Impact Evaluation of the Agricultural Support Project: Georgia

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Presenters: Hansdeep Khaira, IFAD IOE, Dustin Gilbreath, CRRC

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Background of the project

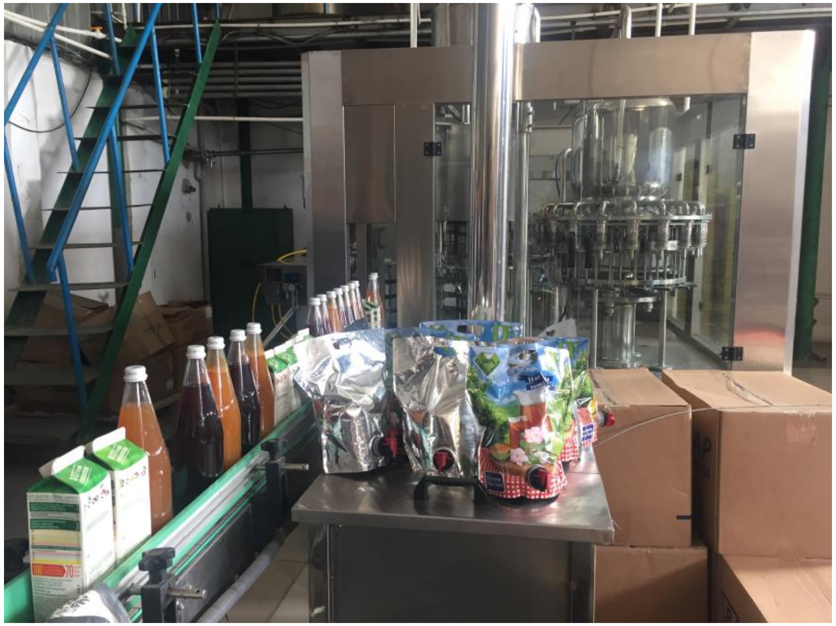
Objectives: (i) Increase assets & incomes among rural poor through commercial agricultural and rural enterprises.

(ii) Remove infrastructural bottlenecks that inhibit the participation of rural poor in enhanced commercialization of agriculture.

Activities: (i) loans on favourable terms through leasing companies and MFIs for leasing equipment; (ii) rehabilitation of 2 bridges and 6 irrigation schemes; iii) construction of one drinking water scheme.

Duration: 2010 to 2015; **Project Cost:** US$12.6 mill.(IFAD 81%)

A visual representation of project activities



Background of the project

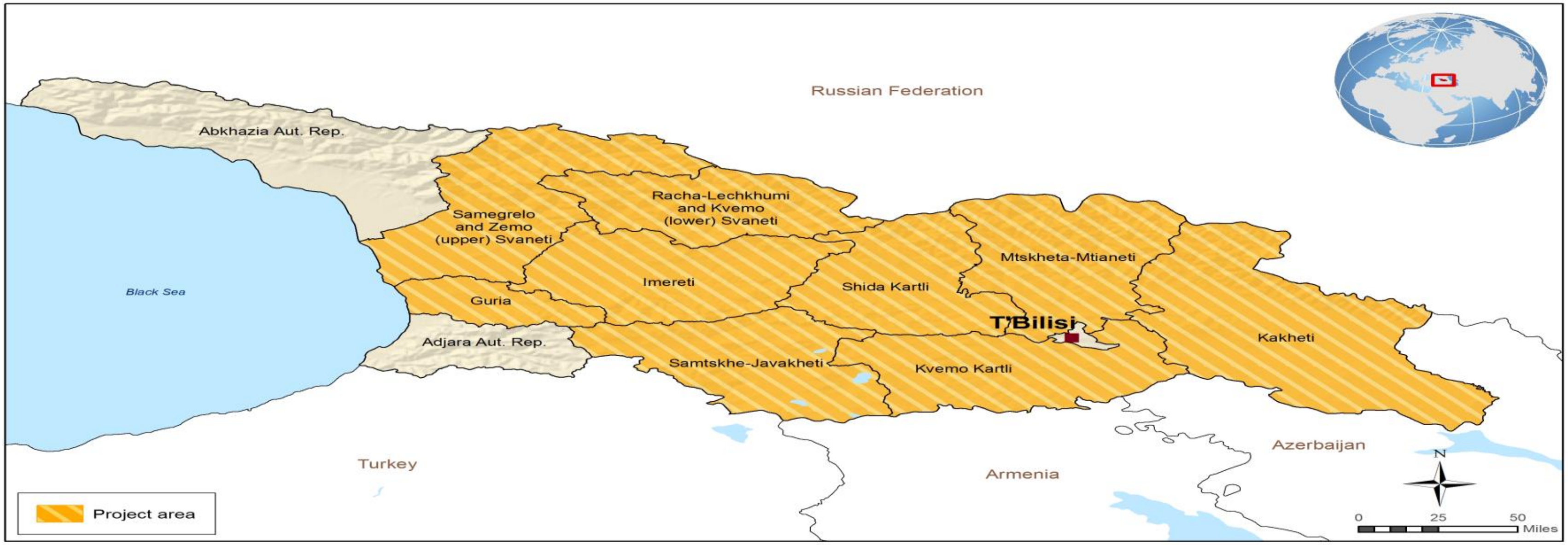
Selection criteria. Regions: high incidences of poor rural people and a high productive potential in agriculture.

Beneficiaries: Direct – smallholder farmers and livestock owners. Indirect - farmers and rural people seeking employment.

Georgia

Agricultural Support Project

Impact evaluation



The designations employed and the presentation of the material in this map do not imply the expression of any opinion whatsoever on the part of IFAD concerning the delimitation of the frontiers or boundaries, or the authorities thereof.

IFAD *Map compiled by IFAD* | 08-03-2017

Impact evaluation methodology: highlights

Why impact evaluation?

- Outcomes of interest determined using *theory of change*.
- *Quasi-experimental* method: counterfactual for better attribution of project effects.
- *Genetic matching* for creating comparison group.
- Geo-spatial analysis for assessing *Normalised Differentiation Vegetation Index* (vegetation changes) caused by irrigation.

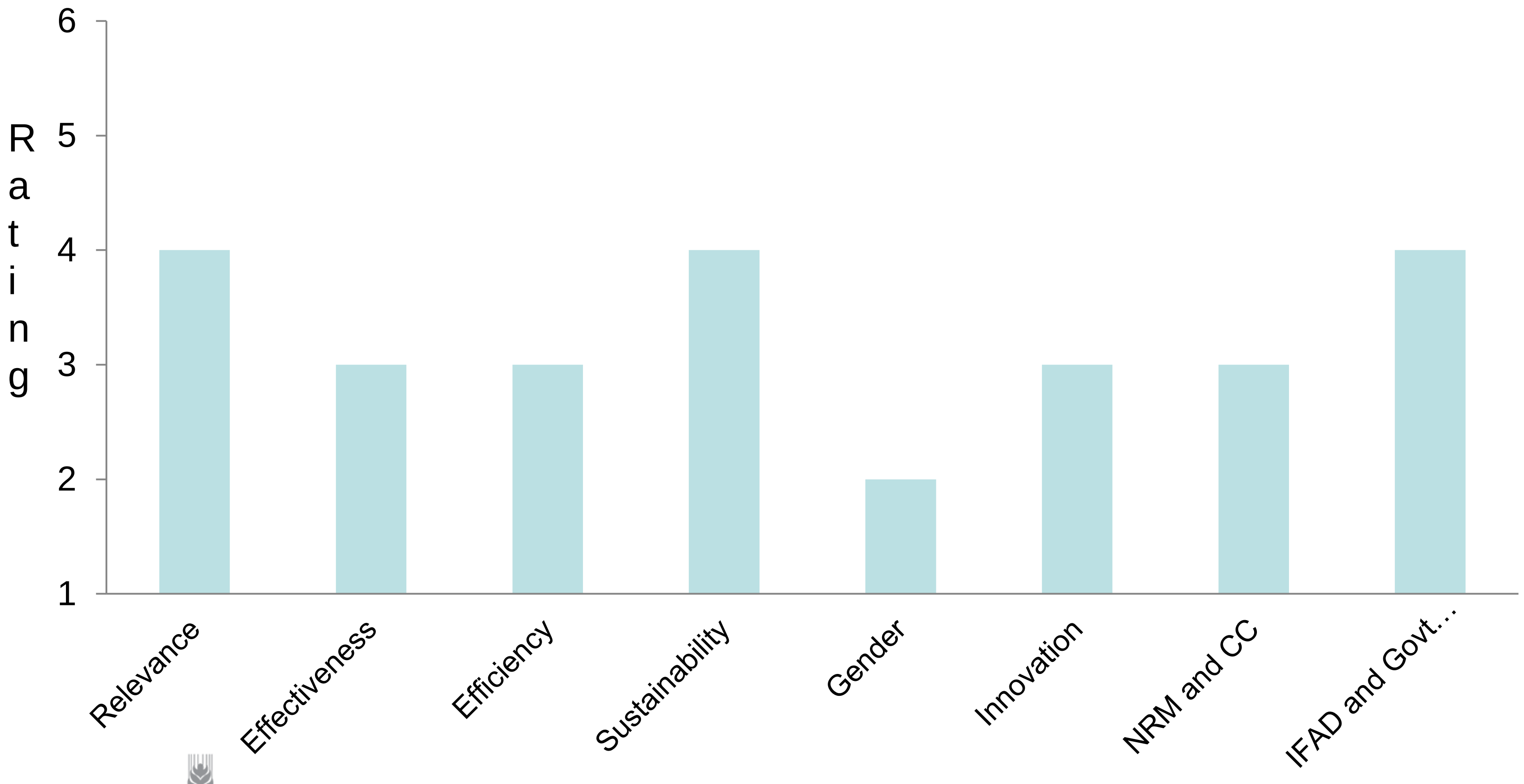
Highlights of results

Difference in difference effects

Outcome of interest	Irrigation	Bridges	Drinking water	Leasing (indirect)
Income	no statistically significant change			increase of 14%
Assets	no statistically significant change			increase
Move out of poverty(25%)	no statistically significant change			205% likelihood
Food security	no statistically significant change			no change
Ag productivity	no change	n.a.	n.a.	no change
Crop diversification	no change	n.a.	n.a.	n.a.
Livestock change	n.a.	increase	n.a.	n.a.

Performance Profile

Other criteria



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Conclusions

✓Project based on correct premise: infrastructure and rural finance key to Georgia's rural growth.

✓Novel attempt to innovate.

✓ Project has triggered some revitalised interest in agriculture.

✓Sustainability of infrastructure.

Conclusions

- Widespread and diverse interventions (large spread, different types of interventions and beneficiaries).
- Late start and partial design failure.
- Missing involvement of grass-roots organizations.
- Lacking a gender focus.
- Unrealistic targets for project duration.

Recommendations

1: Apply a holistic approach to infrastructure rehabilitation to achieve a measurable change in the lives of farmers. Assess the institutional voids of the particular context for long term sustainability of infrastructure.

2: A longer term programmatic approach is necessary for infrastructure related interventions.

3: Minimize the gap between irrigation potential created and that utilized by promoting environment and natural resource management.

4: When introducing innovating products in the rural financial space, undertake analysis of both the demand and supply sides to ensure that new products meet the needs of all concerned.

A deep dive into the impact evaluation methodology

Goal: To assess the impact of the Agricultural Support Program (ASP) on the rural poor on:

- Household income and assets;
- Food security and agricultural productivity;
- Human and social capital and empowerment;
- Institutions and policies.
- Gender equality and women's empowerment

Process

- Desk review-> Reconstructed Theory of Change
- Theory of Change-> Questionnaire and guide development
- Questionnaire and guide development-> Pilot
- Pilot-> Updates and fieldwork protocols
- Sampling
- Data analysis design-> Matched data sets
- Data analysis -> Triangulation of impact

Challenges

- No random assignment of treatments at the individual or cluster level
- Lack of adequate baseline data

Solution 1: Quasi-experimental blocking

- Quasi-experimental blocking
  - Match on cluster level characteristics for the infrastructure component:
    - Step 1: Estimate propensity scores for each community in Georgia
    - Step 2: Calculate genetic weights for the following the year prior to construction of infrastructure:
      - NDVI
      - Gender balance of adults in communities
      - Ethnic minority community
      - Adult population size
      - Average elevation
      - Distance to a primary road
      - Distance to a secondary road
      - Distance to a tertiary road
      - Distance from a regional center
      - Area of the district
      - Koppen climate classification
      - Population density
      - Propensity scores
    - Step 3: Use multivariate matching with genetic weights to identify most similar communities in country

Solution 2: Genetic Matching at the individual level

- Same process as described above for quasi-experimental blocking, except matching on pre-treatment and time invariant qualities at the individual level, including:
  - Land owned in 2012
  - Land used for high value crops
  - Land used for staple crops
  - Irrigated land (dummy variables)
  - Amount of irrigated land in 2012
  - Number of household members
  - Average age of household members
  - Average age of adults
  - Age of Head of Household
  - Female headed household
  - Ethnicity (dummy variables)
  - Education level of Head of household (dummy variables)
  - Religion
  - Propensity score

Data Analysis

- Extract matched datasets
- Calculate differences in differences
- Use regressions appropriate to the outcome variable to estimate effects, with clustered standard errors.
- Check face validity – do the results match up with the expected results. Are estimates reasonable?
- Triangulate impact

Geo Spatial Analysis

- *Objective of analysis:* to estimate magnitude & significance of difference in greenness (NDVI) based on temporal variations (project baseline 2012 and endline 2015) using a counterfactual (project treated v/s non-treated areas).
- The methodology applied is derived from the "**Before/After Control/Impact** 'BACI' contrast presented in the research paper: *Remote sensing monitoring of land restoration interventions in semi-arid environments with a before–after control-impact statistical design, Meroni et al. 2017".*
- The rationale is that the project interventions will cause a different pattern of change from before to after the treatment compared with similar areas not treated by the project.
- The paper applied the BACI to a natural vegetation restoration projects.
- Our pilot project was the first time the BACI was applied in agriculture.

Geo Spatial Analysis

- Data: Analysis performed using 250-m NASA MODIS NDVI product (8 days) from 2004 to 2016

- Project Area: Five irrigation schemes that were rehabilitated as part of project intervention. Farm plots split into three sizes: small (< 2ha), medium (2-10ha) large (> 10ha) - to understand better the effect on different types of farmers.

- Selection of non-treated sites based on:
    - similar land cover
    - geographic proximity
    - not subjected to intervention
    - randomly selected

Geo Spatial Analysis

- Undertook cluster analysis to classify area according to different vegetation development patterns.

- Assessed pixel similarity in treated and non-treated areas and select first-stage non-treated sample (50 sites).

- Computed NDVI for valid pixels for the two areas for the period before and after intervention, and select second-stage non-treated sample with higher RMSE (20 sites).

Geo Spatial Analysis: Methodology

- *Null hypothesis*: No change in vegetation cover

  ($p<0.05$)

BACI contrast = ($\mu CA_a - \mu Ca_b$) − ($\mu PRJ_a - \mu PRJ_b$)

where µ is the site-specific spatial mean of the variable selected to represent the variable of interest (here NDVI); CA_a, PRJ_a stand respectively for non-treated area and treated area at endline; CA_b and PRJ_b stand respectively for non-treated area and treated area at baseline.

- Thus, BACI contrast is normalisation of the NDVI mean, expressed as a percentage.
- A negative BACI contrast indicates that the variable has increased more in the treated site with respect to non-treated site between baseline and endline period.

Results

Perimeter name	Zone	BACI index (contrast)	Relative contrast %	P-value	Before and After Time-frame
Does-Grakali	full area	**-0.0052**	-0.73	0.0080061	2011-13vs2014-16
Does-Grakali	medium fields	**-0.0155**	-2.16	0.0002820	2011-13vs2014-16
Does-Grakali	small fields	**-0.0067**	-0.89	0.2066130	2011-13vs2014-16
Lami-Misaktsieli	full area	0.0024	0.34	0.0000150	2011-13vs2014-16
Lami-Misaktsieli	large fields	**-0.035**	-4.9	0.0892510	2011-13vs2014-16
Lami-Misaktsieli	medium fields	0.0203	2.89	0.0000470	2011-13vs2014-16
Lami-Misaktsieli	small fields	0.0036	0.48	0.0004710	2011-13vs2014-16
Karagaji	full area	0.0216	2.98	0.0001090	2012-14vs2015-16
Karagaji	small fields	-0.0031	-0.41	0.0058530	2012-14vs2015-16
Metehki	full area	0.0065	0.85	0.2082250	2012-14vs2015-16
Metehki	small fields	**-0.0113**	-1.45	0.0001110	2012-14vs2015-16
Dzevera-Shertuli	full area	0.0043	0.61	0.0145280	2013-15vs2016
Dzevera-Shertuli	medium fields	0.0595	9.24	0.3925540	2013-15vs2016
Dzevera-Shertuli	small fields	**-0.0044**	-0.63	0.0140050	2013-15vs2016

Negative BACI contrasts (in bold).
Green background is used to highlight negative BACI contrasts that are significant at the 0.05 P-value.
Light green background is used to highlight negative BACI contrasts that are very close to significant 0.05 P-value.
Grey background indicates a non-significant/no BACI effect.

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Results

- Results show that a significantly negative BACI contrast (i.e. improvement in NDVI with respect to CA after the intervention) was detected in 7 out of 14 samples respectively but only 4 have a significant 0.05 P-value.

- Focussing on the sites for which a significant BACI effect was detected, the average relative contrast is -1.24%.

- Considering NDVI as a rough approximation of the fractional vegetation cover, these numbers translate into a limited improvement in the vegetation development with respect to the controls.

Lessons learned

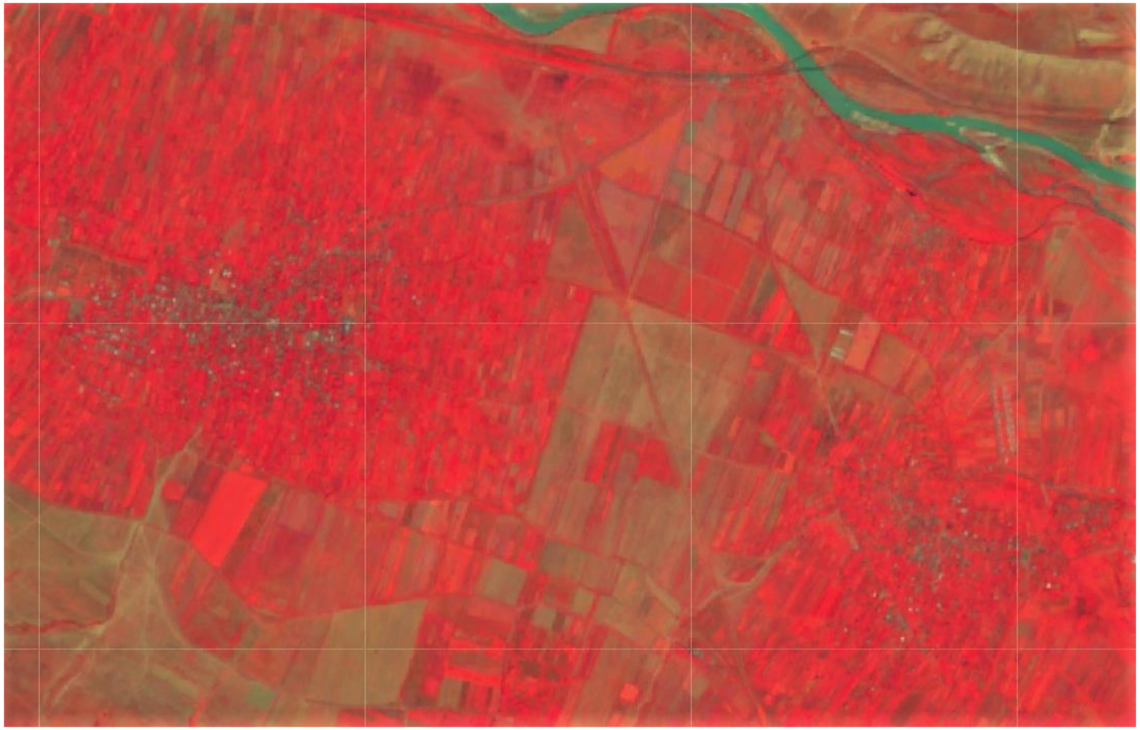
- The application of the methodology to a complex environment such as an irrigated area can face **significant challenges** in explaining whether the change (change in vegetation greenness or switch of cropping patterns).
- **A well-designed field visit is essential to explain the confounding factors** (e.g. crop rotation, crop change, field context etc.). Survey firm to collect household data with coordinates, which could then be utilised for cross-reference of the NDVI data in the same area of interest (AOI).
- **Preparation is the key for implementing this kind of methodologies**
  - the delineation boundary for project's intended command area.
  - holding discussions with project staff to pre-assess the accuracy of treatment area maps.

Lessons learned

- **When NDVI is used in conjunction with household survey, two strategies can be explored**:
    - Using NDVI to aid control group selection of the household survey.
    - Using NDVI to select a control group additional to control group used for household survey.
        - Areas with potential spill-over effects.

Further developments and use

- The methodology has been completely automatized by developing an algorithm in open source statistical software R (R Development CoreTeam, 2016). It can be applied easily to other IE.
- Great potentialities coming from newly available Earth Observation data (Sentinel II at 10 mt. resolution)



Potential application of NDVI

- Synthetic Controls NDVI analysis
  - Use the synthetic controls method to create synthetic villages to test the project's impact
  - Control municipalities could be constructed from the data used for matching
  - High-likelihood of detecting a valid control since treatment community count is ~30, while pool of communities for synthetic

Thank you.

Appendix Slides: The Genetic Matching Process compared with PSM

Figure 1: Flowchart of Algorithm for Iterative Estimation of a Propensity Score Model

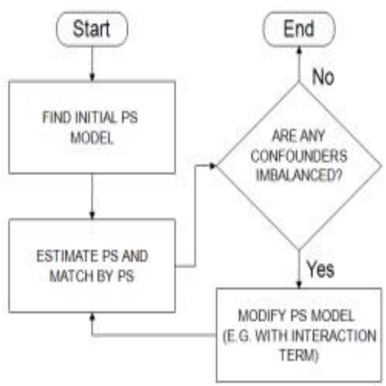
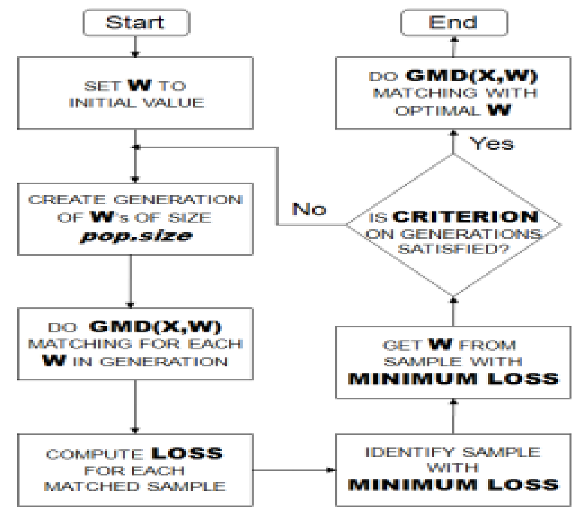


Figure 2: Flowchart of Genetic Matching Algorithm



Appendix Slides: What would a synthetic controls model look like?

FIGURE 1 Trends in per Capita GDP: West Germany versus Rest of the OECD Sample

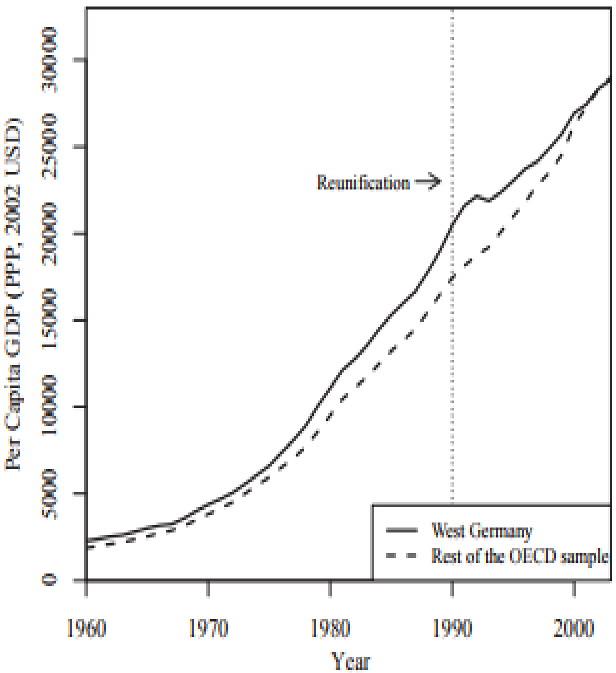
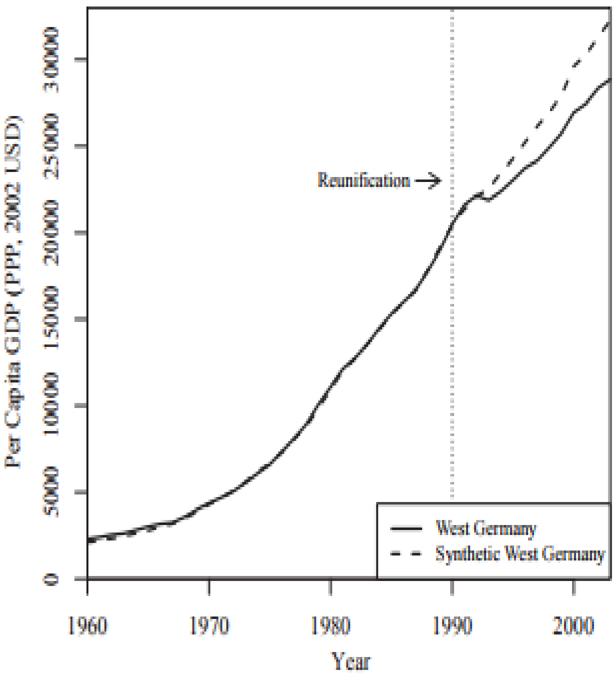


FIGURE 2 Trends in per Capita GDP: West Germany versus Synthetic West Germany



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