Relative Intergenerational Mobility, a global review

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Abstract

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JEL: Código1 Código1 Código3 Código4 Código5

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1 Motivation & Literature Review

We can understand relative intergenerational mobility as the ability of individuals to move from one relative position in the education/income distribution to another across generations over time. A society without relative intergenerational mobility is one in which the same people systematically end up in the same position in the distribution. The most extreme case would be a caste society in which no matter how much talent or potential you have, you will always end up in the place where you were born because you are not allowed to move up the social ladder.

We can summarize the reasons for estimating relative intergenerational mobility in two types:

1) **Normative reasons**: There are economic/social differences due to factors that individuals can control, such as their effort, responsibility, choices, etc. But there are other exogenous factors that individuals do not control and that limit their opportunities to develop their life projects, such as, their parents' income or the money needed for education and health of quality. There is broad consensus that public policy must generate the necessary conditions for the existence of *'equality of opportunities'*. This concept can be thought as the possibility that individuals have to realize their life projects. A society in which there are equality of opportunities is one in which circumstances do not determine the results. Therefore, the results however unequal they may be, would come from a fair process.

2) **Economic Reasons**: If there is equality of opportunity, and talents are spread throughout society, we should expect the relative position of individuals in the income/education distribution to change across generations. In reality, since there is not full equality of opportunity, much talent and ability is wasted as they are unable to realize their full potential, leading to an inefficient allocation of resources in the economy. If people feel that there is not a strong degree of equality of opportunity, this can impact on the effort given by people in the lower tail of the distribution as they feel that their efforts will be wasted and that their children's generation will end up relatively close to where they ended up. The same logic can be applied to the upper tail of the distribution.

There are many papers that have studied this issue, in different time windows, with different methodologies and data. To date, there are only two publications, conducted by the World Bank, that have studied intergenerational mobility with countries of all income levels, and from all regions of the world.

The paper seeks to contrast with the two works developed by Van der Weite et.al (2018 & 2021), on social mobility in the world. The difference is that we have more data available

and the results will be presented using the same methodology without the need to mix our own results with those of other authors. Additionally we will perform an analysis using rank-rank measures, which has been shown by Chetty et.al (2014) to be a more robust estimator. We will also perform a cross section analysis using the year in which the survey was conducted, together with a cohort analysis. This is summarized and detailed in the following table.

	Van der waide et.al		This Work	
	2021 (Education)	2018 (Education & Income)	Education	Income
Surveys	<500	<650	978	379*
Methodology	IV & Coresidents	IV & Coresidents	Coresidents	Coresidents
Approach	Cohort	Cohort	Cohort + Cross Section	Cross Section*
Estimations	Level	Level	Level & Range	Level & Range
Mix of results	Yes	Yes	No	No

*It is worth mentioning that for the income dimension we will concentrate primarily on the Latin American and Caribbean region, given the low number of surveys that are useful in the other regions of the world. We are currently working to add more surveys in this dimension and in the codes to make estimations on cohort approach.

Surveys: This would be the first study to have such a large coverage of surveys for countries around the world. We expect the results to be in line with existing literature for regional level work (LAC), and for the benchmark work we have from Van der Waide et.al. It should be noted that these surveys were chosen after applying a series of filters, which are detailed in later sections of this paper. The distribution of surveys and countries over time can be found in the appendix section.

Methodology: The works of Van der Waide et al. first estimates relative intergenerational mobility using "retrospective questions" to the son to obtain information from the father. For example, it is possible to estimate mobility in education if the son reports how many years of education his father has, as this is fairly straightforward to achieve. On the other hand, income is difficult to report accurately, so if the son does not have this information from his father, it would be possible to estimate how much it would be, using instrumental variables based on the information provided by the son. In the case of not having this type of data, the authors use the coresidents methodology, which allows obtaining information from parents and children living in the same household. In our work we use only the latter methodology, which allows us to obtain more comparable results than if different ways of estimating the same thing were used.

Approach: The works of Van der Waide et.al uses a cohort approach. This allows to know how relative mobility has evolved over different generations (using the year of birth of individuals). For the education dimension we do the same, but in addition we add a cross

section approach, which allows us to see how relative mobility has evolved over different moments in time (each moment takes into account different generations). We do the same for the income dimension, which allows us to generate a richer analysis of the phenomenon under study.

Estimates: Chetty et.al, 2014 studying relative social mobility in the United States used rank measures noting that they are a more robust way of estimating relationships between variables. In this paper we estimate relative mobility in the traditional way by level, but we also add rank estimates using *spearman correlation*. This would allow us to generate robustness analyses of the results found.

Mixing of results: The work of Van der Waide et.al shows results from different sources, the main one being Global Database on Intergenerational Mobility (GDIM) and the "Equalchances" database. The problem is that they do not document in detail the functional form of the regressions, or the filters of observations they used. It is possible that when presenting the results, they do so by mixing these methodologies, which is not ideal. In this paper we will estimate the results ourselves, using the same functional form and filters in each and every survey, without mixing results from other studies.

2   Research Questions

This paper seeks to answer two questions

1) How has intergenerational persistence in education and income behaved historically by cohort and survey years?

With this we seek to get a better idea of whether persistence is concentrated in countries with a certain level of income or in certain regions of the world, analyzing the trend over time.

2) How does intergenerational persistence correlate globally, with key variables from different models that attempt to explain it?

With this question **we do not seek to present causal evidence** as this requires a deeper analysis that is beyond the scope of this study. What we seek is to shed some light on whether the data has any relationship with variables that attempt to explain intergenerational persistence with countries around the world. The hypothesized relationship between intergenerational persistence and the variables is summarized in the following table.

Variables	Model/Study	Hypothesis
Inequality (Gini Coefficient)	Corak (2013)	Positive
Public Spent	Mayer & Lopoo (2007)	Negative
Economic Liberalization	Xie & Chang (2022)	Negative

3   Data

The ideal data to generate this type of work are long panel data that track parents and children in their income history and years of schooling. These types of data are extremely expensive to collect, and if they exist at all, they are typically concentrated in developed world countries.

We have three data sources:

1) International Income Distribution Database (I2D2): In an effort to generate international evidence on different matters, the World Bank generated standardized databases from household and labor market surveys in countries around the world for over a decade. The databases covers economies from developed and developing regions. There is no censoring of any kind in the survey selection. Not all of economy/year/survey points are included in our analysis because some surveys lack key variables. If a survey was available and has all the needed variables, then it was included. A fundamental requirement for a survey to be part of this source is that it must be nationally representative. It should be noted that for a given economy/year, there could be more than one estimate. This is because for that economy/year, there is more than one survey available, or that the same survey is available more frequently than annually. It should be mentioned that many of these databases are not open to the public. This is why in a joint work with Claudio Montenegro we generated the necessary estimates for this research, maintaining the confidentiality of the information at all times.

2) Luxemburg Income Study (LIS): Surveys from this source are nationally representative. More up-to-date income data is available, especially for rich countries, with more developing countries recently included. This data source will be used as a secondary source if any country-year combination is not available in I2D2. LIS surveys will replace I2D2 surveys if income data are better. These data are more public, can be requested for transparency, but access is very limited. The opening is given by entering the server and putting the code to get the results that arrive via email.

3) Quality of Governance (Gothenburg University): In order to find correlational evidence at the international level between our estimates and macroeconomic variables of the coun-

tries, we will use this database. The data in this database have observations that are country-year combinations, which are collected from international organizations such as the World Bank, the International Monetary Fund, among others. This data is open to the public.

*) World Bank Country and Lending Groups: To classify countries by income level and geographic region, we use a World Bank classification updated to the year 2022. The income classification has 4 categories; High income, Low income, Upper middle and Lower middle (the only country that cannot be classified was Venezuela, since the data provided is not reliable for the World Bank). The region classification has 7 categories; East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa, North America, South Asia and Sub-Saharan Africa. The list of countries in each category can be found in the appendix section.

4 Empirical Approach

To measure social mobility across countries, we will use a cross-section approach (many cohorts in each survey) and a cohort approach (many surveys in each generation). The second way is the most used and allows us to see the situation of the older generations with respect to the newer ones.

To calculate the social mobility of countries, the following functional form is typically used

$$y_s = \alpha + \beta y_f + \gamma X + \epsilon_i$$

Where:
y_s=ln(Children's income) or Children's Education
y_f=ln(Father's income) or Father's Education
X=Control variables. Following the methodology of Solon (1992) we used age and age squared as control variables to control for the life cycle of the children and the fathers (in the income dimension)

The closer β is to 0, the greater the social mobility

4.1 Cohort and Cross-Section approach

To understand the approaches, one can rely on the sample table in the appendix section. The table contains information from Chile's Casen surveys between the years 1987 and

2017. The first column corresponds to the cohort of the person, i.e. the year of his birth. The first row corresponds to the year of the survey. The values in the matrix correspond to the age in each cohort-survey year combination.

For example, in the 2017 Casen survey, sons in the 1984 cohort were 23 years old. Since we work with the sons who are between 23 and 30 years old, we can see marked in green color the boxes that show the evolution of the relevant bracket in the different cohort-survey-year combinations.

When we obtain results of relative social mobility with the cross section approach, we are doing a column-by-column analysis. In each column we obtain how much is the average estimator for the relevant age bracket over different cohorts. When we get results with the cohort approach, we are doing a row-by-row analysis. In each row we get how much is the average estimator for the relevant age bracket across different surveys. The cohorts marked in red were eliminated for each economy, since in those cohorts we have less than two survey observations, which makes it impossible to distinguish the cohort effect from the age effect.

4.2   Observation and survey filters

In order to keep the right observations and surveys, we performed a series of filters on the education and income dimensions. These filters are summarized in the following table and are detailed below:

	Education	**Income**
Coresidents Son's Age	23-30	23-30
Semanal Working Hours	-	$\geq$ 22
Father's Age	-	< 65
Exlusion top 0.5% of distribution	-	Yes
Control Variables	-	Son and father age
Surveys $\geq$ year 2000	Cross-Section Approach	Cross-Section Approach
N° Min Surveys per Cohort	2	2
Surveys: N° Obs Min & Max Median Error	200 y 0.2	100 y 0.2

1) Coresidents Son's Age: We believe that 23 years is a reasonable cut-off age for the coresident methodology, given that around this age people finish their tertiary education cycle and start entering the labor market. On the other hand, since the surveys are conducted 3 to 5 years per country, we decided to set the upper cutoff age at 30 years in order to see the effect that exists in a cohort at different ages and to limit the possible coresidence bias. If we analyze the coresidency and labor participation rates of people in this age group, it is confirmed that this is an appropriate bracket.

2) Semanal Working Hours: In the income dimension, we seek to capture what is closest to people's permanent income, so we filter out observations that have 22 or more hours of

work per week.

3) Father's Age: In the income dimension we seek to avoid a problem of selectivity of people leaving the labor market to retire. This was initially intended for men in Chile, but analyzing the retirement age for men in other countries, we consider it to be a good cut-off age.

4) Exlusion top 0.5% of distribution: For every survey, the top 0.5% of the income sample was eliminated. This is a World Bank practice to avoid possible biases due to wage outliers.

5) Control Variables: In the literature on intergenerational mobility there is the concept of "life-cycle bias". This bias occurs when calculating the intergenerational persistence of income of the father at a different age than that of the son. The solution given to solve this problem is to include as a control variable the age of the son and the age of the son squared. Some papers additionally include the father's age. In this paper we will use the son and father age as control variables. In the educational dimension, this bias does not occur because once people obtain an educational level they do not drop out of it, so estimating the intergenerational persistence of parents and children at different ages should not present a problem.

6) Year 2000: We stayed with these surveys from the year 2000 for 3 reasons. First because there is a greater coverage of countries during those years. Second because after the fall of the Berlin Wall and the Soviet Union many countries were created and destroyed, in order to give them time to organize themselves and to collect quality data, we think that the year 2000 is a good cut-off year. Finally, it is evident that the coresidency rate has been increasing over time for the relevant age range, so taking the latest years available is something that is useful in our research to reduce coresidency bias. The latter can be seen graphically in found in the appendix section

7) Approach: We only take into account those cohorts that have a minimum of 2 surveys as observations in order to distinguish the age effect from the cohort effect.

8) Surveys: We leave out surveys with relative mobility estimates less than 0.1 and greater than 0.8 since these extreme magnitudes have not been documented in the literature. Next, we excluded from the survey sample those surveys with a number of observations lower than 200 for the calculation of the statistics of interest. The objective is to ensure that the results have not been distorted by sampling errors due to small sample sizes. We also excluded those with a deviation from the median of their country greater than 0.2 percentage points. A graph illustrating this can be found in the appendix.

To correctly capture the importance of the father's income in the children's income, we annualize the salaries to isolate the effect that the different frequencies with which each

one receives it could have.

4.3   Selection Bias

There are two sources of selection bias in this work. The first is whether the person participates in the labor market. The second is whether the person coresides with his or her parents. To attenuate the first selection bias we will focus only on the father-son combination, leaving aside the mother-son, father-daughter or mother-daughter combinations since female labor participation rate is lower than males.

In this research we will only concentrate on those father-son combinations in which both works (have incomes). Since these father-son combinations are only observed with sons who live with their father, it is possible that there is a selection bias with respect to those sons who do not live with their fathers. This can be summarized in the following two figures.
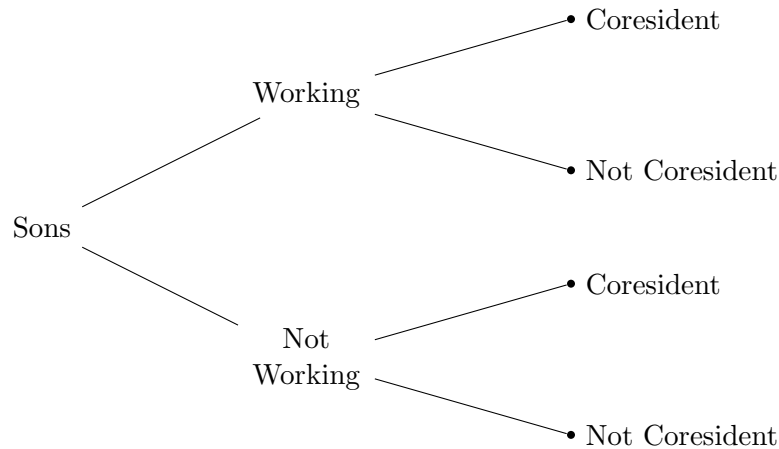
		Son Wage	**Father Wage**
Working	Coresident	✓	✓
	Not Coresident	✓	×
Not Working	Coresident	×	✓
	Not Coresident	×	×

To take care of the second selection bias we will estimate by heckman maximum likelihood only for the income dimension since it has been documented that the coresident bias for education is marginal (Emran et.al, 2016 & Emran et.al, 2018).

If we consider the latent variable v_s^* as the benefit that the son obtains by living with his father, we will observe the sample only when $v_s^* > 0$, so we have the following

$$v_s^* = \gamma Z_s + \epsilon_s$$

$$v_s = \begin{cases} 1 & \text{if } \gamma Z_s + \epsilon_s > 0 \\ 0 & \text{if } \gamma Z_s + \epsilon_s \leq 0 \end{cases}$$

Where Z_s corresponds to a vector of variables that influence the son's decision to live or not with his father.

The estimates of the participation equation are obtained from the following regression model:

$$Cores = \alpha + \beta ecivil + \gamma urban + \delta_1 age + \delta_2 age^2 + \rho crowd + \eta \text{Liability Ratio} + v$$

Variables	Controls	Instruments
Father's wage	✓	✗
Son's age & age^2	✓	✓
Father's age & age^2	✓	✗
Civil status	✗	✓
Urban	✗	✓
Crowd	✗	✓
Liability Ratio	✗	✓

Age: As people get older, the rate of coresidence decreases (see appendix), so the probability of coresidence decreases as well.

Marital status: We define this variable as a dummy that is 1 if the person is married, with a partner, divorced or widowed, and 0 otherwise. It is expected that the probability of coresidence with parents should decrease if the person is in any of these categories.

Urban: We define this variable as a dummy that is 1 if the person lives in an urban area and 0 if not. The probability of coresidence is expected to decrease if the person lives in a city.

Crowd: This is a variable that captures the number of children living in the person's household. It is expected that in a household with more children, the probability of coresidency will decrease.

Liability Ratio: This variable divides the number of "liabilities" with the number of "assets" per household. We define "active" persons as those between the ages of 23 and 65. We define "passive" persons as those who are 75 years of age or older.

The estimates of the income dimension (principal equation) are obtained from the following regression model:

$$y_s = \alpha + \beta y_f + \gamma_1 age + \gamma_2 age^2 + \delta_1 \text{father age} + \delta_2 \text{father } age^2 + \epsilon_s$$

5   Descriptive Statistics

Below is a series of tables with different statistics for the combination of coresident children who have the relevant age between 23 and 30, and their parents.

Table 1: **Education Economies, Cross-Section Approach**

Economies	High income	Low income	Lower middle income	Upper middle income	Total
East Asia & Pacific	1	0	11	3	15
Europe & Central Asia	26	0	3	14	43
Latin America & Caribbean	5	0	5	11	21
Middle East & North Africa	2	2	7	2	13
North America	1	0	0	0	1
South Asia	0	1	6	1	8
Sub-Saharan Africa	0	22	15	5	42
Total	35	25	47	36	143

Self Made: World Bank

Table 2: **Education Economies, Cohort Approach**

Economies	High income	Low income	Lower middle income	Upper middle income	Total
East Asia & Pacific	1	0	10	2	13
Europe & Central Asia	28	0	2	12	42
Latin America & Caribbean	3	0	5	12	20
Middle East & North Africa	1	1	5	2	9
North America	1	0	0	0	1
South Asia	0	1	5	1	7
Sub-Saharan Africa	0	13	10	4	27
Total	34	15	37	33	119

Self Made: World Bank

Table 3: **Income Economies, Cross-Section Approach**

Economies	High income	Low income	Lower middle income	Upper middle income	Total
East Asia & Pacific	1	0	5	2	8
Europe & Central Asia	23	0	3	10	36
Latin America & Caribbean	3	0	4	10	17
Middle East & North Africa	1	1	3	2	7
North America	1	0	0	0	1
South Asia	0	1	5	0	6
Sub-Saharan Africa	0	5	3	1	9
Total	29	7	23	25	84

Self Made: World Bank

Table 4: **Mean Statistics by Income**

Income	Coresidence Rate	Labor Participation Rate	Father Schooling	Son Schooling
High income	.45	.8	11	12
Low income	.3	.77	5.1	7.5
Lower middle income	.46	.83	6.2	9.3
Upper middle income	.5	.84	8.4	11
Total	.46	.82	8.6	11

Self Made: World Bank

It is possible to observe that countries classified as high-income have higher years of schooling than poorer countries. It can also be seen that the average years of schooling of parents is lower than the generation of children for all categories. It is also possible to see that poor countries have the lowest average coresidency rate.

Table 5: **Mean Statistics by Region**

Region	Coresidence Rate	Labor Participation Rate	Father Schooling	Son Schooling
East Asia & Pacific	.52	.82	7.8	11
Europe & Central Asia	.51	.8	11	12
Latin America & Caribbean	.37	.87	7.1	10
Middle East & North Africa	.6	.84	7.3	11
North America	.21	.8	13	13
South Asia	.56	.89	5.2	8.5
Sub-Saharan Africa	.32	.76	5.4	8.1
Total	.46	.82	8.5	11

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6   Results

6.1   Education

Mean Estimations by Income

Table 6: Cross-Section Approach   **Table 7: Cohort Approach**

Income	Beta	Pearson	Spearman
High income	.31	.34	.35
Low income	.45	.44	.45
Lower middle inc	.45	.46	.47
Upper middle inc	.41	.45	.47
Total	.39	.41	.43

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Income	Beta	Pearson	Spearman
High income	.35	.4	.38
Low income	.47	.48	.45
Lower middle inc	.48	.5	.49
Upper middle inc	.44	.47	.45
Total	.43	.46	.44

Self Made: World Bank

In line with the existing literature, it can be seen that rich countries have lower intergenerational persistence (matyor social mobility), in any of its forms of measurement. It can also be seen that most of the time the estimation of Beta (regression coefficient) is the measure with the lowest persistence with respect to the other measures.

Mean Estimations by Region

Table 8: Cross-Section Approach   **Table 9: Cohort Approach**

Region	Beta	Pearson	Spearman
East Asia & Pacific	.43	.38	.45
Europe & Central Asia	.33	.35	.35
Latin America & Caribbean	.46	.53	.53
Middle East & North Africa	.31	.37	.37
North America	.23	.35	.4
South Asia	.46	.47	.5
Sub-Saharan Africa	.43	.44	.44
Total	.4	.41	.43

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Region	Beta	Pearson	Spearman
East Asia & Paci	.47	.46	.45
Europe & Central	.37	.39	.37
Latin America & Caribbean	.48	.52	.5
Middle East & North Africa	.35	.39	.37
North America	.25	.39	.4
South Asia	.5	.51	.52
Sub-Saharan Africa	.45	.49	.46
Total	.43	.46	.44

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Mean Estimations over Time

Table 10: Cross-Section Approach

Year	Beta	Pearson	Spearman
2000	.45	.46	.48
2001	.45	.45	.49
2002	.43	.45	.47
2003	.44	.46	.47
2004	.4	.43	.44
2005	.4	.42	.44
2006	.38	.4	.42
2007	.39	.4	.42
2008	.39	.4	.43
2009	.38	.39	.41
2010	.39	.39	.42
2011	.38	.4	.41
2012	.37	.4	.41
2013	.36	.36	.39
2014	.42	.46	.46
2015	.4	.43	.45
2016	.4	.42	.46
2017	.39	.42	.44
2018	.41	.48	.51
2019	.43	.46	.47
Total	.4	.41	.43

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Table 11: Cohort Approach

Cohort	Beta	Pearson	Spearman
1970	.48	.5	.49
1971	.44	.49	.47
1972	.44	.48	.46
1973	.46	.51	.47
1974	.45	.49	.47
1975	.42	.46	.44
1976	.4	.45	.44
1977	.42	.47	.45
1978	.42	.45	.44
1979	.42	.46	.43
1980	.44	.47	.45
1981	.43	.46	.46
1982	.42	.46	.45
1983	.42	.44	.42
1984	.41	.44	.43
1985	.41	.45	.42
1986	.4	.44	.43
1987	.41	.46	.44
1988	.44	.47	.44
1989	.42	.45	.43
Total	.42	.46	.44

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Great Gatsby Curve

Spearman vs Goverment Expenditure Education % PIB
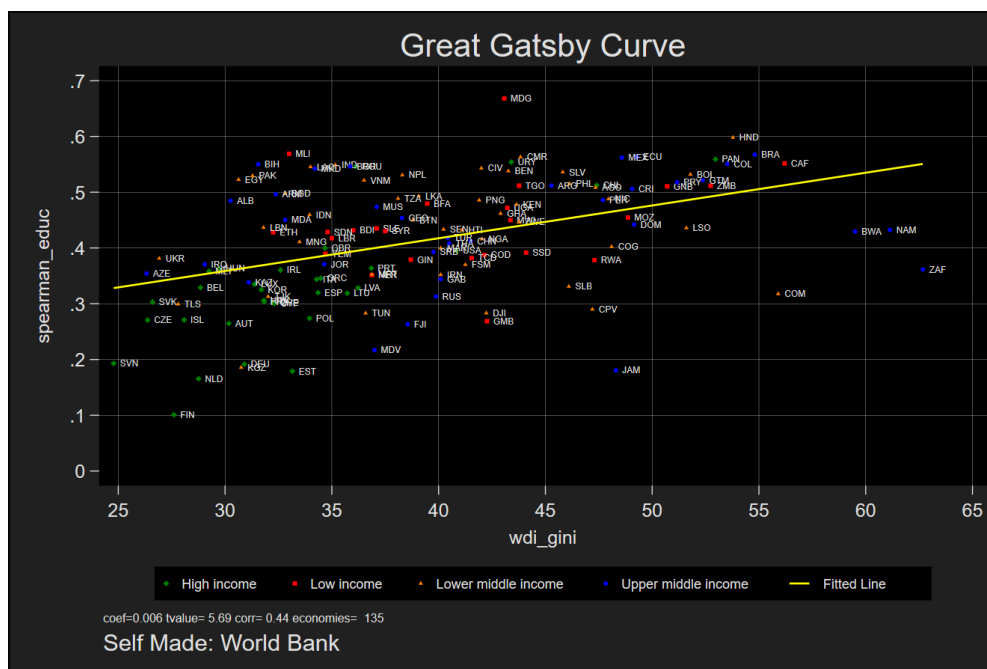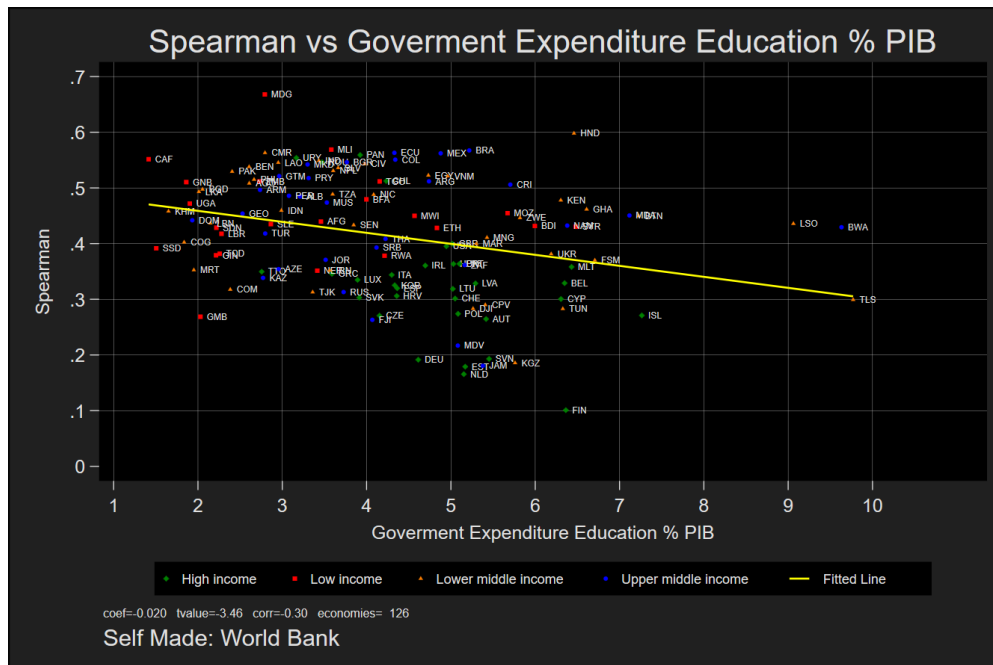
Table 12: Education Relative Mobility

	(1) Correlation	(2) Beta Regression	(3) Spearman
ln(Per Capita PPP)	-0.0265**	-0.0478***	-0.0146*
	(-2.69)	(-5.51)	(-2.16)
ln(Gini)	0.270***	0.168***	0.277***
	(10.60)	(6.26)	(12.77)
ln(Govt Education Expenditure % PIB)	-0.0302	-0.0551**	-0.0553***
	(-1.79)	(-3.22)	(-4.20)
ln(Economy Liberalization)	-0.00754	-0.0119	-0.0799***
	(-0.22)	(-0.56)	(-3.69)
Constant	-0.253	0.354*	-0.0470
	(-1.53)	(2.12)	(-0.34)
R2_ajusted	0.301	0.361	0.499
Akaike	-936.1	-940.9	-1107.4
Bayes	-913.3	-919.3	-1085.7
Observations	702	555	568

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We use the reciprocal of the standard deviation of the dependent variable as the expansion factor for the regressions. It is observed that all regressors have the expected sign, with the income, inequality and education expenditure variables being statistically significant.

6.2   Income

Table 13: **Mean Income Estimations**

Economy	Heckman	Regresion	Elasticity	Pearson	Spearman
ARG	.3	.32	.31	.39	.42
BOL	.22	.24	.24	.31	.3
BRA	.37	.38	.38	.53	.54
CHL	.38	.39	.38	.52	.49
COL	.37	.39	.38	.46	.43
CRI	.29	.3	.29	.39	.4
DOM	.33	.31	.32	.41	.32
ECU	.24	.27	.26	.37	.4
GTM	.21	.24	.24	.35	.32
HND	.32	.33	.33	.46	.5
MEX	.23	.23	.24	.34	.35
NIC	.23	.24	.25	.36	.33
PAN	.35	.36	.35	.48	.45
PER	.21	.22	.21	.28	.24
PRY	.23	.23	.23	.37	.38
SLV	.18	.19	.2	.32	.32
URY	.28	.29	.29	.39	.41
Total	.28	.29	.29	.39	.39

Self Made: World Bank

'Regresion' corresponds to elasticity without age controls. It can be seen that for the different countries the lower bound of the estimates come from Heckman, and the upper bound comes from the level (pearson) and rank (spearman) correlations.

Self Made: World Bank
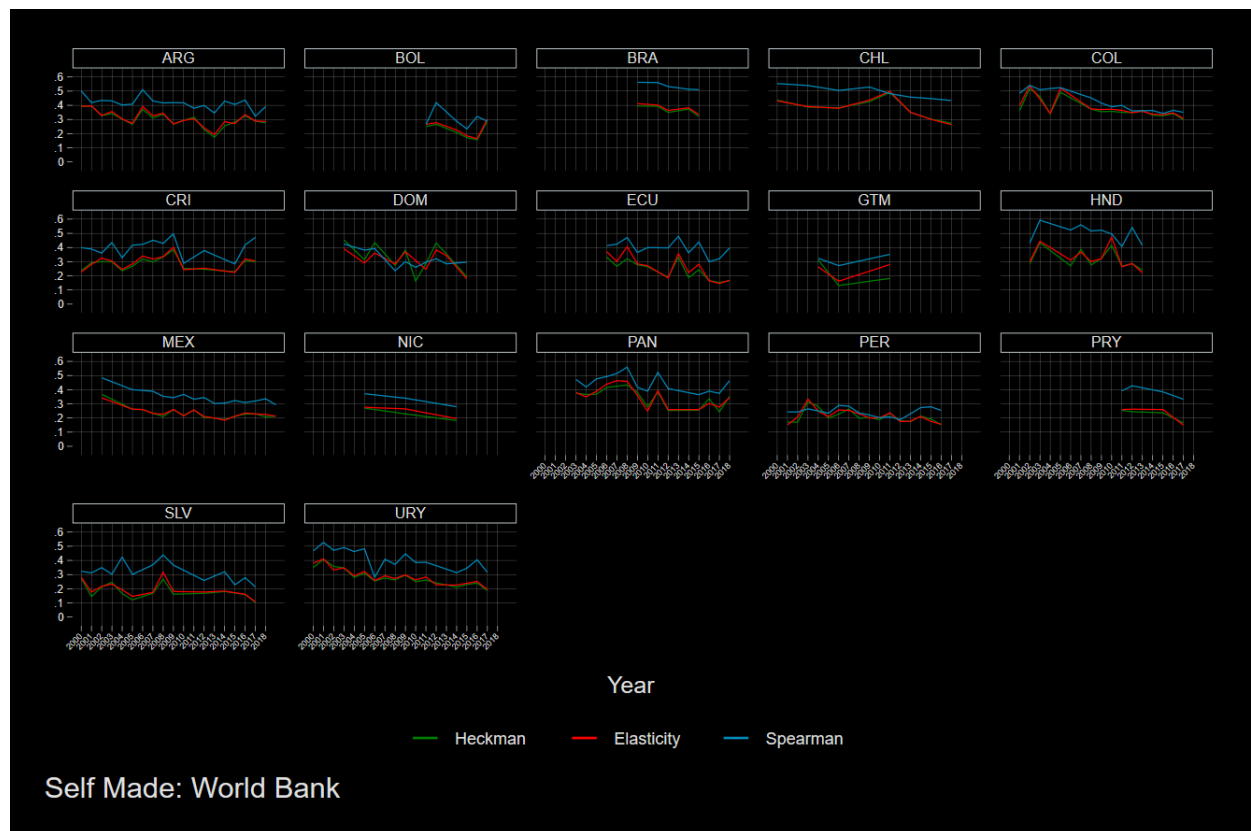
It can be seen that for all countries, the OLS estimate is the one in the middle, with the Heckman estimate as the lower bound and the Spearman rank correlation as the upper bound. It can also be seen that intergenerational persistence has a slight downward trend in Latin American countries over time.

Table 14: LAC Income Relative Mobility

	(1) Heckman	(2) Elasticity	(3) Spearman
ln(Per Capita PPP)	0.134***	0.129***	0.132***
	(8.34)	(8.05)	(6.50)
ln(Gini)	0.602***	0.592***	0.462***
	(11.09)	(11.14)	(7.37)
ln(Govt Education Expenditure % PIB)	-0.0836***	-0.0755***	-0.0193
	(-3.59)	(-3.43)	(-0.53)
ln(Economic Globalization)	-0.0477	-0.0582	-0.0630
	(-1.56)	(-1.88)	(-1.91)
Constant	-3.008***	-2.885***	-2.379***
	(-10.48)	(-9.88)	(-6.91)
R2_ajusted	0.504	0.494	0.377
Akaike	-331.9	-330.1	-282.6
Bayes	-318.0	-316.2	-268.6
Observations	120	120	121

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We use the reciprocal of the standard deviation of the dependent variable as the expansion factor for the regressions. As before, it can be seen that there is statistical significance for the income, inequality and goverment expenditure variables and that all the coefficients have the expected sign, except for income. In this variable we have that higher per capita income (using constant 2017 dollars, PPP) generates higher intergenerational persistence (lower social mobility), which is not very intuitive and is not in line with the literature. One explanation for this would be the low number of surveys we have available when running this regression. It is possible that when we have the surveys from other countries ready, this relationship will change and we will see again something more in line with what has been written.

7 Conclusions

In conclusion we can say that the results found are in line with what was expected and what has been written in the literature. We find that there is statistical significance for the inequality and education expenditure variables with intergenerational persistence, which is

evidence in favor of Corak (2013) and Meyer & Loppo (2007), but we find no evidence in favor of Xie & Chang (2022). With this work we believe we have contributed with estimates that have behind them more surveys available, a uniform methodology that would allow making graphs with comparable points and that would give robustness measures using rank estimates. Further progress remains to be made in the recoding of the income dimension bases and their respective codes using the cohort methodology. We hope that this topic will soon be ready and we will be able to present results with greater statistical power.

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9   Appendix

Education, 23-30 Son's Age
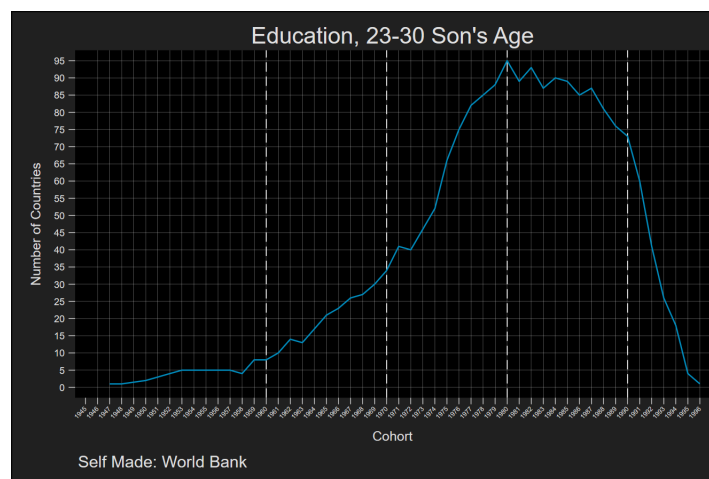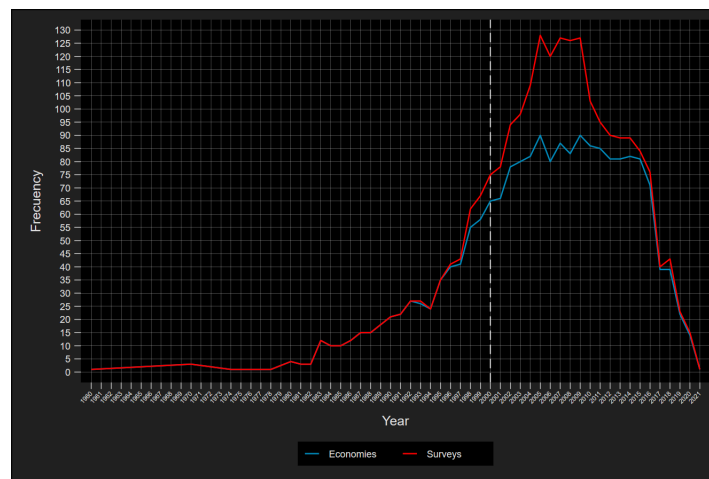
9.1   Concepts

$$\boxed{\text{Coresidence Rate} = \frac{\text{Son's living with their father}}{\text{Total of Son's}}}$$

Self Made: World Bank

Self Made: World Bank

$$\boxed{\text{Labor Force Participation Rate} = \frac{\text{Employed+Unemployed}}{\text{Working age population}}}$$

Self Made: World Bank

Self Made: World Bank

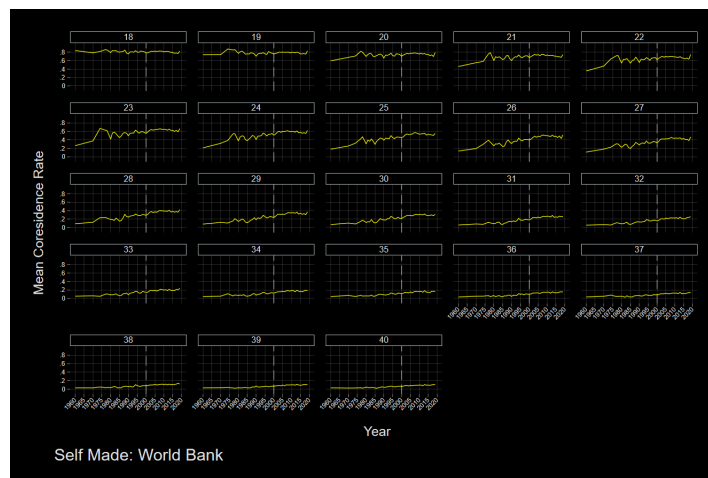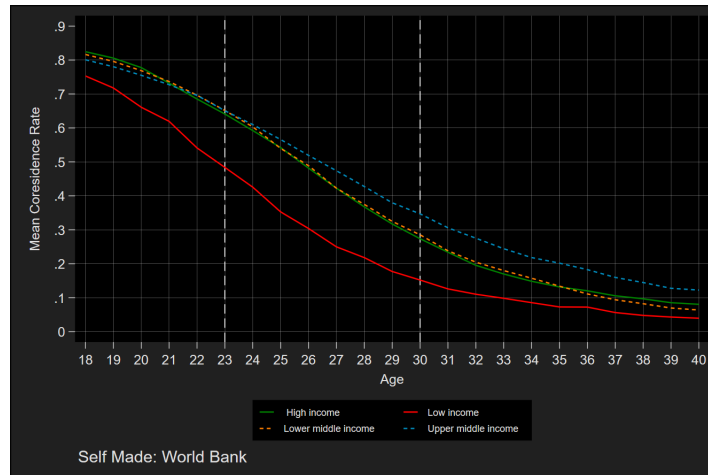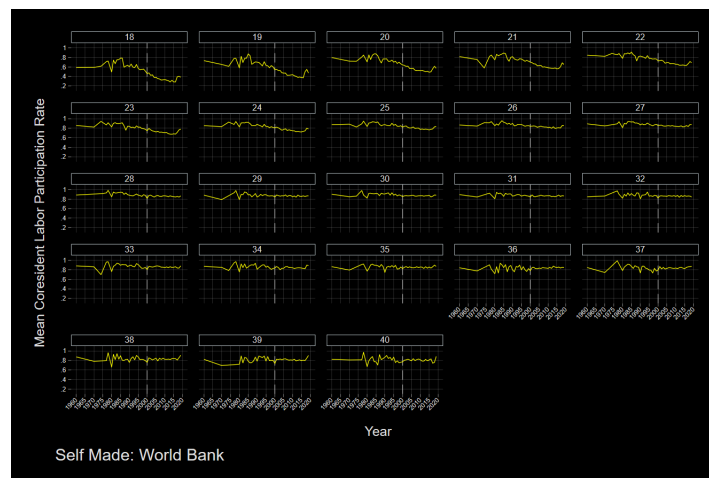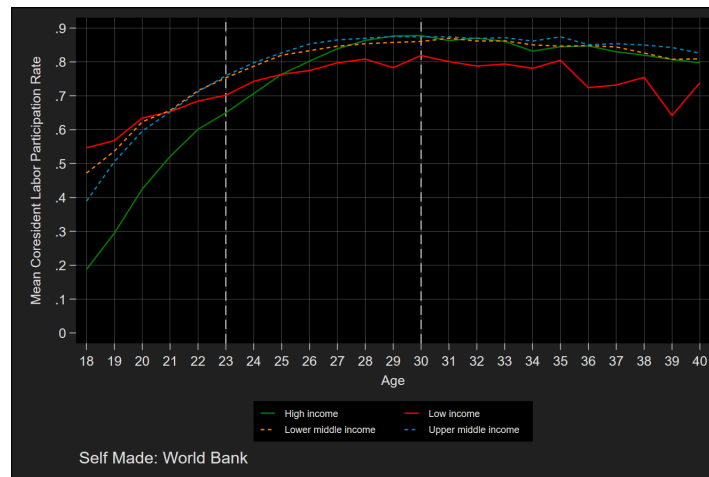|	2017	2015	2013	2011	2009	2006	2003	2000	1998	1996	1994	1992	1990	1987
1994	23	21	19	17	15	12	9	6	4	2	0	-2	-4	-7
1993	24	22	20	18	16	13	10	7	5	3	1	-1	-3	-6
1992	25	23	21	19	17	14	11	8	6	4	2	0	-2	-5
1991	26	24	22	20	18	15	12	9	7	5	3	1	-1	-4
1990	27	25	23	21	19	16	13	10	8	6	4	2	0	-3
1989	28	26	24	22	20	17	14	11	9	7	5	3	1	-2
1988	29	27	25	23	21	18	15	12	10	8	6	4	2	-1
1987	30	28	26	24	22	19	16	13	11	9	7	5	3	0
1986	31	29	27	25	23	20	17	14	12	10	8	6	4	1
1985	32	30	28	26	24	21	18	15	13	11	9	7	5	2
1984	33	31	29	27	25	22	19	16	14	12	10	8	6	3
1983	34	32	30	28	26	23	20	17	15	13	11	9	7	4
1982	35	33	31	29	27	24	21	18	16	14	12	10	8	5
1981	36	34	32	30	28	25	22	19	17	15	13	11	9	6
1980	37	35	33	31	29	26	23	20	18	16	14	12	10	7
1979	38	36	34	32	30	27	24	21	19	17	15	13	11	8
1978	39	37	35	33	31	28	25	22	20	18	16	14	12	9
1977	40	38	36	34	32	29	26	23	21	19	17	15	13	10
1976	41	39	37	35	33	30	27	24	22	20	18	16	14	11
1975	42	40	38	36	34	31	28	25	23	21	19	17	15	12
1974	43	41	39	37	35	32	29	26	24	22	20	18	16	13
1973	44	42	40	38	36	33	30	27	25	23	21	19	17	14
1972	45	43	41	39	37	34	31	28	26	24	22	20	18	15
1971	46	44	42	40	38	35	32	29	27	25	23	21	19	16
1970	47	45	43	41	39	36	33	30	28	26	24	22	20	17
1969	48	46	44	42	40	37	34	31	29	27	25	23	21	18
1968	49	47	45	43	41	38	35	32	30	28	26	24	22	19
1967	50	48	46	44	42	39	36	33	31	29	27	25	23	20
1966	51	49	47	45	43	40	37	34	32	30	28	26	24	21
1965	52	50	48	46	44	41	38	35	33	31	29	27	25	22
1964	53	51	49	47	45	42	39	36	34	32	30	28	26	23
1963	54	52	50	48	46	43	40	37	35	33	31	29	27	24
1962	55	53	51	49	47	44	41	38	36	34	32	30	28	25
1961	56	54	52	50	48	45	42	39	37	35	33	31	29	26
1960	57	55	53	51	49	46	43	40	38	36	34	32	30	27
1959	58	56	54	52	50	47	44	41	39	37	35	33	31	28
1958	59	57	55	53	51	48	45	42	40	38	36	34	32	29
1957	60	58	56	54	52	49	46	43	41	39	37	35	33	30

spearman_educ_error vs ln(obs_educ)

- y-axis: spearman_educ_error
- x-axis: ln(obs_educ)

Legend: • High income   • Low income   • Lower middle income   • Upper middle income   — Cuadratic Fit

total=1194 obs(100)=.9500000000000001 error(0.2)=.97 ambas=.93 if year>=2000
Self Made: World Bank
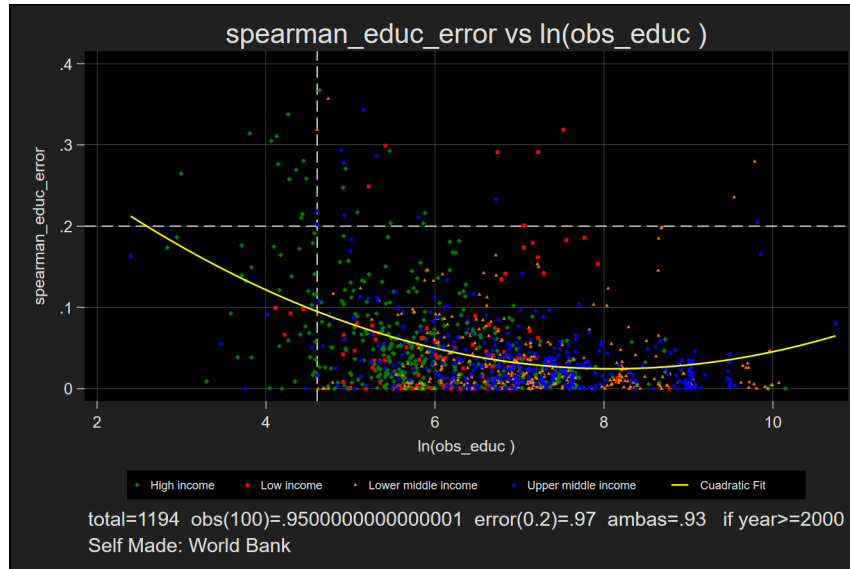
9.2   Mathematical

$$\text{Pearson Correlation} = \frac{\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})}{Sd(x) * Sd(y)}$$

$$\text{Spearman Correlation} = 1 - \frac{6\sum[R(x_i) - R(y_i)]}{n(n^2 - 1)}$$

9.3   Economy Categories

Table 15: High Income

Economy	Code	Region
Aruba	ABW	Latin America & Caribbean
Andorra	AND	Europe & Central Asia
United Arab Emirates	ARE	Middle East & North Africa
Antigua and Barbuda	ATG	Latin America & Caribbean
Australia	AUS	East Asia & Pacific
Austria	AUT	Europe & Central Asia
Belgium	BEL	Europe & Central Asia
Bahrain	BHR	Middle East & North Africa
Bahamas, The	BHS	Latin America & Caribbean
Bermuda	BMU	North America
Barbados	BRB	Latin America & Caribbean
Brunei Darussalam	BRN	East Asia & Pacific
Canada	CAN	North America
Switzerland	CHE	Europe & Central Asia
Channel Islands	CHI	Europe & Central Asia
Chile	CHL	Latin America & Caribbean
Curaçao	CUW	Latin America & Caribbean
Cayman Islands	CYM	Latin America & Caribbean
Cyprus	CYP	Europe & Central Asia
Czech Republic	CZE	Europe & Central Asia
Germany	DEU	Europe & Central Asia
Denmark	DNK	Europe & Central Asia
Spain	ESP	Europe & Central Asia
Estonia	EST	Europe & Central Asia
Finland	FIN	Europe & Central Asia
France	FRA	Europe & Central Asia
Faroe Islands	FRO	Europe & Central Asia
United Kingdom	GBR	Europe & Central Asia
Gibraltar	GIB	Europe & Central Asia
Greece	GRC	Europe & Central Asia
Greenland	GRL	Europe & Central Asia
Guam	GUM	East Asia & Pacific
Hong Kong SAR, China	HKG	East Asia & Pacific
Croatia	HRV	Europe & Central Asia
Hungary	HUN	Europe & Central Asia
Isle of Man	IMN	Europe & Central Asia
Ireland	IRL	Europe & Central Asia
Iceland	ISL	Europe & Central Asia
Israel	ISR	Middle East & North Africa
Italy	ITA	Europe & Central Asia
Japan	JPN	East Asia & Pacific
St. Kitts and Nevis	KNA	Latin America & Caribbean
Korea, Rep.	KOR	East Asia & Pacific
Kuwait	KWT	Middle East & North Africa
Liechtenstein	LIE	Europe & Central Asia
Lithuania	LTU	Europe & Central Asia
Luxembourg	LUX	Europe & Central Asia
Latvia	LVA	Europe & Central Asia
Macao SAR, China	MAC	East Asia & Pacific
St. Martin (French part)	MAF	Latin America & Caribbean
Monaco	MCO	Europe & Central Asia
Malta	MLT	Middle East & North Africa
Northern Mariana Islands	MNP	East Asia & Pacific
New Caledonia	NCL	East Asia & Pacific
Netherlands	NLD	Europe & Central Asia
Norway	NOR	Europe & Central Asia
Nauru	NRU	East Asia & Pacific
New Zealand	NZL	East Asia & Pacific
Oman	OMN	Middle East & North Africa
Panama	PAN	Latin America & Caribbean
Poland	POL	Europe & Central Asia
Puerto Rico	PRI	Latin America & Caribbean
Portugal	PRT	Europe & Central Asia
French Polynesia	PYF	East Asia & Pacific
Qatar	QAT	Middle East & North Africa
Romania	ROU	Europe & Central Asia
Saudi Arabia	SAU	Middle East & North Africa
Singapore	SGP	East Asia & Pacific
San Marino	SMR	Europe & Central Asia
Slovak Republic	SVK	Europe & Central Asia
Slovenia	SVN	Europe & Central Asia
Sweden	SWE	Europe & Central Asia
Sint Maarten (Dutch part)	SXM	Latin America & Caribbean
Seychelles	SYC	Sub-Saharan Africa
Turks and Caicos Islands	TCA	Latin America & Caribbean
Trinidad and Tobago	TTO	Latin America & Caribbean
Taiwan, China	TWN	East Asia & Pacific
Uruguay	URY	Latin America & Caribbean
United States	USA	North America
British Virgin Islands	VGB	Latin America & Caribbean
Virgin Islands (U.S.)	VIR	Latin America & Caribbean

Table 16: Upper Middle Income

Economy	Code	Region
Albania	ALB	Europe & Central Asia
Argentina	ARG	Latin America & Caribbean
Armenia	ARM	Europe & Central Asia
American Samoa	ASM	East Asia & Pacific
Azerbaijan	AZE	Europe & Central Asia
Bulgaria	BGR	Europe & Central Asia
Bosnia and Herzegovina	BIH	Europe & Central Asia
Belarus	BLR	Europe & Central Asia
Belize	BLZ	Latin America & Caribbean
Brazil	BRA	Latin America & Caribbean
Botswana	BWA	Sub-Saharan Africa
China	CHN	East Asia & Pacific
Colombia	COL	Latin America & Caribbean
Costa Rica	CRI	Latin America & Caribbean
Cuba	CUB	Latin America & Caribbean
Dominica	DMA	Latin America & Caribbean
Dominican Republic	DOM	Latin America & Caribbean
Ecuador	ECU	Latin America & Caribbean
Fiji	FJI	East Asia & Pacific
Gabon	GAB	Sub-Saharan Africa
Georgia	GEO	Europe & Central Asia
Equatorial Guinea	GNQ	Sub-Saharan Africa
Grenada	GRD	Latin America & Caribbean
Guatemala	GTM	Latin America & Caribbean
Guyana	GUY	Latin America & Caribbean
Iraq	IRQ	Middle East & North Africa
Jamaica	JAM	Latin America & Caribbean
Jordan	JOR	Middle East & North Africa
Kazakhstan	KAZ	Europe & Central Asia
Libya	LBY	Middle East & North Africa
St. Lucia	LCA	Latin America & Caribbean
Moldova	MDA	Europe & Central Asia
Maldives	MDV	South Asia
Mexico	MEX	Latin America & Caribbean
Marshall Islands	MHL	East Asia & Pacific
North Macedonia	MKD	Europe & Central Asia
Montenegro	MNE	Europe & Central Asia
Mauritius	MUS	Sub-Saharan Africa
Malaysia	MYS	East Asia & Pacific
Namibia	NAM	Sub-Saharan Africa
Peru	PER	Latin America & Caribbean
Palau	PLW	East Asia & Pacific
Paraguay	PRY	Latin America & Caribbean
Russian Federation	RUS	Europe & Central Asia
Serbia	SRB	Europe & Central Asia
Suriname	SUR	Latin America & Caribbean
Thailand	THA	East Asia & Pacific
Turkmenistan	TKM	Europe & Central Asia
Tonga	TON	East Asia & Pacific
Türkiye	TUR	Europe & Central Asia
Tuvalu	TUV	East Asia & Pacific
St. Vincent and the Grenadines	VCT	Latin America & Caribbean
Kosovo	XKX	Europe & Central Asia
South Africa	ZAF	Sub-Saharan Africa

Table 17: Lower Middle Income

Economy	Code	Region
Angola	AGO	Sub-Saharan Africa
Benin	BEN	Sub-Saharan Africa
Bangladesh	BGD	South Asia
Bolivia	BOL	Latin America & Caribbean
Bhutan	BTN	South Asia
Côte d'Ivoire	CIV	Sub-Saharan Africa
Cameroon	CMR	Sub-Saharan Africa
Congo, Rep.	COG	Sub-Saharan Africa
Comoros	COM	Sub-Saharan Africa
Cabo Verde	CPV	Sub-Saharan Africa
Djibouti	DJI	Middle East & North Africa
Algeria	DZA	Middle East & North Africa
Egypt, Arab Rep.	EGY	Middle East & North Africa
Micronesia, Fed. Sts.	FSM	East Asia & Pacific
Ghana	GHA	Sub-Saharan Africa
Honduras	HND	Latin America & Caribbean
Haiti	HTI	Latin America & Caribbean
Indonesia	IDN	East Asia & Pacific
India	IND	South Asia
Iran, Islamic Rep.	IRN	Middle East & North Africa
Kenya	KEN	Sub-Saharan Africa
Kyrgyz Republic	KGZ	Europe & Central Asia
Cambodia	KHM	East Asia & Pacific
Kiribati	KIR	East Asia & Pacific
Lao PDR	LAO	East Asia & Pacific
Lebanon	LBN	Middle East & North Africa
Sri Lanka	LKA	South Asia
Lesotho	LSO	Sub-Saharan Africa
Morocco	MAR	Middle East & North Africa
Myanmar	MMR	East Asia & Pacific
Mongolia	MNG	East Asia & Pacific
Mauritania	MRT	Sub-Saharan Africa
Nigeria	NGA	Sub-Saharan Africa
Nicaragua	NIC	Latin America & Caribbean
Nepal	NPL	South Asia
Pakistan	PAK	South Asia
Philippines	PHL	East Asia & Pacific
Papua New Guinea	PNG	East Asia & Pacific
West Bank and Gaza	PSE	Middle East & North Africa
Senegal	SEN	Sub-Saharan Africa
Solomon Islands	SLB	East Asia & Pacific
El Salvador	SLV	Latin America & Caribbean
São Tomé and Príncipe	STP	Sub-Saharan Africa
Eswatini	SWZ	Sub-Saharan Africa
Tajikistan	TJK	Europe & Central Asia
Timor-Leste	TLS	East Asia & Pacific
Tunisia	TUN	Middle East & North Africa
Tanzania	TZA	Sub-Saharan Africa
Ukraine	UKR	Europe & Central Asia
Uzbekistan	UZB	Europe & Central Asia
Vietnam	VNM	East Asia & Pacific
Vanuatu	VUT	East Asia & Pacific
Samoa	WSM	East Asia & Pacific
Zimbabwe	ZWE	Sub-Saharan Africa

Table 18: Low Income

Economy	Code	Region
Afghanistan	AFG	South Asia
Burundi	BDI	Sub-Saharan Africa
Burkina Faso	BFA	Sub-Saharan Africa
Central African Republic	CAF	Sub-Saharan Africa
Congo, Dem. Rep.	COD	Sub-Saharan Africa
Eritrea	ERI	Sub-Saharan Africa
Ethiopia	ETH	Sub-Saharan Africa
Guinea	GIN	Sub-Saharan Africa
Gambia, The	GMB	Sub-Saharan Africa
Guinea-Bissau	GNB	Sub-Saharan Africa
Liberia	LBR	Sub-Saharan Africa
Madagascar	MDG	Sub-Saharan Africa
Mali	MLI	Sub-Saharan Africa
Mozambique	MOZ	Sub-Saharan Africa
Malawi	MWI	Sub-Saharan Africa
Niger	NER	Sub-Saharan Africa
Korea, Dem. People's Rep.	PRK	East Asia & Pacific
Rwanda	RWA	Sub-Saharan Africa
Sudan	SDN	Sub-Saharan Africa
Sierra Leone	SLE	Sub-Saharan Africa
Somalia	SOM	Sub-Saharan Africa
South Sudan	SSD	Sub-Saharan Africa
Syrian Arab Republic	SYR	Middle East & North Africa
Chad	TCD	Sub-Saharan Africa
Togo	TGO	Sub-Saharan Africa
Uganda	UGA	Sub-Saharan Africa
Yemen, Rep.	YEM	Middle East & North Africa
Zambia	ZMB	Sub-Saharan Africa