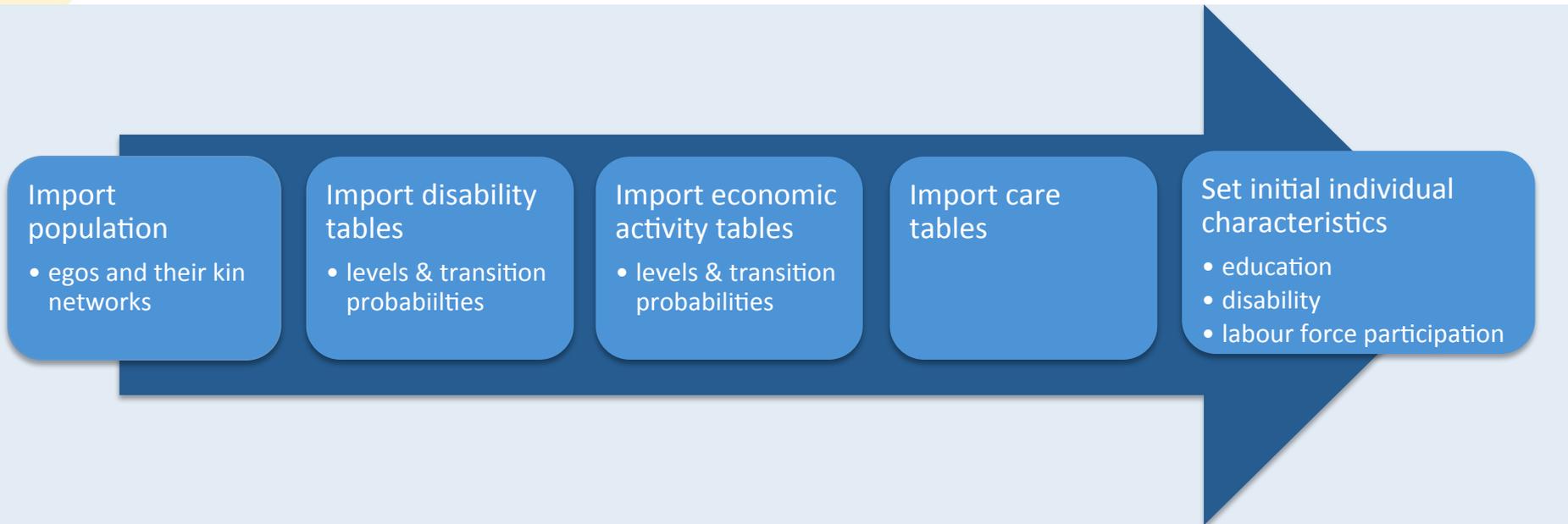
ABM follows agents from age 50 until their death (1)

- Agent-Based-Model written in NetLogo
- Setup phase: read kin networks, disability and economic activity tables,...
- Update phase: at each tick (year):
 - individuals are exposed to competing risks:
 - of falling into a higher disability state
 - of transition towards other states of labour force participation
 - The demand (needs) for hours of care of disabled egos and the supply of informal care available in the kin network is evaluated at each tick
- End phase: the last ego alive dies



Method: Step 2

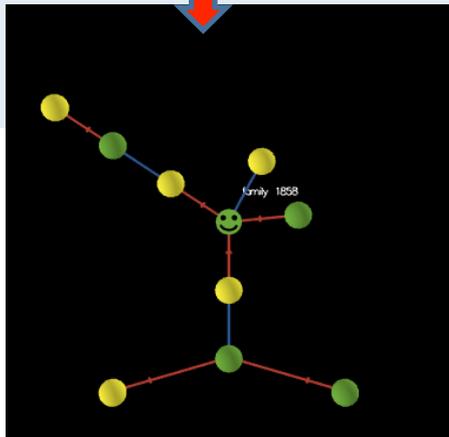
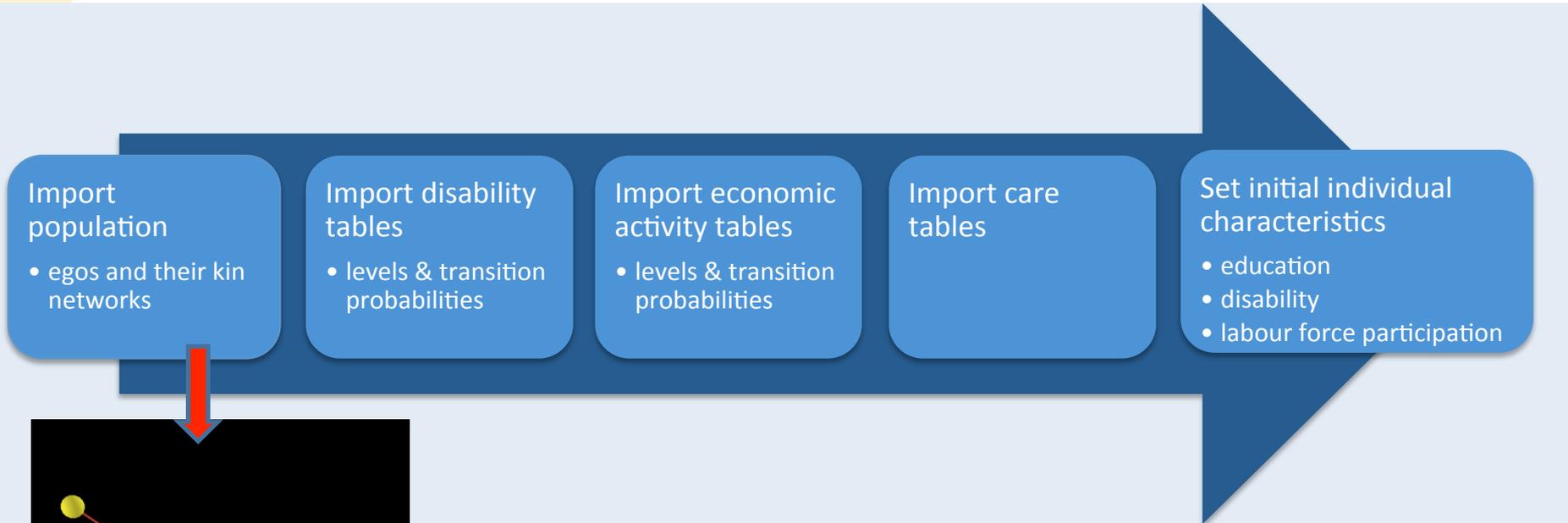
ABM follows agents from age 50 until their death (2): setup phase





Method: Step 2

ABM follows agents from age 50 until their death (2): setup phase



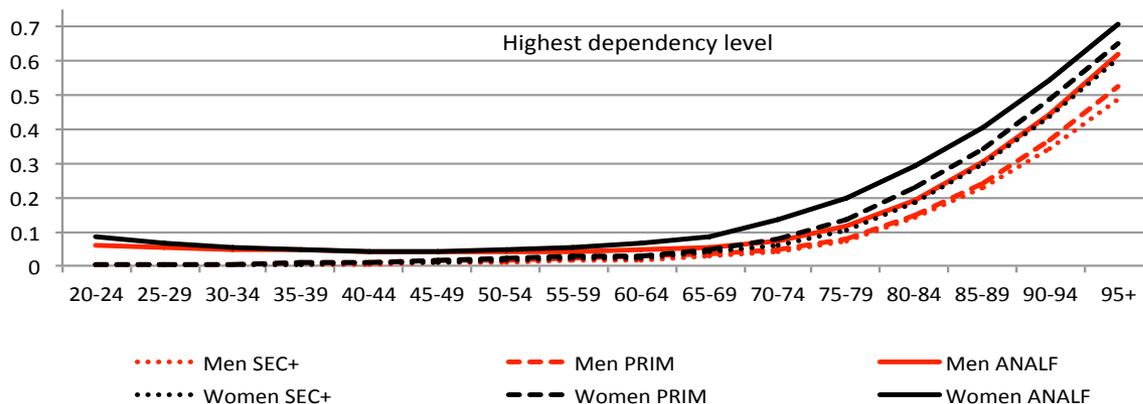


Method: Step 2

ABM follows agents from age 50 until their death (2): setup phase



Figure 1. Proportion of men and women in the highest state of dependency, by age and by educational level, according to the 2008 Spanish Survey of Disability





Method: Step 2

ABM follows agents from age 50 until their death (2): setup phase

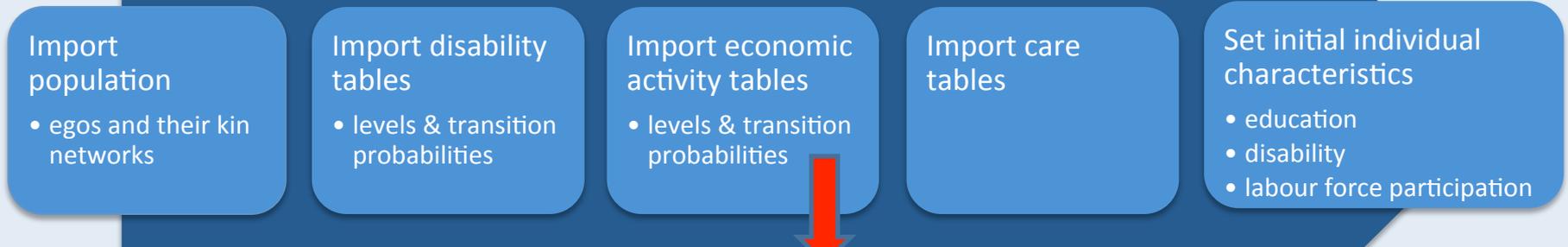


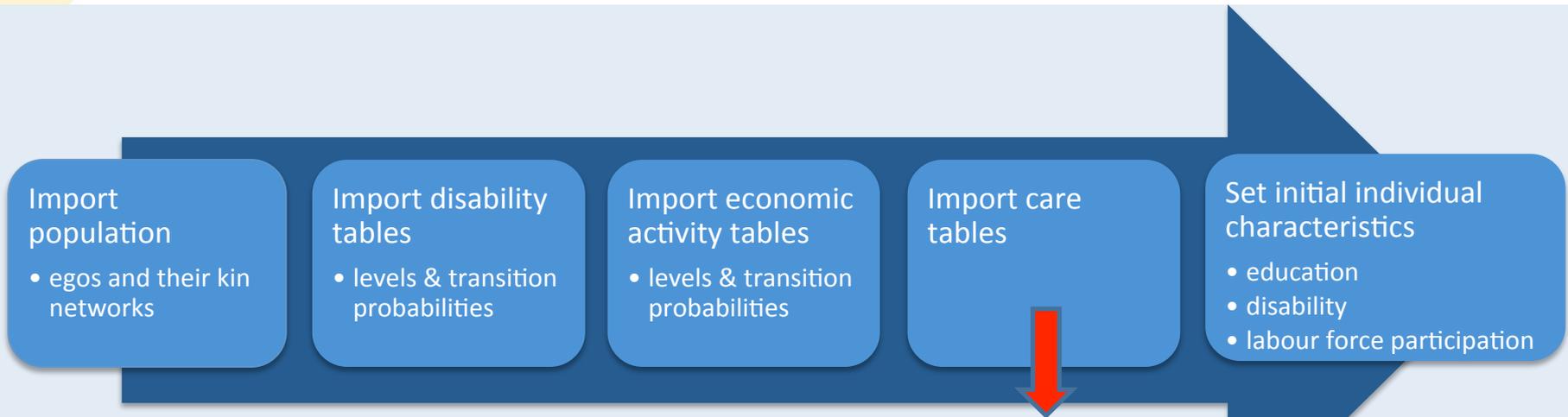
Table 1. Distribution of population by activity status, and by sex, educational level, state of dependency, according to the 2008 Spanish Survey of Disability

	<i>Men</i>			<i>Women</i>		
	<i>High</i>	<i>Medium</i>	<i>Low</i>	<i>High</i>	<i>Medium</i>	<i>Low</i>
2+ADL						
<i>Inactive</i>	80%	89%	95%	81%	94%	95%
<i>Active half time</i>	6%	3%	2%	7%	2%	2%
<i>Active full time</i>	13%	8%	3%	12%	4%	3%
IADL1ADL						
<i>Inactive</i>	68%	76%	94%	70%	84%	94%
<i>Active half time</i>	11%	9%	2%	10%	6%	3%
<i>Active full time</i>	21%	14%	5%	20%	10%	3%
Discap without dep						
<i>Inactive</i>	44%	65%	77%	54%	76%	90%
<i>Active half time</i>	21%	13%	9%	20%	11%	4%
<i>Active full time</i>	35%	22%	14%	26%	13%	6%
No discapacity						
<i>Inactive</i>	23%	29%	46%	38%	60%	77%
<i>Active half time</i>	3%	3%	2%	13%	13%	9%
<i>Active full time</i>	74%	69%	52%	49%	28%	14%



Method: Step 2

ABM follows agents from age 50 until their death (2): setup phase



Weekly hours of care, according to age, labour force participation (LFP) and dependency status. Demand (negative values) and supply (positive values) used in the ABM model

<i>Age group</i>	<i>LFP</i>	<i>Good health</i>	<i>Dependency status</i>		
			Low	Medium	High
<i>Less than 5 years</i>	Inactive	-20	-20	-30	-80
<i>5 to 11 years</i>	Inactive	-10	-18	-30	-80
<i>12-16 years</i>	Inactive	-5	-16	-30	-80
<i>Adults</i>	Inactive	60	30	-30	-80
	Part-time	45	22.5	-30	-80
	Full-time	30	15	-30	-80



Method: Step 2

ABM follows agents from age 50 until their death (3): update phase

- At each tick (year) demand and supply of care at the family level is evaluated
- **Demand:** hours of care needed by elderly persons (egos), depending on their:
 - gender
 - disability state
 - economic activity state
 - educational level
- **Supply:** informal care provided by kin depending on:
 - their own individual characteristics
 - care needs of their own family
- **Formal care** = Demand by egos – total supply of hours of care available for ego in the family (partner, children and children-in-law)
- **End phase:** the last ego alive dies



Method: Step 2

ABM follows agents from age 50 until their death (3): update phase

Control panel for the simulation:

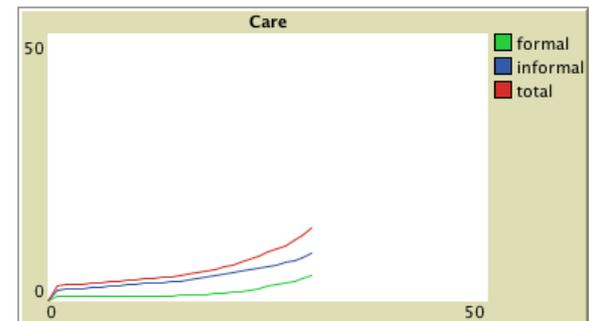
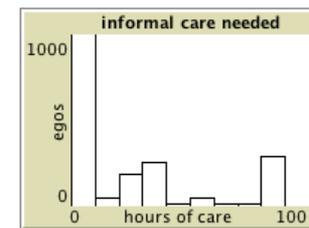
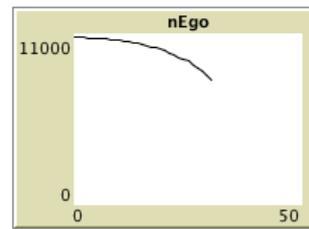
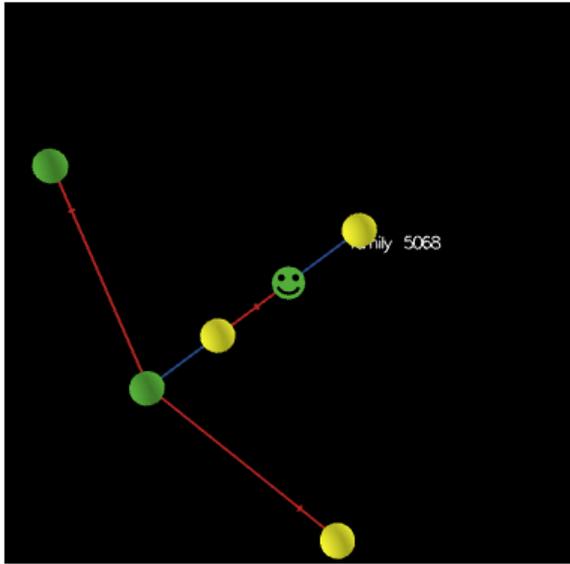
- Buttons: setup, go, go (with refresh icon), goTicks, ticks (30)
- Input fields: inputKin (cohort 68), educKind (stochastic), On/Off bigData?

Control panel for family and dependency settings:

- Buttons: On/Off idind?, On/Off showInactive..., famNum (0), Individual (0), View family, On/Off childDep
- Dropdowns: egoDependency (all), partnerEgoDep (all), inLawDep (all)
- Input field: numFamSel (5268)

Control panel for outputs and file operations:

- Buttons: On/Off outputs?, On/Off askName?, On/Off fileAppe...
- Dropdown: outputKind (ego)



```

Fam Ag Ego Active age mStatus nCh nInLaws care netCareSupply egoThTotal egoTotCare famCareDep famCarWork famCareOthers netCareDemand carebyPart
5068 27936 true true 80 1 1 1 -80 0 180 30 90 60 30.909090909090907 50.90909090909091 0 29.090909090909093 0 0 0 0 partner [27937] descendant
5068 27937 false true 85 1 1 1 -30 0 0 0 0 0 19.090909090909093 0 10.909090909090907 0 0 0 0 partner [27936]
5068 27938 false true 49 1 2 0 30 0 0 0 0 0 0 0 7.272727272727273 2.727272727272727 20 partner [27939] ascendant 27936
5068 27939 false true 34 1 2 0 30 0 0 0 0 0 0 0 21.81818181818182 8.181818181818182 -1.7763568394002505E-15 partner [27938] descendant
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5068 27941 false true 8 0 0 0 -10 0 0 0 0 0 0 0 10 0 0 0 ascendant 27939

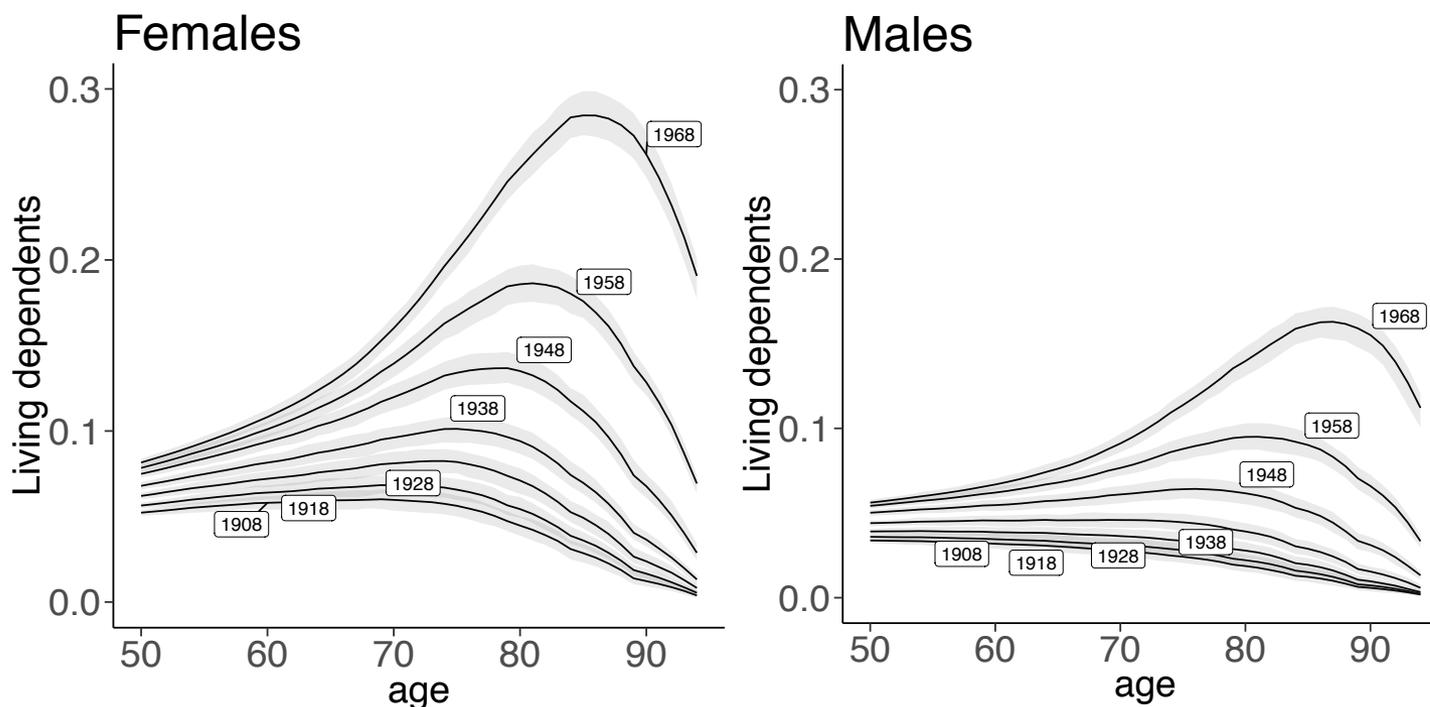
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Results



Demand for care: effects of change in the demographic regime (1)

Probability of being alive AND in state of dependency according to cohort



↑ in life expectancy after age 50 is the main factor behind the
 ↑ in the number of dependents

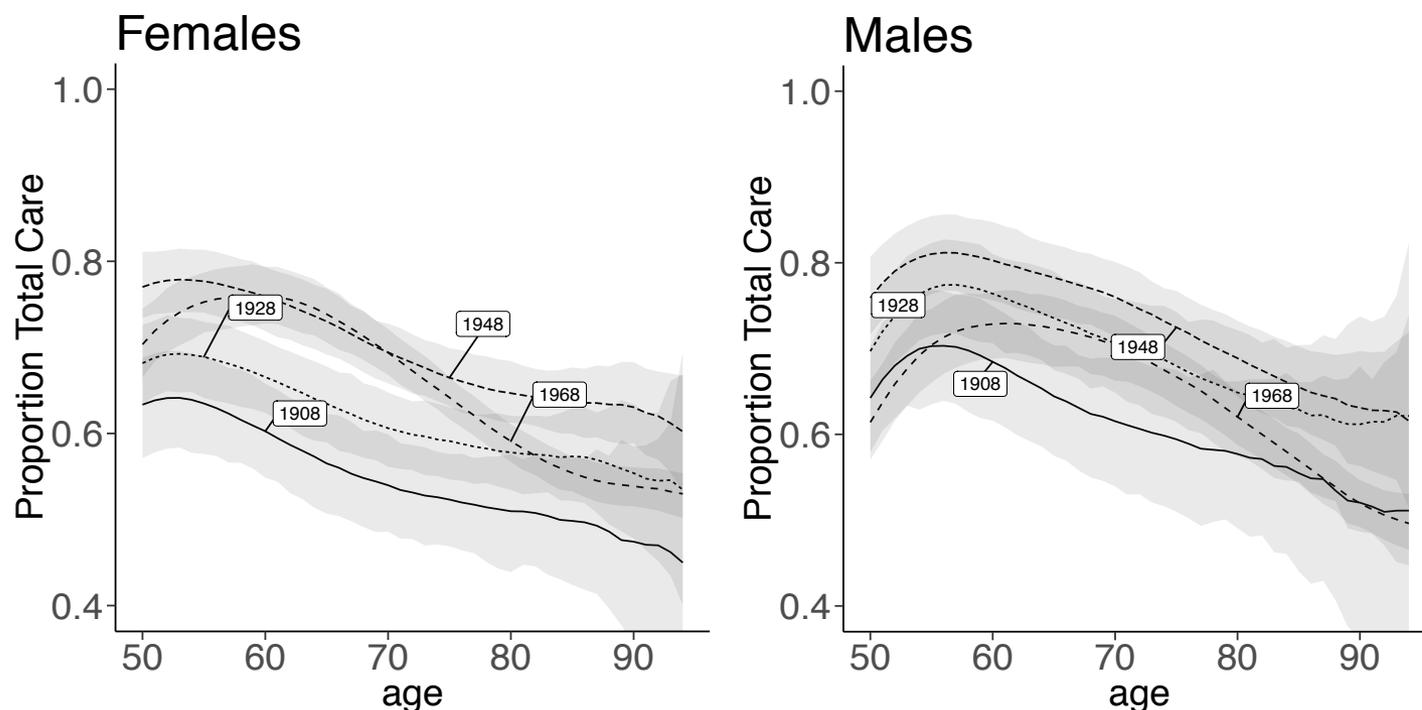
e ₅₀ in dependency state by birth cohort					
Cohort	1928	1938	1948	1958	1968
e ₅₀	2.5	2.9	3.4	4.9	6.3

Results



Demand for care: effects of change in the demographic regime (2)

Informal care: Proportion of care needed by dependents covered by the family



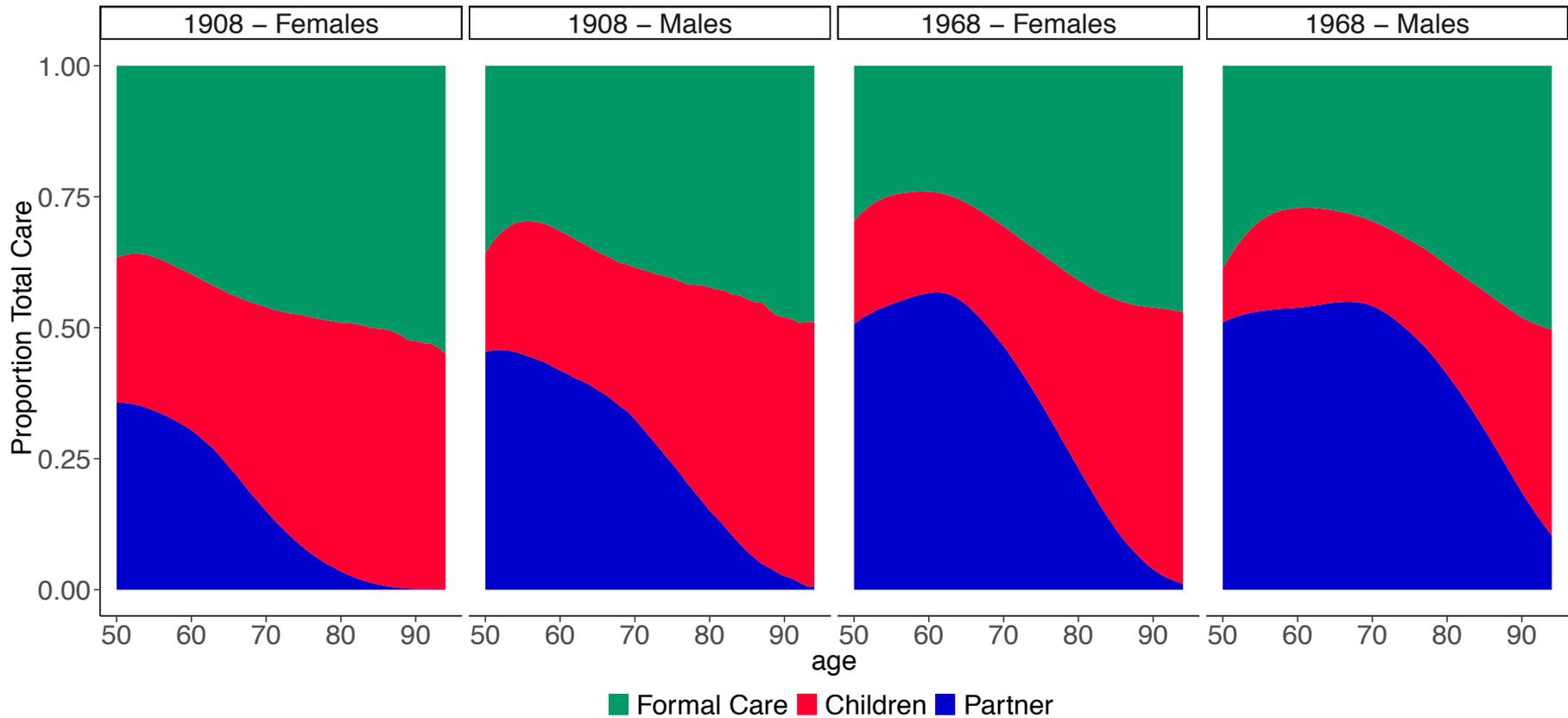
↑ in proportion of informal care from cohorts 1908 to 48 due to ↓ in widowhood
↓ in proportion of informal care from cohorts 1948- before age 60 due to the fall of fertility and higher childlessness



Results

Demand for care: effects of change in the demographic regime (3)

Proportion of care needed by dependents and given by the partner, children, or by persons external to the family (formal care). 1908 and 1968 cohorts by sex.

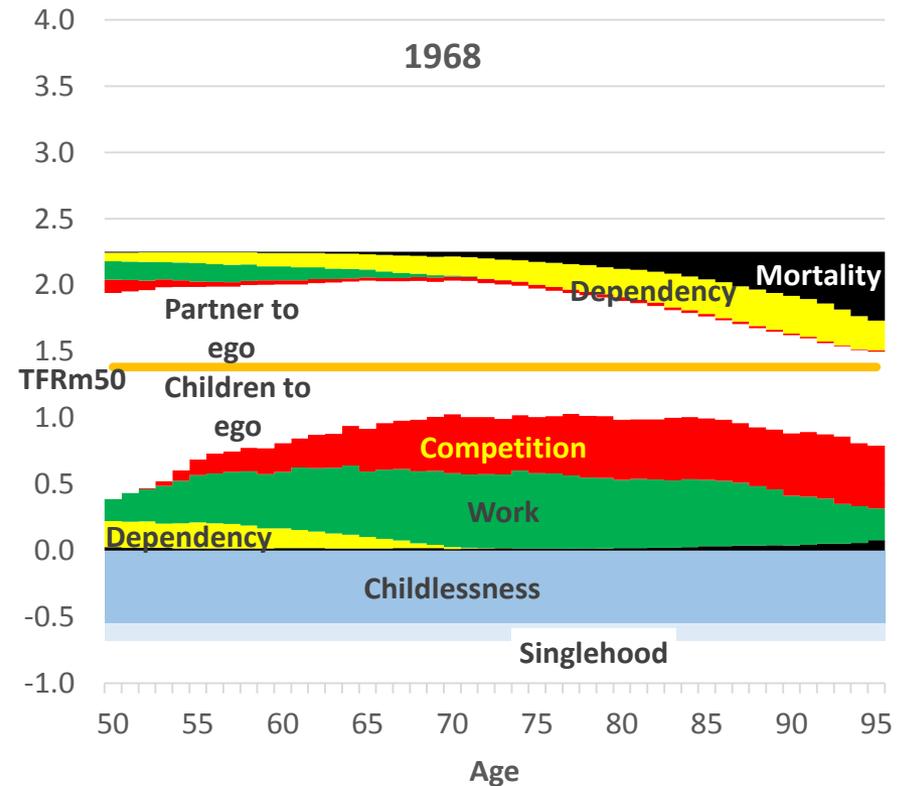
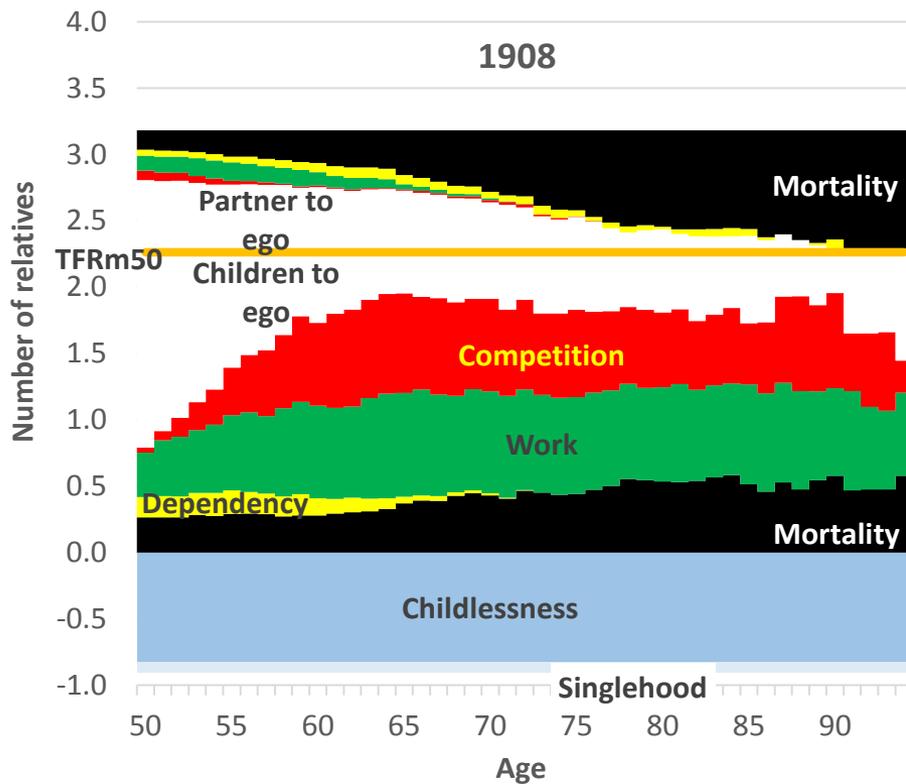




Results

Factors associated with loss of potential care due to change in the demographic regime and other factors

Counted in terms of the number of carers (partner/children). 1908 and 1968 cohorts.



Discussion and conclusions (1)

- Declining fertility and increasing infertility, coupled with greater labour force participation and lower willingness of women to assume the role of main carer, called for a real transformation of the care system for both today's and future's elderly, who will have a smaller family network.
- However, little variation has been observed in recent years in who assumes the role of primary caregiver: mostly informal and from the family.

Discussion and conclusions (2)

- ▶ The ABM model is developed in order to determine whether families can cope with the increasing demand for elderly care in terms of demographic and other factors that constraint the availability of informal care. Possibly useful for the formulation of public policies.
- ▶ Improvements we plan to introduce in our model are:
 - ▶ Evolution in time of the disability and dependence risks (useful for projections)
 - ▶ Possibility of health improvement
 - ▶ Physical distance between children and parents
 - ▶ Divorce (for current elderly cohorts, still of little importance)
- ▶ Additional analyses: different scenarios with “what if’s”, e.g.:
 - ▶ What if women’s LFP equals that of men’s?
 - ▶ What if everyone is higher educated?
 - ▶ What if age-specific dependency declines annually by some %?

Thank you

Whakawhetai ki a koutou

Jeroen Spijker

jspijker@ced.uab.es

Twitter: @popageing

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Results – Kin and the residential situation of the main carer. Spain, 1999 and 2008.



	Elderly# aged 65-79 with a disability				Elderly# aged 80+ with a disability			
	1999		2008		1999		2008	
	Co-residence	Lives elsewhere	Co-residence	Lives elsewhere	Co-residence	Lives elsewhere	Co-residence	Lives elsewhere
Husband	24.4%	...	26.0%	0.1%	4.7%	...	6.5%	...
Wife	27.8%	...	29.1%	0.1%	11.4%	...	11.7%	...
Daughter	24.1%	37.0%	22.3%	44.0%	45.6%	36.2%	44.8%	43.5%
Son	6.5%	4.0%	8.8%	7.1%	7.8%	4.7%	9.2%	7.6%
Daughter-in-law	4.0%	6.3%	2.7%	2.7%	8.9%	7.7%	8.3%	4.8%
Other informal	11.3%	19.6%	7.8%	15.7%	18.5%	15.2%	12.1%	11.8%
Total informal	98.0%	66.9%	96.8%	69.6%	97.0%	63.8%	92.5%	67.7%
N	363524	112259	359071	68235	304810	100140	447122	126636
Employee	1.6%	24.3%	3.2%	20.3%	2.5%	25.6%	7.5%	20.5%
Social services	0.4%	8.8%	...	10.1%	0.5%	10.6%	...	11.8%
Total formal	2.0%	33.1%	3.2%	30.4%	3.0%	36.2%	7.5%	32.3%
N	7740	55492	11792	32155	9493	56911	36205	60521
Total with known relation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
N	370964	167751	370863	105899	314564	157052	483327	187157
Unknown relation	66349		166618	166618	36816		86431	
Total N	605064		643379	643379	508432		756914	

Sources: EDDDES 1999 and EDAD 2008. #Resident in households, i.e. excludes people in institutions.