

# The Agricultural Productivity Gap

## Online Appendix

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### ABSTRACT

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Online Appendix for “The Agricultural Productivity Gap in Developing Countries”

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## A. Data Appendix

In this section we provide more detail about the data sources used in the paper. Section 1.1 describes the Living Standards Measurement Surveys and our associated calculations, while 1.2 details the sources for our data on hours worked and years of schooling.

### 1.1. Living Standards Measurement Surveys

The Living Standards Measurement Surveys (LSMS) have been conducted in a number of developing countries over the last three decades. They are conducted in most cases by the World Bank and the national statistical agencies in the country in question. We make use of ten of these surveys, which are listed in Table 1 below, along with their sample sizes (the number of households surveyed.)

**Table 1: LSMS Surveys**

Country	Survey	Sample Size
Armenia	Household Budget Survey, 1996	4,920
Bulgaria	Multitopic Household Survey, 2003	3,023
Cote d'Ivoire	Cote d'Ivoire Living Standards Survey, 1988	1,600
Guatemala	National Survey of Living Standards, 2000	7,276
Ghana	Ghana Living Standards Survey, 1998	5,998
Kyrgyz Republic	Kyrgyz Poverty Monitoring Survey, 1998	2,934
Pakistan	Pakistan Integrated Household Survey, 1991	4,800
Panama	Survey of Living Standards of 2003	5,591
South Africa	South Africa Integrated Household Survey, 1993	8,811
Tajikistan	Living Standards Survey, 2009	1,500

Each of the surveys in Table 1 are *nationally representative* surveys of households, and employ a two-stage sampling methodology. In the first stage, a set of “primary sampling units,” (PSU) or geographic regions, are chosen at random from an existing list. One can think of PSUs as “villages” in rural areas and “neighborhoods” in urban areas. In the second stage, a set of households are chosen at random from each PSU.<sup>1</sup> Every member in the sampled households are then interviewed. While survey content varies from country to country, all of them cover basic demographic information, educational attainment, employment status in the last week, month and/or year. For households employed in agricultural production of any kind, there is

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<sup>1</sup>We use sample weights whenever they are available; several of the surveys are self-weighting, and do not require weights.

an agriculture module which contains detailed questions on agricultural outputs, such as the quantity of each crop grown, and inputs, such as fertilizer use or the cost of hired labor. For households with non-agricultural production, there is an additional module with questions about the type of business, revenues, and input costs.

For each country, we compute the share of employment in agriculture as the fraction of all economically active persons aged 15 or greater whose primary employment is in agriculture, hunting or fishing. We define economically active persons to be those who are either employed or seeking work at the time of the survey. Following the national accounts methodology, we do not use a minimum hours worked threshold. We compute the share of value added by sector using equations (5), (6), (7) and (8). The prices used to value output are either the locally prevailing price paid to producers, or the households' reported price that it would receive, depending on the crop and survey. We define the input costs to be all expenditures on hired labor, rented equipment or land, repair services, purchased fertilizer or seeds, or any other expenditure listed on the survey questionnaire.

In each survey, some of the aggregation to the household level has been computed by the World Bank and/or the national statistical agency associated with the survey. We make use of these aggregated variables where available. For example, in all surveys the total value of agricultural output by household has already been constructed. In some surveys, labor income at the individual level has already been aggregated to include wage and in-kind payments plus bonuses at all jobs. In others, the input costs of non-agricultural or agricultural businesses have been aggregated to the household level. In all surveys, the World Bank or statistical agencies have imputed missing variables or re-coded outliers (or missing variables) where they deemed appropriate. We drop any additional households with missing income data, although typically this involves a very small number of records. We do not drop any outliers, although we found that our results are robust to dropping the top and bottom 1 percent of households by income or consumption.

Wage income, self-employment income and capital income are all measured before taxes. Wage income is measured at the individual level and then aggregated to the household level. It includes all payments in currency or in kind plus any bonuses received at primary, secondary or other jobs. Capital income is measured directly at the household level, and varies slightly from country to country in what is available. In most countries, capital income includes payments from rental of land, housing, or other property, plus interest payments. Most countries do not record dividends from shares of business owned but not controlled, as income from these sources is likely to be quite small in these countries.

We do *not* include transfer payments, gifts, inheritances or "other income" in any of our income calculations. The rationale is that while these income sources are relevant items in the

budget constraints of individual households, they do not correspond to income from a national accounting perspective. Put differently, they do not correspond with production of new goods or services by the households in the survey.

Measures of household expenditure have been aggregated by broad expenditure category by the World Bank or relevant statistical agency in each of the surveys. We compute total household expenditure to be the sum of purchased food and non-food non-durable expenditures, plus service expenditures, plus the value of food or non-food items produced and consumed directly by the households. Some surveys also contain the imputed value of durables owned by the households, which we include if it is available. The yearly flow value of durables is imputed as the price paid for the durable good divided by an estimate of its usable life in years. In all surveys, these computations are made in the same way for agricultural and non-agricultural households.

All of the LSMS surveys are publicly available (often at no charge) from the World Bank website. For more on any individual survey, a basic information document is available for each country, as are the survey questionnaires themselves. Our household-level data (and our computer code used to construct it) is available upon request for each country where our user agreement permits us to share it.

## **1.2. Hours and Schooling by Sector**

Table 2 below details the sources of data on schooling and hours used for each country in our data set. If not otherwise indicated, the samples include only economically active individuals aged 15 or greater, schooling is computed as the number of years of schooling completed, hours worked means the total number of hours worked in the reference week of the sample, and workers are classified by industry using the industry of primary employment if employed, the primary industry of previous employment if unemployed, or rural-urban status if unemployed and previous industry is not available. Whenever urban-rural status was used in place of agricultural non-agricultural status this is marked in the final column of the table. All other deviations are indicated using footnotes.

Our final country-level data set, including the raw and adjusted agricultural productivity gaps, average hours worked by sector, average schooling by sector, and human capital by sector is available upon request.

**Table 2: Schooling and Hours Source Information by Country**

Country	Variable	Year	Source	Ag/Non-Ag or Urban/Rural
Albania	Schooling	2002	Living Standards Measurement Survey	A
	Hours	2002	Living Standards Measurement Survey	A
Argentina	Schooling	2001	Census of Population and Housing (IPUMS)	A
Armenia	Schooling	1996	Living Standards Measurement Survey	A
	Hours	1996	Living Standards Measurement Survey	A
Australia	Schooling	2009	Household Income and Labor Dynamics	A
	Hours	2009	Household Income and Labor Dynamics	A
Austria	Schooling	2001	Population Census (IPUMS)	A
Azerbaijan	Schooling	2006	Demographic and Health Survey (EPDC)	U
Bangladesh	Schooling	2000	Household Income and Expend. Survey	A
	Hours	2000	Household Income and Expend. Survey	A
Belarus	Schooling	1999	Population Census (IPUMS)	A
Belgium	Hours	YR	Harmonised European Time Use Survey	A
Belize	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Bhutan	Schooling	2005	Population and Housing Census	U
	Hours <sup>4</sup>	2007	Living Standard Survey	U
Bolivia	Schooling	2001	Census of Housing and Population (IPUMS)	A
	Hours	2000	Mecovi Survey	U
Botswana	Schooling	1996	Labour Force Survey	A
	Hours	1996	Labour Force Survey	A
Brazil	Schooling	2000	Demographic Census (IPUMS)	A
	Hours	2000	Demographic Census (IPUMS)	A
Bulgaria	Schooling	2003	Living Standards Measurement Study	A
	Hours	2003	Living Standards Measurement Study	A
Burkina Faso	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U

Burundi	Schooling <sup>6</sup>	1998	Enquete Prioritaire	A
Cambodia	Schooling	1998	General Population Census (IPUMS)	A
	Hours <sup>4</sup>	2001	Labour Force Survey	U
Cameroon	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Canada	Schooling	2001	Census (IPUMS)	A
	Hours	2001	Census (IPUMS)	A
Cent. African Rep.	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Chad	Schooling	2004	Demographic and Health Survey (EPDC)	U
Chile	Schooling	2009	National Socioeconomic Characterization Survey	U
	Hours	2009	National Socioeconomic Characterization Survey	U
China	Schooling	1990	National Population Census (IPUMS)	A
Colombia	Schooling	2005	General Census (IPUMS)	A
Costa Rica	Schooling	2000	Population and Housing Census (IPUMS)	A
Cote d'Ivoire	Schooling	1988	Living Standards Measurement Survey	A
	Hours	1988	Living Standards Measurement Survey	A
Cuba	Schooling	2002	Population and Dwelling Census (IPUMS)	A
Dominican Republic	Schooling	2007	Demographic and Health Survey (EPDC)	A
Ecuador	Schooling	2001	Census of Population and Dwelling (IPUMS)	A
	Hours	2001	Census of Population and Dwelling (IPUMS)	A
Egypt	Schooling	2006	Labor Market Panel Survey	A
	Hours	2006	Labor Market Panel Survey	A
El Salvador	Schooling	2007	Census of Population (IPUMS)	A
	Hours	2007	Census of Population (IPUMS)	A
Estonia	Hours	YR	Harmonised European Time Use Survey	A
Ethiopia	Schooling	2005	Demographic and Health Survey (EPDC)	U

	Hours	2005	Labour Force Survey	U
France	Schooling	2001	Employment Survey	A
	Hours	2001	Employment Survey	A
Fiji	Schooling <sup>7</sup>	1996	Census of Population and Housing	U
	Hours <sup>4</sup>	2005	Employment and Unemployment Survey	U
Finland	Hours	YR	Harmonised European Time Use Survey	A
Gabon	Schooling	2000	Demographic and Health Survey (EPDC)	U
Gambia	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Georgia	Schooling	2005	Multiple Indicator Cluster Survey (EPDC)	U
Germany	Schooling	2009	Socioeconomic Panel	A
	Hours	2009	Socioeconomic Panel	A
Ghana	Schooling	2000	Population and Housing Census (IPUMS)	A
	Hours	2000	Population and Housing Census (IPUMS)	A
Guatemala	Schooling	2010	National Survey of Employment and Income	A
	Hours	2000	Living Standards Measurement Survey	A
Guinea	Schooling	1996	Census of Population and Housing (IPUMS)	A
Guyana	Schooling	2005	Demographic and Health Survey (EPDC)	U
Honduras	Schooling	2005	Permanent Household Survey	A
	Hours	2005	Permanent Household Survey	A
Hungary	Schooling	2001	Population Census (IPUMS)	A
	Hours	2001	Population Census (IPUMS)	A
India	Schooling	2004	Socio-Economic Survey (IPUMS)	A
Indonesia	Schooling	2010	Population Census (IPUMS)	U
	Hours	2010	Sakernas Survey	A
Iran	Schooling	2006	Census of Population and Housing (IPUMS)	A
Iraq	Schooling	1997	Population Census (IPUMS)	A

	Hours	2007	Household (LSMS)	Socio-Economic	Survey	A
Ireland	Schooling	2006	Census of Population (IPUMS)			A
Israel	Schooling	1995	Census of Population and Housing			A
	Hours	1995	Census of Population and Housing			A
Italy	Schooling	2010	Survey on Household Income and Wealth			A
	Hours	2010	Survey on Household Income and Wealth			A
Jamaica	Schooling	2001	Population and Housing Census (IPUMS)			A
	Hours	2001	Population and Housing Census (IPUMS)			A
Jordan	Schooling	2004	Population and Housing Census (IPUMS)			A
	Hours	2004	Population and Housing Census (IPUMS)			A
Kazakhstan	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)			U
Kenya	Schooling	1999	Population and Housing Census (IPUMS)			A
	Hours	2006	Integrated Budget Household Survey			U
Korea Republic	Schooling	2008	Labor and Income Panel Study			A
	Hours	2008	Labor and Income Panel Study			A
Kyrgyz Republic	Schooling	1999	Population Census (IPUMS)			A
Lao PDR	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)			U
Latvia	Hours	YR	Harmonised European Time Use Survey			A
Lesotho	Schooling	2004	Demographic and Health Survey (EPDC)			U
	Hours <sup>4</sup>	2008	Integrated Labour Force Survey			U
Liberia	Schooling	2007	Demographic and Health Survey (EPDC)			U
	Hours <sup>4</sup>	2010	Labour Force Survey			U
Lithuania	Schooling <sup>79</sup>	2000	Population and Housing Census			U
	Hours	YR H	Harmonised European Time Use Survey			A
Macedonia	Schooling	2005	Multiple Indicator Cluster Survey (EPDC)			U



Madagascar	Schooling	2008	Demographic and Health Survey (EPDC)	U
Malawi	Schooling	2008	Population and Housing Census (IPUMS)	A
	Hours	2004	Living Standards Measurement Survey	A
Malaysia	Schooling	2000	Population and Housing Census (IPUMS)	A
Maldives	Schooling	2009	Demographic and Health Survey (EPDC)	U
Mali	Schooling	1998	Census of Population and Housing (IPUMS)	A
Marshall Islands	Schooling	1994	Multi-Subject Household Survey	A
Mauritius	Hours <sup>5</sup>	2009	Continuous Multi-Purpose Household Survey	A
Mexico	Schooling	2000	Population and Dwelling Count II (IPUMS)	A
	Hours	2000	Population and Dwelling Count II (IPUMS)	A
Moldova	Schooling	2004	Demographic and Health Survey (EPDC)	U
Mongolia	Schooling	2000	Population and Housing Census (IPUMS)	A
Morocco	Schooling	2004	General Census of Population and Housing (IPUMS)	A
Namibia	Schooling	2006	Demographic and Health Survey (EPDC)	U
Nepal	Schooling	2001	National Population Census (IPUMS)	A
	Hours <sup>4</sup>	2008	Labour Force Survey	A
Nicaragua	Schooling	2005	National Census (IPUMS)	A
	Hours	2005	National Census (IPUMS)	A
Netherlands	Schooling	2011	DNB Household Survey	U
	Hours	2011	DNB Household Survey	U
Nigeria	Schooling	2008	Demographic and Health Survey (EPDC)	U
	Hours <sup>4</sup>	2009	Labour Force Survey	U
Pakistan	Schooling <sup>7</sup>	1998	Housing and Population Census (IPUMS)	U
	Hours <sup>4</sup>	2009	Labour Force Survey	U
Panama	Schooling	2003	Encuesta de Condiciones de Vida	A

	Hours	2003	Encuesta de Condiciones de Vida	A
Papua New Guinea	Schooling <sup>78</sup>	2000	Census National Report	U
Paraguay	Schooling	2011	Permanent Household Survey	A
	Hours	2011	Permanent Household Survey	A
Peru	Schooling	2007	Census of Housing and Population (IPUMS)	A
	Hours	2007	Estadísticas del Mercado de Trabajo	U
Philippines	Schooling	2010	Labor Force Survey	A
	Hours	2010	Labor Force Survey	A
Poland	Hours	YR	Harmonised European Time Use Survey	A
Portugal	Schooling	2001	General Census of Population and Housing (IPUMS)	A
	Hours	2001	General Census of Population and Housing (IPUMS)	A
Puerto Rico	Schooling	2005	American Community Survey	A
	Hours	2005	American Community Survey	A
Romania	Schooling	2002	Population and Housing Census (IPUMS)	A
	Hours	2002	Population and Housing Census (IPUMS)	A
Russia	Schooling	2010	Longitudinal Monitoring Survey	A
	Hours	2010	Longitudinal Monitoring Survey	A
Rwanda	Schooling	2002	Census of Population and Housing (IPUMS)	A
	Hours	2006	Integrated Living Conditions Survey	A
Saint Lucia	Schooling	1991	Population and Housing Census (IPUMS)	A
	Hours	1991	Population and Housing Census (IPUMS)	A
Sao Tome and Principe	Schooling	2009	Demographic and Health Survey (EPDC)	U
Senegal	Schooling	2002	Census of Population and Housing (IPUMS)	A
Serbia	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U

Sierra Leone	Schooling	2004	Population and Housing Census (IPUMS)	A
	Hours	1989	Labour Force Survey	A
Slovenia	Schooling	2002	Census of Population, Households and Housing (IPUMS)	A
	Hours	YR H	Harmonised European Time Use Survey	?
South Africa	Schooling	2007	Community Survey (IPUMS)	A
	Hours	2009	Labour Market Dynamics in South Africa	A
Spain	Schooling	2001	Census of Population and Housing (IPUMS)	A
	Hours	2001	Census of Population and Housing (IPUMS)	A
Sri Lanka	Schooling <sup>9</sup>	2001	Census of Population and Housing	U
	Hours <sup>4</sup>	2009	Labour Force Survey	A
Sudan	Schooling	2008	Population and Housing Census (IPUMS)	A
Suriname	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Swaziland	Schooling	2006	Demographic and Health Survey (EPDC)	U
	Hours <sup>5</sup>	2008	Labour Force Survey	A
Sweden	Hours	YR	Harmonised European Time Use Survey	A
Switzerland	Schooling	2000	Federal Census (IPUMS)	A
	Hours	2000	Federal Census (IPUMS)	A
Syria	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
	Hours	2010	Labour Force Survey	A
Tajikistan	Schooling	2005	Multiple Indicator Cluster Survey (EPDC)	U
Tanzania	Schooling	2002	Population and Housing Census (IPUMS)	A
	Hours	2009	Integrated Labour Force Survey	A
Thailand	Schooling <sup>5</sup>	2000	Population and Housing Census (IPUMS)	A
Tonga	Schooling <sup>7</sup>	2006	Census of Population and Housing	U

	Hours <sup>4</sup>	2003	Labour Force Survey	A
Turkey	Schooling	2010	Household Labor Force Survey	A
	Hours	2010	Household Labor Force Survey	A
Uganda	Schooling	2002	Population and Housing Census (IPUMS)	A
	Hours	2006	National Household Survey	A
Ukraine	Schooling	2007	Demographic and Health Survey (EPDC)	U
United Kingdom	Schooling	2009	British Household Panel Survey	A
	Hours	YR H	British Household Panel Survey	?
United States	Schooling	2000	Census (IPUMS)	A
	Hours	2000	Census (IPUMS)	?
Uruguay	Schooling	2006	Extended National Survey of Households (IPUMS)	A
Uzbekistan	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Venezuela	Schooling	2001	Population and Housing Census (IPUMS)	A
	Hours	2001	Population and Housing Census (IPUMS)	A
Vietnam	Schooling	2002	Household Living Standards Survey	A
	Hours	2002	Household Living Standards Survey	A
Yemen	Schooling	2006	Multiple Indicator Cluster Survey (EPDC)	U
Zambia	Schooling	2007	Demographic and Health Survey (EPDC)	U
	Hours	2005	Labour Force Survey	A
Zimbabwe	Schooling	2006	Demographic and Health Survey (EPDC)	U
	Hours <sup>5</sup>	2009	Labour Force Survey	A

Note: Hours worked and years of schooling data are for all economically active persons aged 15+ unless otherwise noted. IPUMS is the International Public-Use Microdata Series; EPDC is the Education Policy and Data Center

<sup>1</sup>Years of schooling imputed from educational attainment.

<sup>2</sup>Hours worked in main occupation.

<sup>3</sup>Agriculture status determined from occupation

<sup>4</sup>Computed from intervalled hours data.

<sup>5</sup>Sample consists of only employed persons.

<sup>6</sup>Sample consists of heads of households only.

<sup>7</sup>Sample includes economically inactive persons.

<sup>8</sup>Sample includes persons aged 5+. <sup>9</sup>Sample includes persons aged 10+.

## B. Data Citation

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