

Model Migration Schedules

New Ideas and Future Research

**Colorado Conference
on the
Estimation of Migration**

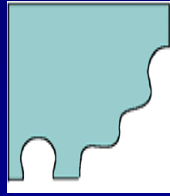
September 24-26, 2004

Luis J. Castro

- **Formal Research Programs**
- **Applications Oriented to User's Demand**



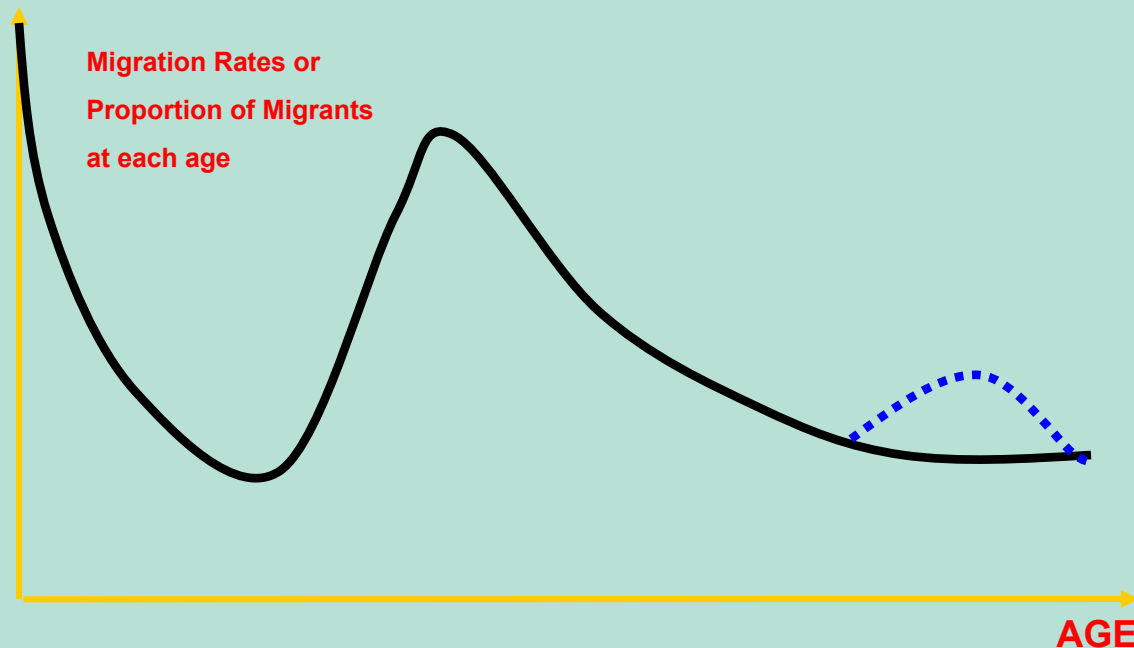
I. Measurement and Analysis

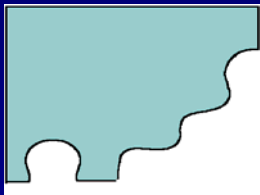


I. MEASUREMENT AND ANALYSIS

RESEARCH OBJECTIVE:

There are age-specific gross migration flows regularities as in fertility and mortality





I. MEASUREMENT AND ANALYSIS

References

Model Multiregional Life Tables and Stable Populations, Andrei Rogers and Luis J. Castro, RR-76-9 (Laxenburg, Austria, IIASA, first printing May 1976; second printing, February 1981), p. 82.

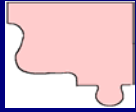
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Migration Age Patterns: Measurement and Analysis, Andrei Rogers and Luis J. Castro, WP-79-16, February 1979, p. 57.

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Age Patterns of Migration: Cause-Specific Profiles in Advances in Multiregional Demography, edited by A. Rogers, RR-81-6 (Laxenburg, Austria, IIASA, May 1981), p. 125.160.

II. Model Migration Schedules (MMS)

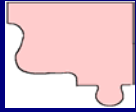


II. MODEL MIGRATION SCHEDULES

RESEARCH OBJECTIVE:

The Migration regularities fit a mathematical function.

Recognizing that most human populations experience rates of age-specific fertility and mortality that exhibit remarkably persistent regularities, it was found possible to summarize and codify migration regularities by means of mathematical expressions called Model Migration Schedules (MMS).



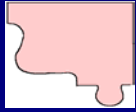
II. MODEL MIGRATION SCHEDULES

The full model schedule has 13 parameters: $a_1, \alpha_1, a_2, \mu_2, \alpha_2, \lambda_2, a_3, \mu_3, \alpha_3, \lambda_3, \alpha_{14}, a_4$, and c .

The profile of the full model schedule is defined by 8 of the 13 parameters: $\alpha_1, \mu_2, \alpha_2, \lambda_2, \mu_3, \alpha_3, \lambda_3, \alpha_4$.

Its level is determined by the remaining 5 parameters: a_1, a_2, a_3, a_4 , and c .

A change in the value of the area under a particular model schedule alters proportionally the values of the latter but does not affect the former.



II. MODEL MIGRATION SCHEDULES

References

Model Migration Schedules and Their Applications, A. Rogers, R. Raquillet and Luis J. Castro, *Environment and Planning A*, Vol. 10 (London, Pion Limited, 1978), p. 475-502.

Migration, Urbanization and Development: A Case Study of Mexico, Donaldo Colosio, Luis J. Castro and A. Rogers, IIASA, WP-78-27, September 1978.

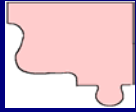
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II. MODEL MIGRATION SCHEDULES

References

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Migration, Chapter 5, p.157-210, Migration and Settlement, edited by Andrei Rogers and Frank J. Willekens, D. Reidel Publishing Company, Boston, Andrei Rogers and Luis J. Castro (1982).

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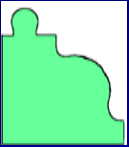
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Migration in Migration and Settlement: Multiregional Comparative Study, edited by A. Rogers and F. Willekens (Boston, Westview Press, 1985), p. 41-146.



**III. What the Age
Composition of Migrants
can Tell Us**



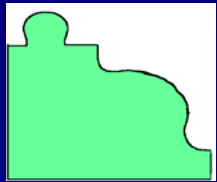
III. WHAT THE AGE COMPOSITION OF MIGRANTS CAN TELL US

RESEARCH OBJECTIVE:

MMS based on parameters that interpret migration behavior (Family Migration)

Parameters:

- **Age at which first migration occurs as independent (head of family)**
- **Mean age of head family migrants**
- **Mean age of dependents migrants (children moving w/parents)**
- **Dependency Ratio**
- **Sex dependency (Women migrating with men)**



III. WHAT THE AGE COMPOSITION OF MIGRANTS CAN TELL US

References

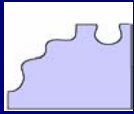
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What the Age Composition of Migrants Can Tell Us. Population Bulletin of the United Nations, No. 15 (New York, United Nations Sales Publication No. E. 83.XIII.4, 1983) in English, French and Spanish, p. 63-79.

Patterns of Family Migration: Two Methodological Approaches, Luis J. Castro and Andrei Rogers, Environment and Planning A, Vol. 15 (London, Pion Limited, 1983), p. 237-254.



IV. Simplified MMS



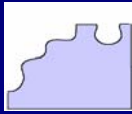
IV. SIMPLIFIED MMS

RESEARCH OBJECTIVE:

MMS with few parameters representing demographic characteristics of the migrants

PARAMETERS:

- Adult mean age
- Children mean age
- Proportion of children migrants



IV. SIMPLIFIED MMS

References

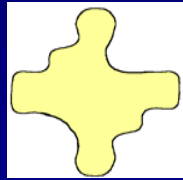
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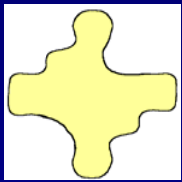


**V. Future Research
and Applications**

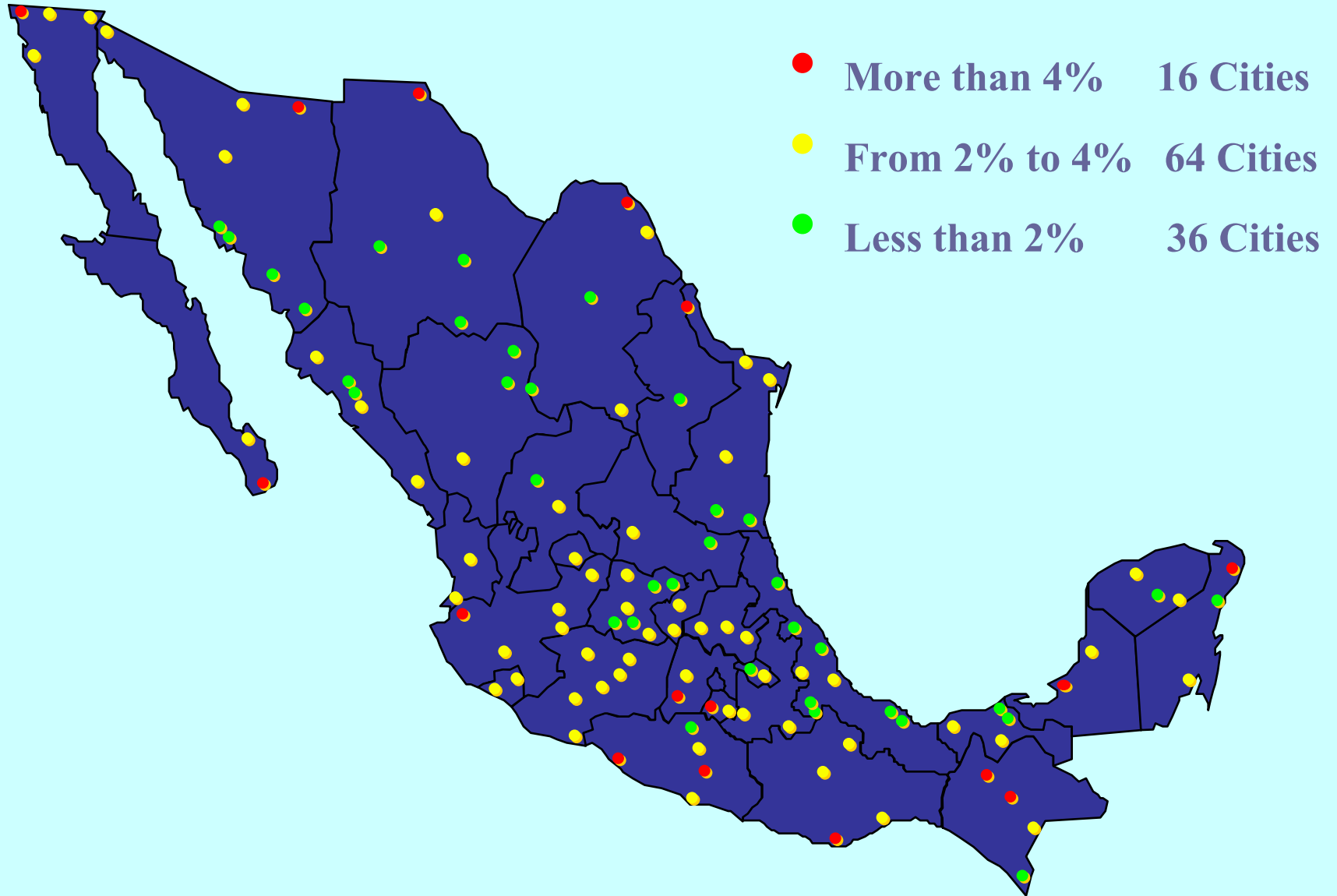


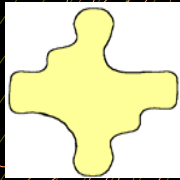
V. FUTURE RESEARCH

- **More Focus on Users in Developing Countries**
- **Local Population Analysis**
- **Modeling Migration Dynamics Analysis**
 - **Gross to Net Migration**
 - **Net to Gross Migration**
 - **Urbanization**
- **International Migration Modeling**

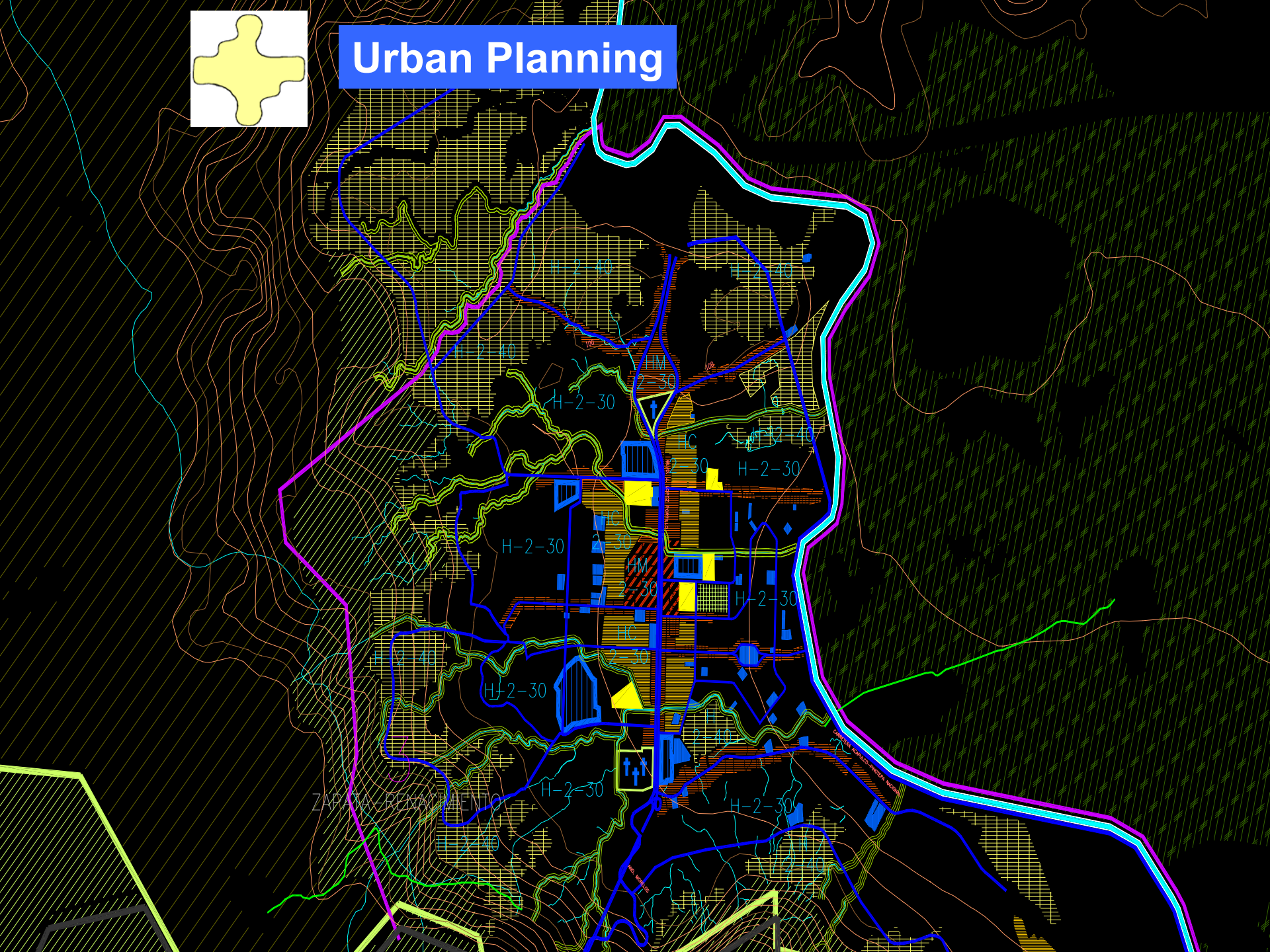


MIDDLE & SMALL SIZE CITIES



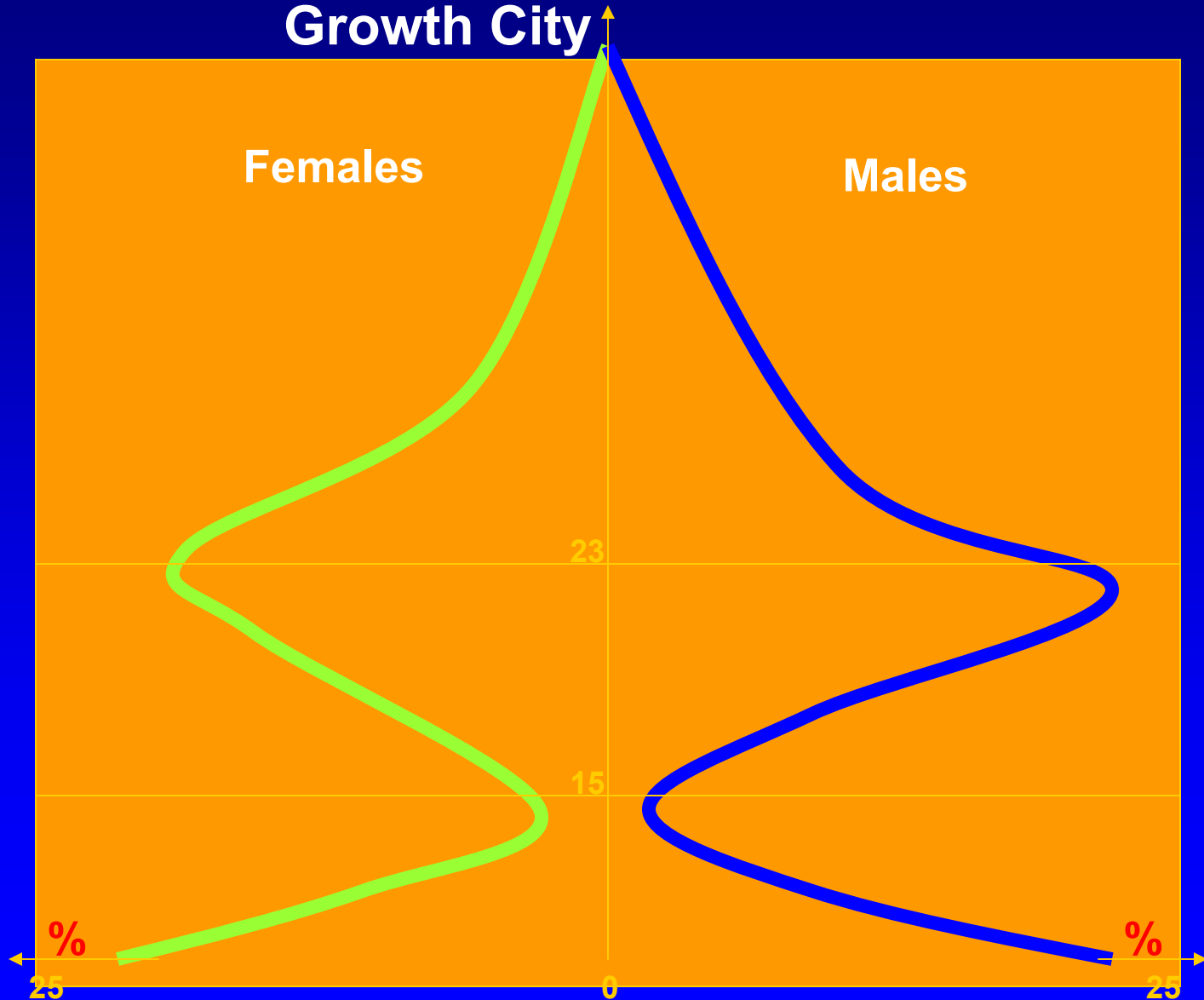


Urban Planning

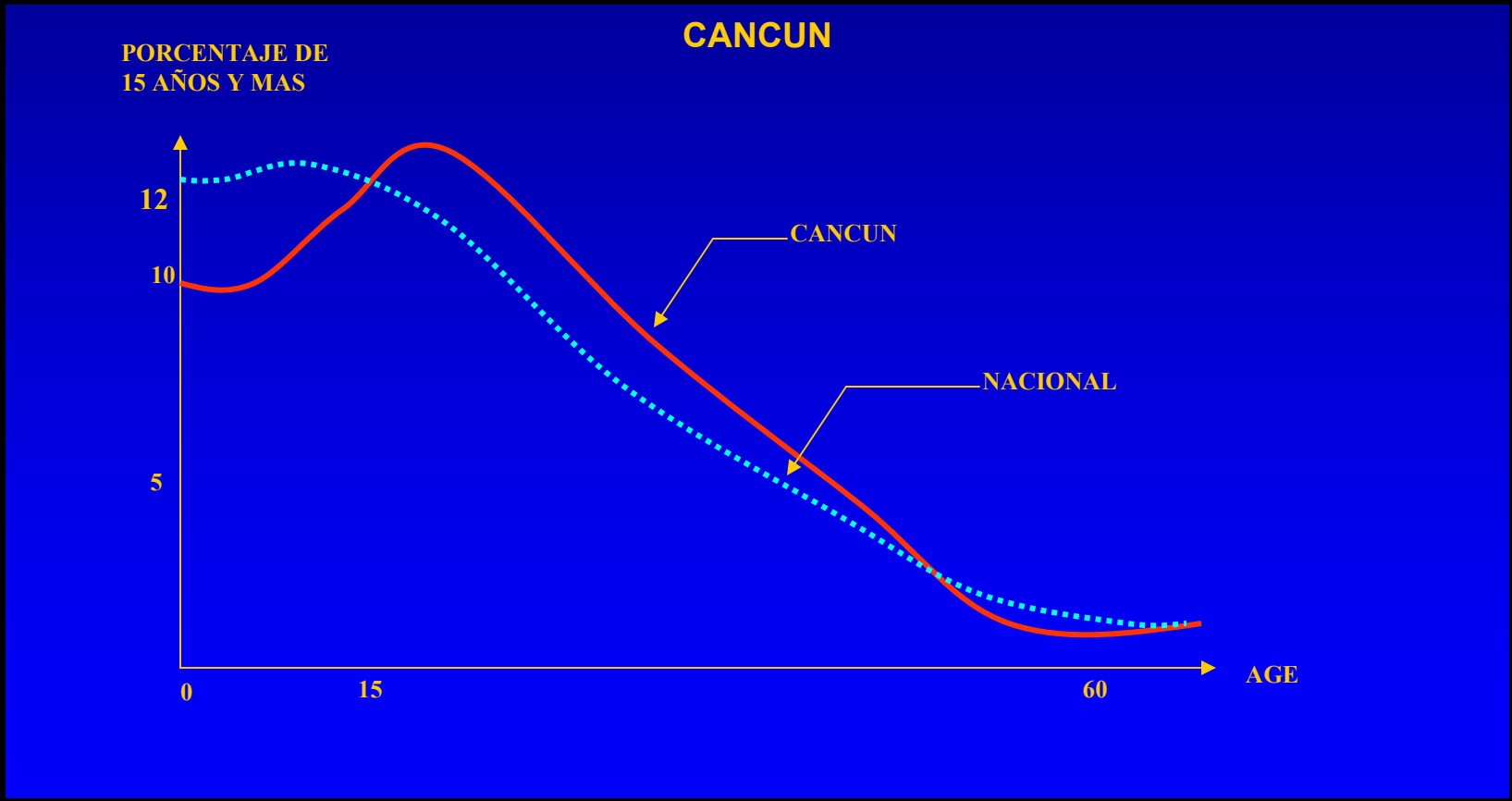


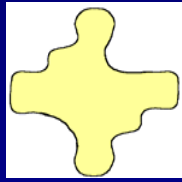


Age Population Composition of a High Population Growth City

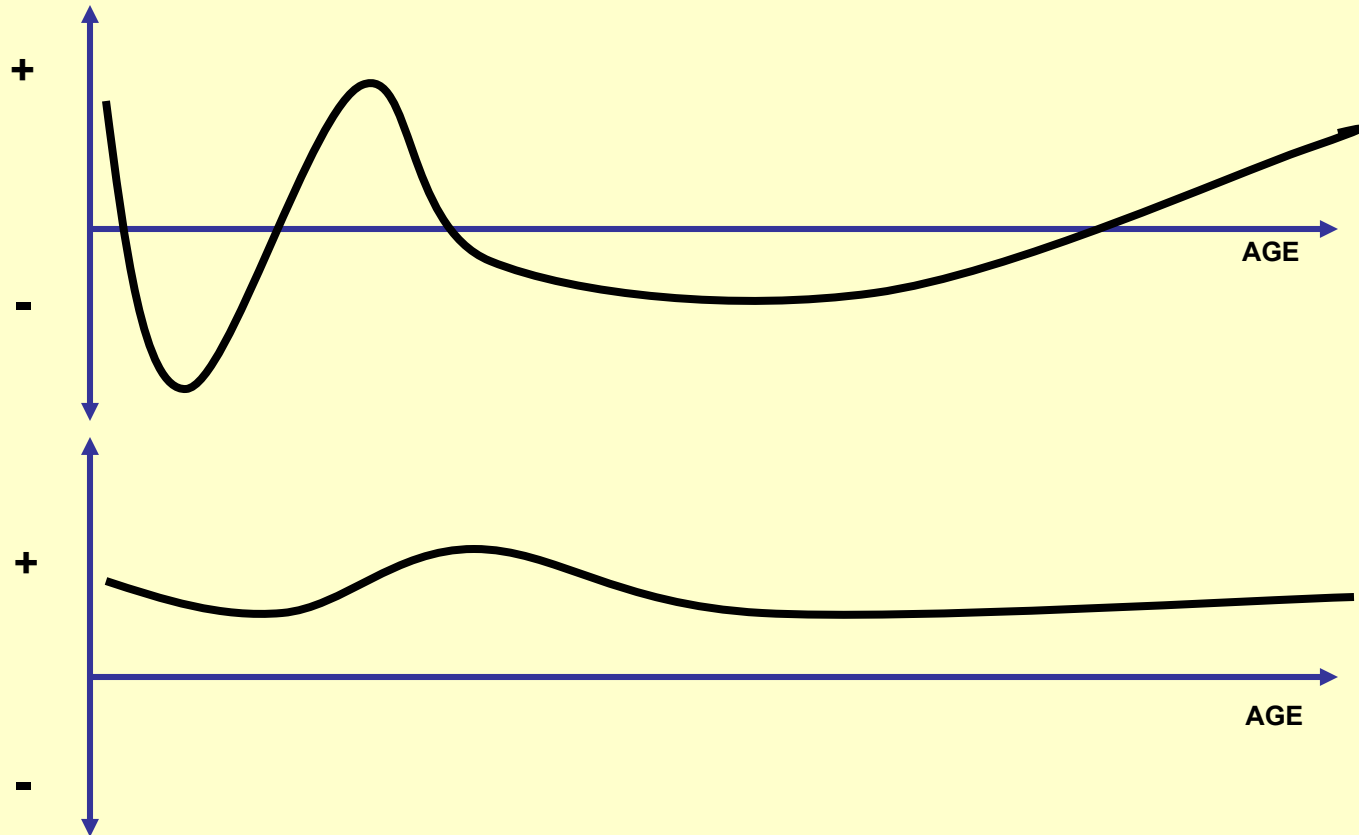


Age Population Composition

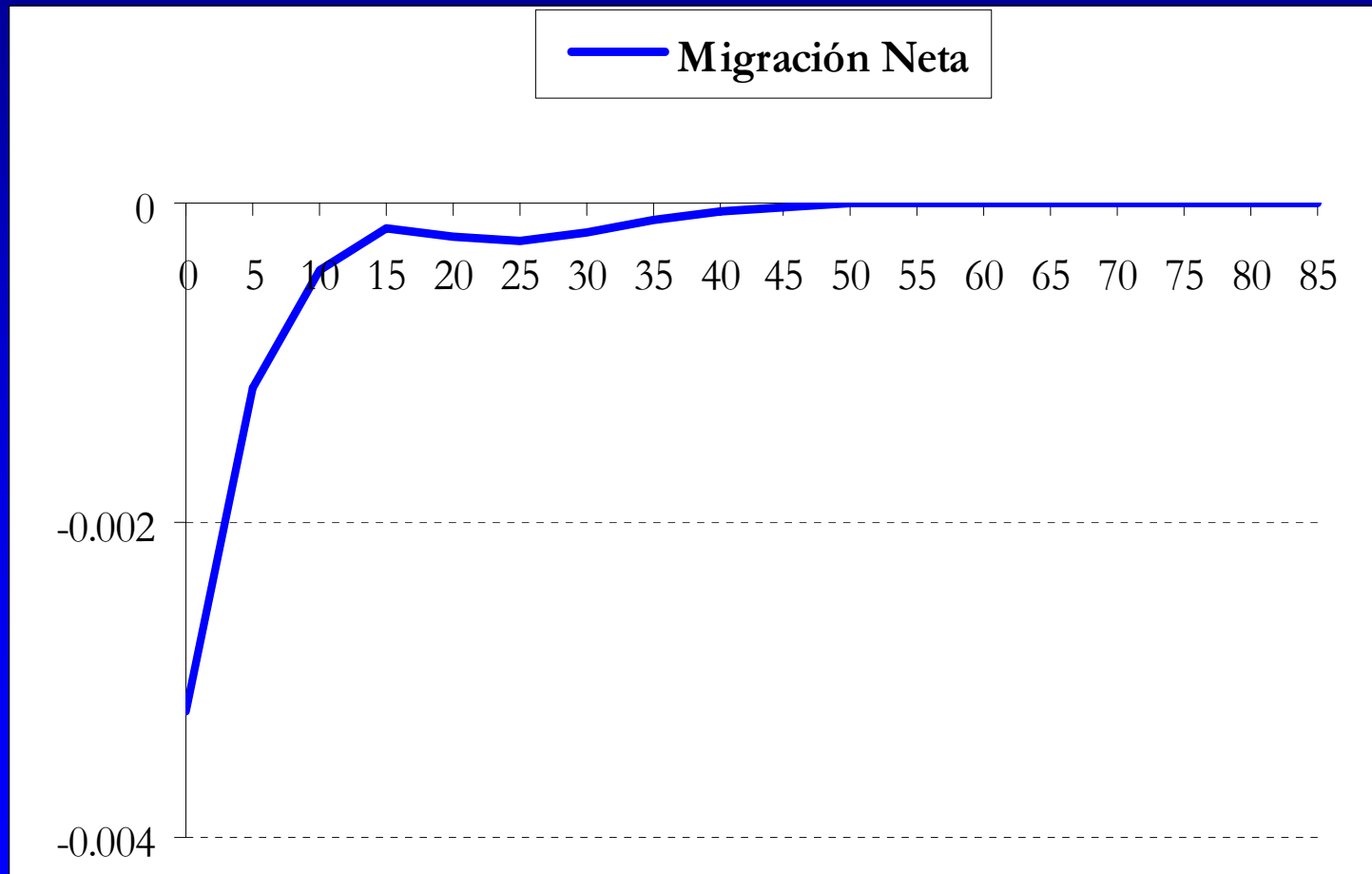




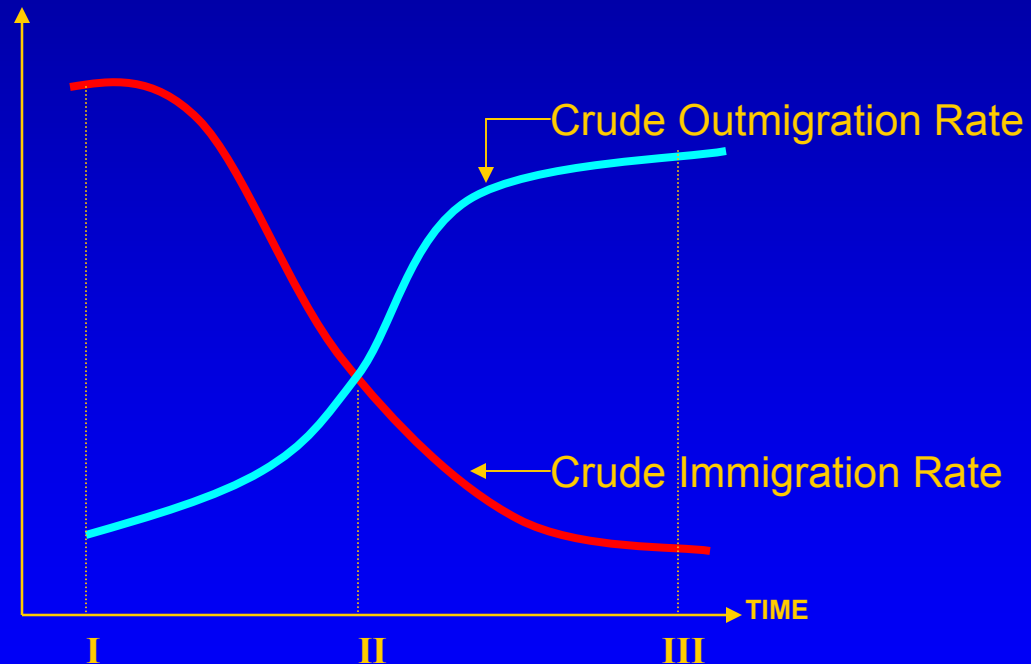
V. FUTURE RESEARCH



MEXICO CITY METROPOLITAN AREA



MIGRATION PHASES OF A CITY



PHASES OF MIGRATION

I High Immigration City

II City in Equilibrium

III High Outmigration City

AGE-SPECIFIC IN-MIGRATION DISTRIBUTION

$$i(x) = W_i c_i(x) + (1-W_i) a_i(x)$$

where,

$$i(x) = I(x)/IT$$

$I(x)$ in-migrants at age x

IT Total of in-migrants

$a_i(x)$ proportion of adult in-migrants at age x

$c_i(x)$ proportion of children in-migrants at age x

W_i total proportion of children in-migrants.

In similar way the age-specific out-migration distribution:

AGE-SPECIFIC OUT-MIGRATION DISTRIBUTION

$$e(x) = W_e c_e(x) + (1-W_e) a_e(x)$$

Where $c_e(x)$, $a_e(x)$, y W_e are defined as in the in-migration distribution

In turn, the adult and children functions are defined as follow:

$$a(x) = [1/(ma-23)] \exp - [(x - 23)/(ma - 23)] - \exp[-0.2(x - 23)]$$

$$c(x) = (1/mc) \exp(-x/mc)$$

Where ma and mc are the adult and children mean age of migrants respectively

AGE-SPECIFIC NET MIGRATION PROFILES

$$N(x)/K = [\iota i(x) - \varepsilon e(x)]$$

Where ι and ε are the crude in- and out-migration rates respectively and K is total population. The crude rates are defined as: $\iota = IT/K$ and $\varepsilon = ET/K$

HIGH IN-MIGRATION FLOW

SMMS PARAMETERS:

In-migration

ma= 30 yrs.

mc= 5 yrs.

W= 30% dependency ratio

Out-migration

ma=35 yrs.

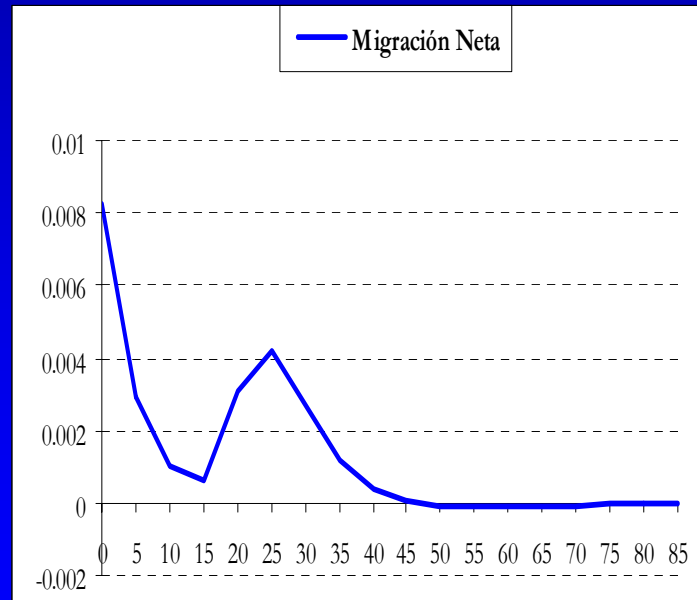
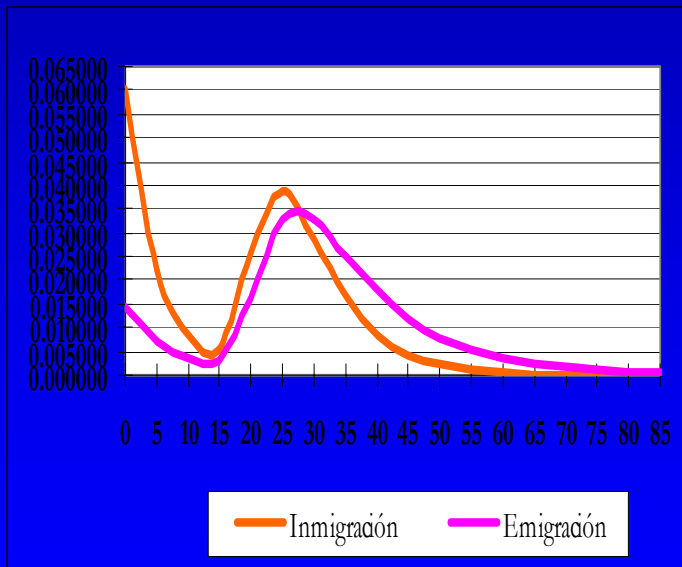
mc=7 yrs.

W= 10%

Crude Rates

$\tau = 0.15$ (in-)

$\varepsilon = 0.05$ (out-)



HIGH OUT-MIGRATION FLOW

SMMS PARAMETERS

In-migration

ma= 35 yrs.

mc= 7 yrs.

W= 30% dependency ratio

Out-migration

ma=30 yrs.

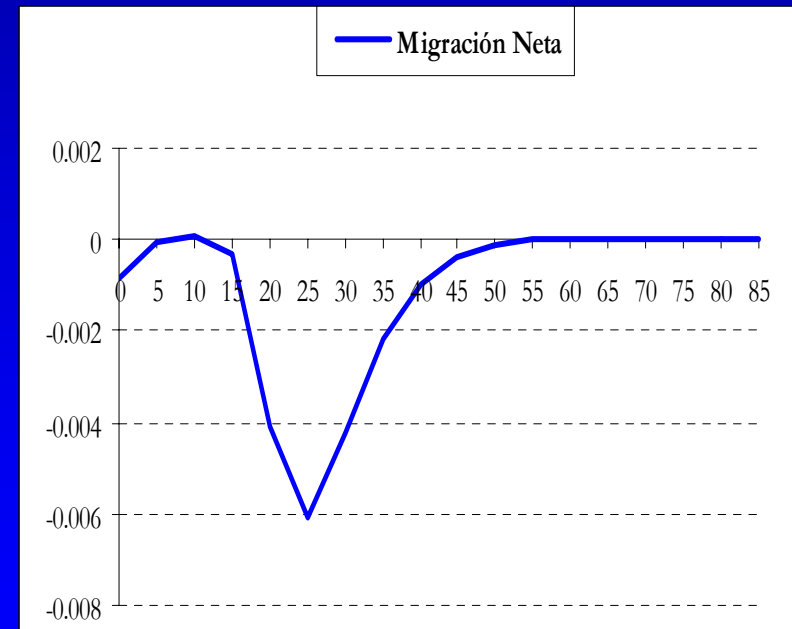
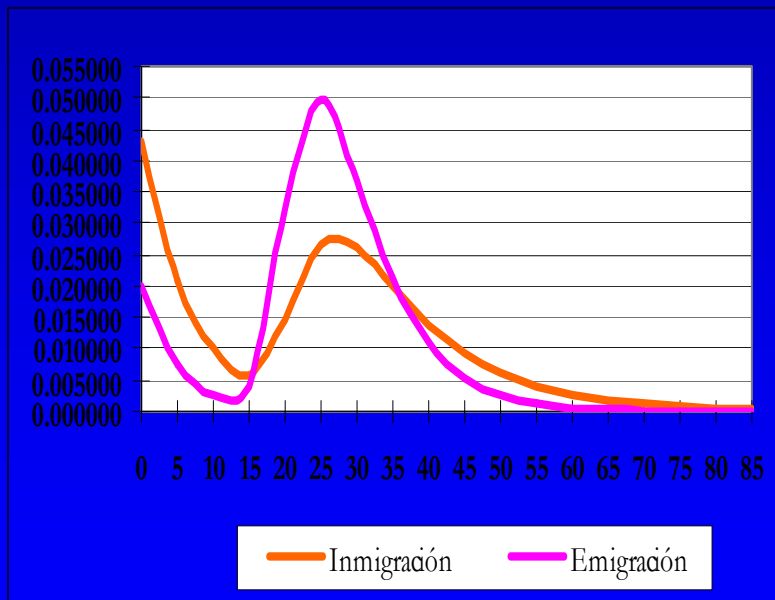
mc= 5 yrs.

W= 10%

Crude Rates

$\tau = 0.05$ (in-migration)

$\varepsilon = 0.15$ (out-migration)



SIMILAR IN AND OUT MIGRATION FLOWS

SMMS PARAMETERS:

In-migration

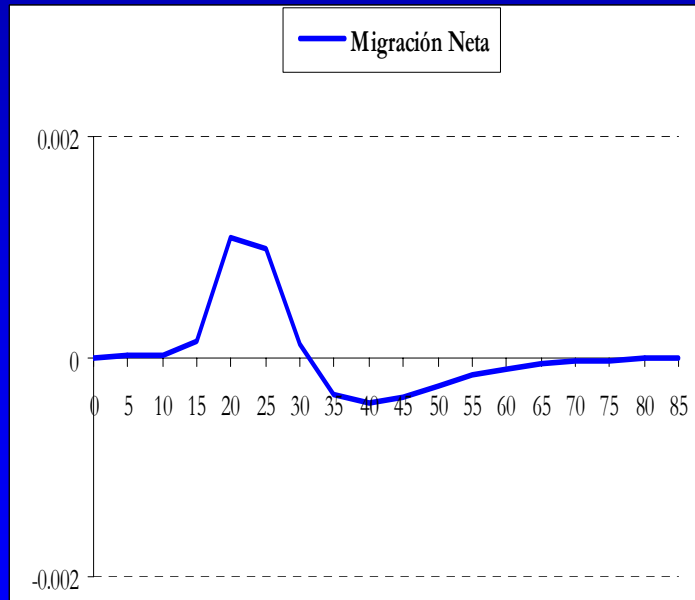
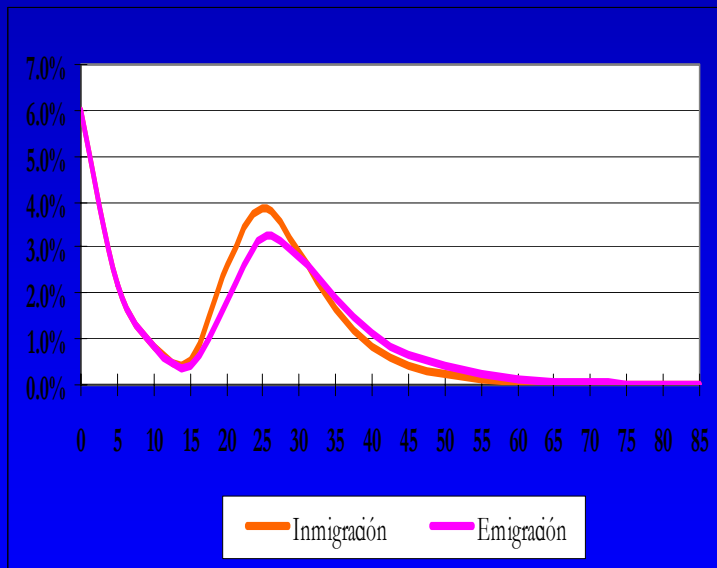
ma= 30 yrs.
mc= 7 yrs.
W= 30% dependency ratio

Out-migration

ma=32 yrs.
mc= 5 yrs.
W= 30%

Crude Rates

$\tau = 0.15$ (in-migration)
 $\varepsilon = 0.15$ (out-migration)



LINEAR METHOD

$$N(x)/K = [\tau i(x) - \varepsilon e(x)]$$

Multiple Regression or Linear Programming

1. Net migration estimation by age $N(x)$ by a residual or Cohort-Component method (Dependent Variable)
2. SMMS by age $i(x)$ y $e(x)$ (Independent variables)

Output:

Crude migration rates τ y ε (Regression coefficients)

.

NON LINEAR METHOD

$$N(x)/K = [\iota i(x) - \varepsilon e(x)]$$

No-linear Parameter Estimation

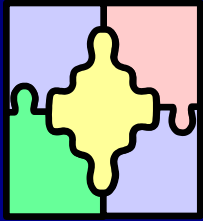
1. Residual or Cohort-Component Method to obtain net migration by age $N(x)$
2. SMMS for $i(x)$ and $e(x)$.

Outputs:

- Crude migration rates ι γ ε

And for in- and out-migration flows:

- Adult mean age
- Children mean age
- Proportion of children migrants



Model Migration Schedules Research



I. Measurement and Analysis



II. Model Migration Schedules



III. What the Age Composition Of Migrants can Tell Us



IV. Simplified Model Migration Schedules



V. Future Research and Applications

Model Migration Schedules Research

I. Measurement and Analysis

II. Model Migration Schedules (MMS)

V. Future Research
and
Applications

III. What the Age Composition of Migrants can Tell Us

IV. Simplified Model Migration Schedules (SMMS)