*Online Appendix*

*Tariffs and Trees: The Effects of the  
 Austro-Hungarian Customs Union on   
Specialization and Land-Use Change*

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# *Appendix A Additional Summary Table*

### Table A1 Summary Statistics of Variables Used in Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Mean | SD | Min. | Max. |
| Crops (0/1) | 0.358 | 0.479 | 0.000 | 1.000 |
| Pasture (0/1) | 0.181 | 0.385 | 0.000 | 1.000 |
| Wetlands (0/1) | 0.012 | 0.110 | 0.000 | 1.000 |
| Forest/grasslands (0/1) | 0.354 | 0.478 | 0.000 | 1.000 |
| Urban (0/1) | 0.012 | 0.109 | 0.000 | 1.000 |
| Ruggedness index | 0.837 | 0.665 | 0.000 | 3.093 |
| Km to nearest city | 17.864 | 11.143 | 0.022 | 80.520 |
| Km to nearest river | 43.157 | 28.737 | 0.001 | 137.848 |
| No ag. limitations (0/1) | 0.678 | 0.467 | 0.000 | 1.000 |
| Approx. population density | 53.095 | 46.742 | 20.424 | 3978.750 |
| Observations | 81,407 |  |  |  |

*Source*: Author’s calculations using dataset described in Data and Methodology section.

*Appendix B Alternative Discontinuity Window Results*

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Table B2  
Impacts of customs union within Hungary

40 kilometer discontinuity, only districts with time variation

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Dependent Variable | | | | | | | | | | |
|  | | Crops | | | | Pasture | | | Forest | | | |
|  | | (1) | | (2) | | (3) | | (4) | (5) | | (6) | |
| Post customs union | | 0.028 | | 0.050 | | –0.042 | | –0.054 | –0.001 | | 0.009 | |
|  | | (0.062) | | (0.051) | | (0.062) | | (0.050) | (0.073) | | (0.027) | |
|  | | [–0.209, 0.158] | | [–0.095, 0.139] | | [–0.274, 0.121] | | [–0.236, 0.075] | [–0.096, 0.294] | | [–0.017, 0.162] | |
|  | |  | |  | |  | |  |  | |  | |
| Years since 1850 x post union | | 0.046\* | | 0.049\*\* | | –0.001 | | –0.007 | –0.050\*\* | | –0.039\*\*\* | |
|  | | (0.022) | | (0.017) | | (0.013) | | (0.012) | (0.019) | | (0.011) | |
|  | | [–0.006, 0.135] | | [0.028, 0.078] | | [–0.021, 0.040] | | [–0.034, 0.016] | [–0.141, –0.025] | | [–0.059, –0.019] | |
|  | |  | |  | |  | |  |  | |  | |
| Other covariates | | No | | Yes | | No | | Yes | No | | Yes | |
| District FE | | Yes | | Yes | | Yes | | Yes | Yes | | Yes | |
| Observations | | 7,618 | | 7,618 | | 7,618 | | 7,618 | 7,618 | | 7,618 | |
| R2 0.010 | 0.010 | | 0.049 | | | 0.004 | 0.018 | | 0.019 | 0.125 | | |
| δ | | 9.146 | | 49.346 | | –0.824 | | –2.618 | 12.550 | | 6.332 | |
| N districts | | 10 | | 10 | | 10 | | 10 | 10 | | 10 | |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | | | |  |  | |  |  | | |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. All estimates include years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river. Ninety-five percent wild bootstrap clustered CIs in [].

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

### Table B3

### Impacts of customs union within Hungary 30-kilometer discontinuity

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.031 | 0.051 | –0.058 | –0.061 | 0.013 | 0.016 |
|  | (0.058) | (0.043) | (0.049) | (0.045) | (0.070) | (0.039) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.041\*\* | 0.038\*\* | –0.003 | –0.008 | –0.040\*\* | –0.025\* |
|  | (0.020) | (0.016) | (0.011) | (0.012) | (0.018) | (0.014) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,186 | 8,186 | 8,186 | 8,186 | 8,186 | 8,186 |
| R2 | 0.009 | 0.054 | 0.002 | 0.013 | 0.013 | 0.122 |
| N districts | 23 | 23 | 23 | 23 | 23 | 23 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 30 km of a mapping border. All estimates include years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

### Table B4

### Impacts of customs union within Hungary 20-kilometer discontinuity

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.031 | 0.057 | –0.055 | –0.072 | 0.010 | 0.014 |
|  | (0.067) | (0.046) | (0.033) | (0.041) | (0.068) | (0.038) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.042\* | 0.045\*\* | –0.005 | –0.014 | –0.042\* | –0.031\* |
|  | (0.023) | (0.017) | (0.011) | (0.013) | (0.022) | (0.015) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,772 | 5,772 | 5,772 | 5,772 | 5,772 | 5,772 |
| R2 | 0.011 | 0.053 | 0.002 | 0.016 | 0.014 | 0.122 |
| N districts | 18 | 18 | 18 | 18 | 18 | 18 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 20 km of a mapping border. All estimates include years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

# *Appendix C Results Including District Time Trends*

### Table C5

### Impacts of customs union within Hungary with district by year trends

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.033 | 0.004 | –0.029 | –0.067 | –0.029 | 0.063 |
|  | (0.055) | (0.100) | (0.049) | (0.044) | (0.068) | (0.071) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.035\* | 0.053\*\* | 0.005 | –0.018 | –0.040\*\* | –0.030\* |
|  | (0.017) | (0.020) | (0.010) | (0.014) | (0.015) | (0.016) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 10,356 | 10,356 | 10,356 | 10,356 | 10,356 | 10,356 |
| R2 | 0.007 | 0.054 | 0.003 | 0.024 | 0.014 | 0.132 |
| N districts | 23 | 23 | 23 | 23 | 23 | 23 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. All estimates include years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

### Table C6

### Impacts of customs union within Hungary

with district BY YEAR trends and using sample   
with within-district variation in treatment

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.028 | 0.004 | –0.042 | –0.066 | –0.001 | 0.059 |
|  | (0.062) | (0.101) | (0.062) | (0.043) | (0.073) | (0.073) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.046\* | 0.055\*\* | –0.001 | –0.018 | –0.050\*\* | –0.032\* |
|  | (0.022) | (0.020) | (0.013) | (0.014) | (0.019) | (0.017) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 7,618 | 7,618 | 7,618 | 7,618 | 7,618 | 7,618 |
| R2 | 0.010 | 0.052 | 0.004 | 0.023 | 0.019 | 0.127 |
| N districts | 10 | 10 | 10 | 10 | 10 | 10 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. All estimates include years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

# *Appendix D Results Including Population Density*

### Table D7

### Impacts of customs union in Hungary, including population

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.050 | 0.036 | –0.014 | –0.037 | –0.064 | –0.005 |
|  | (0.059) | (0.049) | (0.049) | (0.044) | (0.064) | (0.037) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.030 | 0.029\* | 0.001 | –0.005 | –0.031\* | –0.018 |
|  | (0.018) | (0.015) | (0.010) | (0.010) | (0.016) | (0.013) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 10,356 | 10,356 | 10,356 | 10,356 | 10,356 | 10,356 |
| R2 | 0.008 | 0.048 | 0.004 | 0.018 | 0.017 | 0.126 |
| N districts | 23 | 23 | 23 | 23 | 23 | 23 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. All estimates include ln(population density), years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

### Table D8

### Impacts of customs union within Hungary – 40 kilometer discontinuity, only districts with time variation, including population density

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dependent Variable | | | | | |
|  | Crops | | Pasture | | Forest | |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Post customs union | 0.047 | 0.059 | –0.027 | –0.045 | –0.037 | –0.008 |
|  | (0.067) | (0.058) | (0.063) | (0.053) | (0.068) | (0.030) |
|  |  |  |  |  |  |  |
| Years since 1850 x post union | 0.042\* | 0.047\*\* | –0.004 | –0.008 | –0.043\* | –0.036\*\* |
|  | (0.022) | (0.017) | (0.012) | (0.012) | (0.019) | (0.013) |
|  |  |  |  |  |  |  |
| Other covariates | No | Yes | No | Yes | No | Yes |
| District FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 7,618 | 7,618 | 7,618 | 7,618 | 7,618 | 7,618 |
| R2 | 0.010 | 0.049 | 0.005 | 0.018 | 0.022 | 0.126 |
| N districts | 10 | 10 | 10 | 10 | 10 | 10 |
| \* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01. | | |  |  |  |  |

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. All estimates include ln(population density), years since 1850, a quadratic of distance to discontinuity, and ln(km to border with Austria). Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, and proximity to river.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

### Table D9

### Impact of customs union by distance to Austro-Hungarian border, with population density

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dependent Variable | | |
|  | Crops | Pasture | Forest |
|  | (1) | (2) | (3) |
| Post customs union | –0.014 | –0.071 | 0.079\* |
|  | (0.053) | (0.044) | (0.041) |
|  |  |  |  |
| Post union x border proximity | 4.200\*\* | 3.418\*\*\* | –7.461\*\* |
|  | (1.957) | (0.659) | (2.687) |
|  |  |  |  |
| Years since 1850 x post union | 0.041\*\* | 0.005 | –0.039\*\*\* |
|  | (0.018) | (0.010) | (0.014) |
|  |  |  |  |
| Post union x year x border proximity | –1.137\* | –1.022\*\*\* | 2.094\*\* |
|  | (0.579) | (0.173) | (0.780) |
|  |  |  |  |
| Other covariates | Yes | Yes | Yes |
| District FE | Yes | Yes | Yes |
| Observations | 10,356 | 10,356 | 10,356 |
| R2 | 0.049 | 0.019 | 0.129 |
| N districts | 23 | 23 | 23 |

\* p*<* 0.10, \*\* p*<*0.05, \*\*\* p *<* 0.01.

Unit of observation is the point. Standard errors are in parentheses and are clustered at the district level. These are partial results using the sample within 40 km of a mapping border. Other covariates include ruggedness, an indicator for agricultural soil, proximity to city, a quadratic for distance to discontinuity, proximity to river, ln(population density), and years since 1850. Border proximity is measured as 1/km to border.

*Sources*: Authors’ calculations using dataset described in Data and Methodology.

# *Appendix E: Additional Figures*

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|  |
| Figure E1Relative Prices*Source*: *Tafeln zur Statistik der Österreichischen Monarchie* (1828–1865). |

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|  |
| Figure E2Historic map and sampled points*Source*: The underlying map comes from section 11, west column XI of the Habsburg Second Military Survey (Timár et al. 2006) and covers what are now the southern areas around Krosno County Poland. The black circles represent the sampled points that comprise our dataset. |

Density

.02 .04 .06

.08

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|  |
| Figure E3Mapping years and agricultural limitationsThe figure shows the density of land mapped over time with no agricultural limitations (solid line) and with some agricultural limitations (dotted line).*Sources*: Authors’ calculations using ESDB (2004) and Timár et al. (2006) historical maps. |

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|  |
| Figure E4Sample for within-Hungary discontinuity estimation*Source*: Authors' calculations using Timár et al. (2006) historical maps. |

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|  |
| Figure E5Inherent agricultural productivity by yearThis graph uses the subsample of land in agricultural use after 1850 within the discontinuity window of 40 kilometers.*Sources*: Authors’ calculations using ESDB (2004) and Timár et al. (2006) historical maps. |

|  |  |
| --- | --- |
|  |  |
| 1. Austria – Crops | 1. Austria – Forest |
|  |  |
| 1. Moravia – Crops | 1. Moravia – Forest |
| Figure E6  Trends in crop fields and forested area as a percent of total land: 1831–1880  Estimates are simple OLS quadratic fit regressions using data from Habsburg statistical yearbooks.  *Source*: See text for specific sources. | |

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| --- |
|  |
| Figure E7Marginal effects of distance to border on land-use after 1850Marginal effects and 95 percent confidence intervals calculated from estimates in columns (1) and (3) in Table 6. Black lines are for agriculture, and gray for forest. Marginal effects for pasture are not shown.*Source*: Authors’ calculations. |