**Appendix**

TABLE A.1

World Agricultural Production and Productivities, 1965-2005

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor productivity (Y/L)** | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | Growth Rate (%) |
| Eastern Europe | 1,664 | 1,870 | 2,312 | 3,135 | 3,694 | 4,059 | 4,191 | 5,004 | 6,365 | 3.35 |
| Western Europe | 5,347 | 7,719 | 10,001 | 11,905 | 14,510 | 17,258 | 20,593 | 25,411 | 29,034 | 4.23 |
| North America | 19,974 | 31,122 | 42,842 | 33,119 | 36,372 | 40,202 | 50,709 | 59,474 | 70,666 | 3.16 |
| Latin America | 1,993 | 2,333 | 2,562 | 2,735 | 3,042 | 3,433 | 3,909 | 4,586 | 5,572 | 2.57 |
| Australia+New Zealand | 28,794 | 33,161 | 38,048 | 36,875 | 38,110 | 38,556 | 44,393 | 54,082 | 51,339 | 1.45 |
| Southern Asia (Central and East) | 447 | 489 | 522 | 556 | 614 | 664 | 731 | 786 | 853 | 1.61 |
| China, mainland | 316 | 315 | 360 | 312 | 376 | 416 | 540 | 677 | 819 | 2.38 |
| Japan | 1,051 | 1,531 | 2,038 | 3,082 | 3,749 | 4,333 | 5,344 | 6,696 | 8,872 | 5.33 |
| Middle East and North Africa | 1,103 | 1,284 | 1,457 | 1,741 | 1,929 | 2,148 | 2,513 | 2,817 | 3,308 | 2.75 |
| Sub-Saharan Africa | 537 | 620 | 621 | 604 | 597 | 650 | 663 | 694 | 757 | 0.86 |
|  |  |  |  |  |  |  |  |  |  |  |
| **Land productivity (Y/A)** |  |  |  |  |  |  |  |  |  |  |
| Eastern Europe | 760 | 845 | 996 | 1,073 | 1,157 | 1,141 | 969 | 997 | 1,126 | 0.98 |
| Western Europe | 1,363 | 1,550 | 1,752 | 1,952 | 2,079 | 2,129 | 2,195 | 2,335 | 2,344 | 1.36 |
| North America | 487 | 499 | 577 | 650 | 678 | 707 | 810 | 903 | 1,009 | 1.82 |
| Latin America | 675 | 697 | 743 | 847 | 932 | 994 | 1,070 | 1,248 | 1,359 | 1.75 |
| Australia+New Zealand | 416 | 415 | 443 | 464 | 469 | 488 | 667 | 681 | 647 | 1.10 |
| Southern Asia (Central and East) | 419 | 483 | 534 | 619 | 732 | 838 | 984 | 1,097 | 1,232 | 2.69 |
| China, mainland | 705 | 821 | 968 | 1,175 | 1,285 | 1,529 | 2,075 | 2,623 | 3,295 | 3.85 |
| Japan | 2,306 | 2,772 | 3,114 | 3,472 | 3,778 | 3,813 | 3,832 | 3,760 | 3,761 | 1.22 |
| Middle East and North Africa | 392 | 450 | 514 | 599 | 705 | 805 | 912 | 1,078 | 1,232 | 2.86 |
| Sub-Saharan Africa | 294 | 334 | 368 | 404 | 417 | 477 | 504 | 568 | 642 | 1.95 |
|  |  |  |  |  |  |  |  |  |  |  |
| **Land-Labor ratio (A/L)** |  |  |  |  |  |  |  |  |  |  |
| Eastern Europe | 2.19 | 2.21 | 2.32 | 2.92 | 3.19 | 3.56 | 4.32 | 5.02 | 5.65 | 2.37 |
| Western Europe | 3.92 | 4.98 | 5.71 | 6.10 | 6.98 | 8.11 | 9.38 | 10.88 | 12.38 | 2.87 |
| North America | 40.97 | 62.39 | 74.26 | 50.96 | 53.63 | 56.85 | 62.64 | 65.88 | 70.03 | 1.34 |
| Latin America | 2.95 | 3.35 | 3.45 | 3.23 | 3.26 | 3.45 | 3.65 | 3.68 | 4.10 | 0.82 |
| Australia+New Zealand | 69.21 | 79.97 | 85.84 | 79.52 | 81.23 | 79.09 | 66.55 | 79.40 | 79.35 | 0.34 |
| Southern Asia (Central and East) | 1.07 | 1.01 | 0.98 | 0.90 | 0.84 | 0.79 | 0.74 | 0.72 | 0.69 | -1.08 |
| China, mainland | 0.45 | 0.38 | 0.37 | 0.27 | 0.29 | 0.27 | 0.26 | 0.26 | 0.25 | -1.47 |
| Japan | 0.46 | 0.55 | 0.65 | 0.89 | 0.99 | 1.14 | 1.39 | 1.78 | 2.36 | 4.11 |
| Middle East and North Africa | 2.81 | 2.85 | 2.83 | 2.90 | 2.74 | 2.67 | 2.75 | 2.61 | 2.69 | -0.11 |
| Sub-Saharan Africa | 1.82 | 1.86 | 1.69 | 1.49 | 1.43 | 1.36 | 1.31 | 1.22 | 1.18 | -1.09 |

Y/L in US $ 2004-2006 prices per people engaged in agriculture.

Y/A in US $ 2004-2006 prices per hectare of arable land and permanent crops.

A/L hectare of arable land and permanent crops per people engaged in agriculture.

Source: FAO (1948-2004) and FAOSTAT (2014).

FIGURE A.1

Sources of agricultural output, 1950-2008

Source: the same as Table 3 (main text)

FIGURE A.2

Agricultural Labor Productivity Decomposition, 1950-2008

Source: the same as Table 5 (main text)

FIGURE A.3

Agricultural Labor Productivity Decomposition, 1950-2008

Source: the same as Table 6 (main text)

**Construction of variables**

Agricultural production

As mentioned in the main text, from FAOSTAT (2012) we obtained a series for each country from 1961 valued at international 2004-2006 prices in dollars. In order to complete the data for the whole period of our study, we assumed that during the 1950s the series followed the agricultural production index which appears in FAO (1948-2004). In this way, we obtained a complete series for each Latin American country from 1950 to 2008.

Inputs

We followed the same procedure as in the agricultural production, but with some differences. FAO (1948-2004) does not provide these variables, namely, labor, land, machinery, livestock units and fertilizers, in continuous series for the 1950s. These variables were offered in some specific years during this decade. We calculated a continuous series for this decade taking into account the data which appear in these yearbooks for each variable and country and we then completed the series with a linear interpolation.

As explained in the main text, the data for chemical fertilizers correspond to the period 1961 to 2008 from IFA (2014).

Another exception is the obtaining of the series of the active population in agriculture. When we downloaded the data from FAOSTAT (2012), these data are available from 1980 in the online webpage. Consequently, we followed the same strategy as in the rest of variables but taking into account the data from FAO (1948-2004) from 1950 to 1980. The omitted data were completed.

The land factor is calculated following Fuglie (2010 and 2012). We obtained the surfaces of arable land and permanent crops, the area equipped for irrigation and permanent meadows from FAOSTAT (2012) and for the production yearbook from FAO (1948-2004). We have homogenized these surfaces using the conversion coefficients for different land types from Fuglie (2010 and 2012). We cannot include the improvements of the land, because the availability of the data is limited for all the Latin American countries during the whole second half of the twentieth century.

In the case of the livestock numbers, we included the weightings of Hayami and Ruttan (1985), commonly used in agricultural economics studies to calculate livestock numbers when calculating the livestock population of a country. These authors incorporated camels, horses (1), mules (1), donkeys (0.8), beef cattle (0.8), ovine cattle (0.1), goats (0.1), pigs (0.2), as well as rabbits, chickens, geese, ducks and turkeys (0.01). The factor that appears in each animal type is multiplied by the number of animals to obtain an aggregate measurement of the livestock population.

TABLE A2.1

Agricultural gross production in millions of US$ (constant prices 2004-2006).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1950 | 1973 | 1993 | 2008 |
| Argentina | 12,186 | 14,277 | 19,487 | 30,370 |
| Brazil | 8,265 | 20,707 | 41,708 | 79,744 |
| Chile | 1,466 | 1,966 | 3,935 | 5,809 |
| Colombia | 2,980 | 5,260 | 9,290 | 12,931 |
| Honduras | 381 | 852 | 1,367 | 2,195 |
| Mexico | 4,461 | 14,188 | 23,912 | 35,271 |
| Panama | 232 | 493 | 784 | 1,293 |
| Peru | 1,312 | 2,129 | 2,783 | 6,301 |
| Uruguay | 1,211 | 1,313 | 1,686 | 2,521 |
| Venezuela | 1,557 | 4,155 | 7,381 | 10,960 |
| LA | 34,050 | 65,338 | 112,333 | 187,397 |

Triennial averages.

Source: FAO (1948-2004) and FAOSTAT (2012).

TABLE A2.2

Land factor (thousands of hectares).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1950 | 1973 | 1993 | 2008 |
| Argentina | 2,1469 | 31,390 | 32,558 | 37,893 |
| Brazil | 24,221 | 51,404 | 115,842 | 123,977 |
| Chile | 5,318 | 5,876 | 4,763 | 4,060 |
| Colombia | 3,303 | 6,566 | 6,844 | 5,544 |
| Honduras | 782 | 1,700 | 2,073 | 1,561 |
| Mexico | 25,051 | 30,087 | 35,527 | 36,605 |
| Panama | 244 | 601 | 739 | 1,193 |
| Peru | 3,209 | 4,752 | 5,784 | 6,191 |
| Uruguay | 1,886 | 1,892 | 1,884 | 2,298 |
| Venezuela | 3,584 | 4,276 | 4,419 | 4,481 |
| LA | 89,068 | 138,545 | 210,434 | 223,802 |

This variable takes into account arable land and permanent crops, irrigated land and permanent pastures. See the text of the Appendix for the calculation. Triennial averages, except 1950.

Source: FAO (1948-2004), FAOSTAT (2012) and Fuglie (2010) and (2012).

TABLE A2.3

Agricultural labor (thousands of people).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1950 | 1973 | 1993 | 2008 |
| Argentina | 1,623 | 1,448 | 1,454 | 1,421 |
| Brazil | 9,887 | 14,497 | 14,037 | 11,622 |
| Chile | 648 | 709 | 973 | 969 |
| Colombia | 1,975 | 2759 | 3,503 | 3,559 |
| Honduras | 538 | 557 | 700 | 670 |
| Mexico | 4,824 | 6,942 | 8,751 | 8,098 |
| Panama | 132 | 202 | 256 | 252 |
| Peru | 1,361 | 1,864 | 2,954 | 3,648 |
| Uruguay | 216 | 178 | 195 | 187 |
| Venezuela | 705 | 752 | 849 | 745 |
| LA | 21,909 | 29,908 | 33,672 | 31,171 |

Source: FAO (1948-2004) and FAOSTAT (2012).

The rest of the input variables used in calculation TFP can be found in Martín-Retortillo *et al.* (2019).

Estimation of TFP

The estimation of the TFP is obtained from the difference of the agricultural production growth and a combination of the inputs growth. This combination is formed by labor, land ­-which is a combination of arable land and permanent crops with the irrigated land-, machinery, chemical fertilizers and livestock units. In order to measure the growth of production and inputs, we used the Tornqvist Theil index (Demicavilla-Herrero and San Juan-Mesonada 2000). To carry out the combination, the growths of inputs have to be weighted. We used three different combinations of weightings, taking into account their economic and climatic conditions. One strong point of using this TFP calculation with unfixed weightings it that it takes into account the evolution of the different importance of the inputs. Based on these benchmark years, we constructed an annual series of weightings through linear interpolation. The benchmark years weightings appear in Tables A3.1, A3.2 and A3.3. For our calculation we considered three types of weightings drawn from studies on Mexico, Brazil and Argentina. We applied to Argentina, Chile and Uruguay the weightings of Argentina; to Mexico, Colombia, Honduras and Peru that of Mexico; and to the rest that of Brazil. In order to group the countries, we referred to the discussion on the typologies of Latin American economies conducted by Luis Bértola and José Antonio Ocampo in *El desarrollo económico de América Latina desde la independencia* (*Fondo de Cultura Económica, México*, 2013) on pages 24-29. These authors offer several possibilities taking into account the economy as a whole and the timeframe. In our opinion, for our case it would be appropriate to select what is principally based on agriculture. Therefore, we classified the countries into three groups:

- temperate climate agricultures: Argentina, Chile, Uruguay

- tropical agricultures with a large Afro-American workforce: Brazil, Venezuela and Panama

- mixed temperate-tropical climate agricultures, with traditional subsistence farming and a predominantly Indo-American workforce: Mexico, Colombia, Honduras, Peru.

Besides, as explained in the Appendix from Martín-Retortillo *et al.* (2019), in order to confirm the robustness of the criteria adopted and to determine how sensitive the calculations are to a change in the weightings, we ran simulations using alternative values. In general, as we can observe in Table A.3.1 for Mexico, the differences are small. Furthermore, when we calculate the correlation between the results obtained for each corresponding group of weightings (Argentina, Mexico and Brazil), considered *vis-à-vis*, we find high coefficients: 0.94 (between the values obtained with the weightings of Argentina and Mexico), 0.96 (Argentina and Brazil) and 0.86 (Mexico and Brazil). We believe that these correlation coefficients, which are high and close to the values obtained, constitute solid proof of robustness, although it should be taken into account that different weightings do not generate exactly the same results. In the case of Argentinian weightings, we took two fixed weightings into account (Díaz Alejandro, 1950 for 1950 and Elías, 1992 for 2008). We estimated a linear interpolation between these two years in order to obtain an annual series. These two references offered weightings for labor, land and capital. We disaggregate the capital weightings assuming this is the same distribution as the Brazilian weightings.

TABLE A3.1.

*Weightings corresponding to Mexico*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Work | Land | Cattle | Fixed capital | Chemicals |
| 1950 | 0.256 | 0.489 | 0.118 | 0.089 | 0.048 |
| 1973 | 0.242 | 0.373 | 0.200 | 0.147 | 0.038 |
| 1990 | 0.117 | 0.202 | 0.362 | 0.289 | 0.031 |
| 2008 | 0.115 | 0.225 | 0.353 | 0.263 | 0.045 |

*Source:* Calculated with data from Fuglie (2012).

TABLE A3.2.

*Weightings corresponding to Brazil*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Work | Land | Cattle | Fixed capital | Chemicals |
| 1950 | 0.434 | 0.342 | 0.126 | 0.071 | 0.027 |
| 1973 | 0.434 | 0.342 | 0.126 | 0.071 | 0.027 |
| 1990 | 0.429 | 0.137 | 0.1745 | 0.144 | 0.116 |
| 2008 | 0.373 | 0.083 | 0.129 | 0.161 | 0.255 |

*Source:* Calculated with data from Fuglie (2012).

TABLE A3.3

*Weightings corresponding to Argentina*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Work | Land | Cattle | Fixed capital | Chemicals |
| 1950 | 0.333 | 0.333 | 0.188 | 0.106 | 0.040 |
| 1973 | 0.340 | 0.261 | 0.160 | 0.122 | 0.117 |
| 1990 | 0.345 | 0.207 | 0.140 | 0.135 | 0.174 |
| 2008 | 0.350 | 0.150 | 0.118 | 0.148 | 0.234 |

*Source:* Díaz Alejandro (1970) and Elías (1992).

Tables

FIGURE A.6

Agricultural TFP for each Latin American country



Sources: Specified in Section 2 ‘Analytical model and data’ of the main text.

References

BÉRTOLA, L. and OCAMPO, J. A. (2012). *El desarrollo económico en América Latina desde su independencia*. México D. F.: Fondo de Cultura Económica.

Decimavilla-Herrero, E. & San Juan-Mesonada, C. (2000) “Diferencias de productividad en Europa. Equilibrio a corto y largo plazo”. Documentos de trabajo 00-18, Series de Economía 03, Departamento de Economía, Universidad Carlos III de Madrid.

DÍAZ ALEJANDRO, C. (1970). *Essays on the Economic History of the Argentine Republic*. New Haven CT: Yale University Press.

Elías, V. J. (1992). *Sources of Growth. A Study of Seven Latin American Economies*. San Francisco CA: International Center of Economic Growth.

IFA (2014). International Fertilizer Industry Association, http://ifadata.fertilizer.org/ucSearch.aspx, downloaded September 2014.

FAOSTAT (2012). *FAO database* (*faostat.org*) Net Production, Machinery, Labor, Land, Livestock, Irrigation for Latin American Countries. Accessed on November 2012 and January 2020.

FAO (1948-2004). *FAO Production Yearbook*. Rome, Food and Agriculture Organization of the United Nations.

Fuglie, K. O. (2010). “Total Factor Productivity in the Global Agricultural Economy: Evidence from FAO data”. In J. M. Alston, B. A. Babcock and P. G. Pardey, *The Shifting Patterns of Agricultural Production*. Ames: Midwest Agribusiness Trade Research and Information Center, 63-95.

Fuglie, K.O. (2012). “Productivity Growth and Technology Capital in the Global Agricultural Economy”. In: K. O. Fuglie, S. Ling Wang and V. Eldon Ball (eds.), *Productivity Growth in Agriculture: An International Perspective*. Oxfordshire: CAB International, 335-69.

HAYAMI, Y. and RUTTAN, V. (1985)*”*. Baltimore: The Johns Hopkins University Press.

MARTÍN-RETORTILLO, M., PINILLA, V., VELAZCO, J. and WILLEBALD, H. (2019). “The Dynamics of Latin American Agricultural Production Growth since 1950”. *Journal of Latin American Studies*, 51, 3, pp. 573-605