# **Appendices**

## **Appendix 1. Proof of Proposition A**

### Proof of proposition A.1: IPI is sensitive to asymmetric polarization.

Starting with $IPI=2\sqrt{L}\sqrt{R}$, the derivatives with respect to L and R are:

$$\frac{∂PI}{∂L}=\frac{\sqrt{R}}{\sqrt{L}} , \frac{∂PI}{∂R}=\frac{\sqrt{L}}{\sqrt{R}}$$

Provided L,R>0, both of these derivatives are positive, independent of which is larger or whether they are both the same. Thus, an asymmetric increase in one of the extremes will increase PI’s measure of polarization.

### Proof of proposition A.2: IPI is bimodal. It increases when extremes get more balanced.

For any $ε\rightarrow 0, ε>0$, $L+ε<R-ε$ and:

$$IPI\left(L+ε,R-ε\right)≈PI\left(L,R\right)+\frac{\sqrt{R}}{\sqrt{L}}ε-\frac{\sqrt{L}}{\sqrt{R}}ε$$

Suppose R>L. Then, $\frac{\sqrt{R}}{\sqrt{L}}>\frac{\sqrt{L}}{\sqrt{R}}$ and so

$$IPI\left(L+ε,R-ε\right)>PI\left(L,R\right)$$

Thus, as the two groups get more balanced, the polarization index increases.

### Proof of Proposition A.3: IPI agrees that there is no polarization without both extremes.

Trivial, just an application of the formula:

$$IPI\left(0,R\right)=2\sqrt{0}\sqrt{R}=0$$

$$IPI\left(L,0\right)=2\sqrt{L}\sqrt{0}=0$$

$$IPI\left(0,0\right)=2\sqrt{0}\sqrt{0}=0$$

### Proof of proposition A.4: IPI has a well-defined range, from 0 to 1.

First, as shown above, IPI=0 whenever L, R, or both are equal to 0.

$$IPI\left(0,R\right)=2\sqrt{0}\sqrt{R}=0=2\sqrt{L}\sqrt{0}=PI\left(R,0\right)=2\sqrt{0}\sqrt{0}=PI\left(0,0\right)$$

And it weakly increases in L and R, as shown by the proof of proposition A.1.

Given proposition A.2, we know that the maximum IPI(L,R) is achieved when L=R. A.1 tells us that IPI(L,R) is non decreasing with both L,R, and increasing when both L,R>0. Thus, the maximum IPI(L,R) is achieved when L+R is maximum (1) and L=R, which frequires L=R=0.5:

$PI\left(0.5,0.5\right)=2\sqrt{0.5}\sqrt{0.5}=1$

## **Appendix 2. Proposition B and Proof**

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### Proposition B: IPI is bounded below by 2Min(L,R) and above by 2Mean(L,R).

### Proof of proposition B:

Bounded below by 2Min(L,R).

* L=R $\rightarrow 2Min\left(L,R\right)=2L=2R$.
* L=R $\rightarrow IPI\left(L,R\right)=2\sqrt{L}\sqrt{R}=2\sqrt{(L)^{2}}=2\sqrt{(R)^{2}}=2L=2R$.

Now, suppose there is an $R'= L+ε$. For $ε\rightarrow 0, ε>0$,

$$2Min\left(L,L+ε\right)=2L$$

However, in the case of $IPI\left(L,R'\right)$:

$$IPI\left(L,R'\right)=2\sqrt{L}\sqrt{L+ε}≈2L+ε$$

Thus, proving that $IPI\left(L,R'\right)\geq 2Min\left(L,R\right)$.

Bounded above by 2Mean(LR).

* L=R $\rightarrow 2Mean\left(L,R\right)=2\left(\frac{L+R}{2}\right)=2L=2R$.
* L=R $\rightarrow IPI\left(L,R\right)=2\sqrt{L}\sqrt{R}=2\sqrt{(L)^{2}}=2\sqrt{(R)^{2}}=2L=2R$.

Now, suppose there is an $ε\rightarrow 0, ε>0$, such that$L^{'}=L-ε$ and $R^{'}=L+ε$.

* $2Mean\left(L',R'\right)=2\left(\frac{L-ε+R+ε}{2}\right)=2\left(\frac{L+R}{2}\right)=2L$.
* $IPI\left(L^{'},R'\right)=2\sqrt{L}\sqrt{L}+\frac{\sqrt{R}}{\sqrt{L}}ε-\frac{\sqrt{L}}{\sqrt{R}}ε$

However, as proven by proposition A.4, $IPI\left(L^{'},R'\right)<IPI\left(L,R\right)$, so $IPI\left(L^{'},R'\right)<2Mean\left(L',R'\right)$.

## **Appendix 3. Self-placed Ideology and Policy Preferences**

In this appendix, we present a summary of ideological consistency checks using almost all variables that, in our understanding, have a clear connection with theoretical differences between the two ideologies. LAPOP surveys provide many such items, though geographical and temporal coverage vary. For brevity, we excluded variables which were asked in a single country-wave within our time frame (2006 to 2019), such as domw14c (included only in Dominican Republic survey of 2018/19). We also excluded questions about immigrants, as their number was extensive, and we didn’t want to select just a few.

We found 36 such variables and divided them into 4 themes: redistribution and progressive taxation (8 items), support for public provision of social services (6 items), equality of rights and opportunity, as well as affirmative action to improve on those rights (9 items) and othering of minorities (13 items).

We then checked whether extreme left and extreme right individuals have different opinions in a way that is consistent with the theoretical meaning of their professed ideology. This is a hypothesis test of whether opinions from both sides of the spectrum are similar (null hypothesis) or different. Our level of analysis in this case is the individual.

We classify our findings in three types:

* Compatible: Left and right wingers have different opinions in a way that is aligned with theoretical predictions, and this difference is significant at 10% or better. Subtypes:
	+ Strongly compatible: Besides being significant (at 5%) the difference in opinion between left and right wingers is substantial, above 10%.
	+ Compatible: Opinions are significantly different (at 5% significance).
	+ Weakly compatible: Opinions of left and right wingers are only significantly different at 10% significance level.
* Null: Opinions of left and right wingers are not statistically different.
* Incompatible: Left and right wingers have significantly different opinions at 10% significance level, but this difference is the opposite of what theory predicts.

We found 21 variables which are compatible with the theory (58%), 13 null results (36%) and 2 items with results incompatible with the theory (6%). Overall, we think this shows evidence that extreme left and right wingers in Latin America are somewhat consistent with their ideologies.

Actual results are not shown for brevity (except those seen in the article, for variables ROS4 and D5). We can supply results upon request.

Table A1. Summary of 37 variables and related checks of ideological consistency.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Sample size[[1]](#footnote-1) | country-waves  | Compatible with theory?  | Description of the original variable (Tests used dummy versions, see detailed descriptions in the analysis of each empirical test) |
| Variables related to income redistribution and progressive taxation |
| redist1 | 21738 | 15 | Compatible | Government must spend more to help the poor.  |
| redist2 | 5362 | 4 | Null | Unfair for the rich to pay high taxes but receive few services. |
| redist2a | 15957 | 11 | Null | Okay for the rich to pay high taxes but receive few services. |
| ros4 | 177872 | 111 | Weakly compatible  | Government should implement policies to reduce income inequality.  |
| soc1 | 9276 | 11 | Null | Tax rate preference (progressive, somewhat progressive, neutral, other). |
| td1 | 7454 | 5 | Strongly compatible | There have always been rich and poor individuals, and this can´t be changed. |
| td2 | 7326 | 5 | Strongly compatible | It is good that inequality exists so that the poor people work harder. |
| td5 | 19213 | 12 | Null | I would be willing to pay more taxes if they were used to give more to those who have less. |
| Variables related to public spending on social services |
| ros5 | 36852 | 22 | Null | Pensions: government is better at providing pensions than private sector. |
| ros6 | 63360 | 38 | Incompatible | Health: government should be the main responsible for providing health, rather than private sector. |
| soc4 | 9520 | 11 | Null | Spending to improve quality of education. |
| soc5 | 11525 | 13 | Compatible | Higher taxes for more education spending. |
| soc8 | 9599 | 11 | Null | Spending to improve quality of public health services. |
| soc9 | 11600 | 13 | Compatible | Higher taxes for more healthcare spending. |
| Variables related to equality of rights, equality of opportunities, and affirmative action |
| aoj8 | 74170 | 52 | Compatible | Police respect laws vs. break laws to capture criminals. |
| d5 | 206293 | 130 | Compatible | Approval of homosexuals’ right to run for office. |
| d6 | 132686 | 92 | Compatible | Approval of same-sex couples' right to marry. |
| d7 | 19512 | 19 | Null | Approval of disabled people’s right to run for political office. |
| rac2a | 15932 | 19 | Null | Universities should reserve places for darker-skinned students, even if they must exclude other students. |
| rac3a | 16066 | 9 | Null | The mixing of races is good for Bolivia. |
| w10 | 8922 | 6 | Compatible | Attitudes towards participation of women in politics. |
| gen1 | 22716 | 24 | Compatible | Men have greater rights to jobs than women. |
| gen6 | 20042 | 22 | Incompatible | Ballot quotas for women.  |
| Othering of minorities. |
| b43 | 157010 | 95 | Compatible | Pride in nationality. |
| cct3 | 25284 | 21 | Compatible | Beneficiaries of social programs are lazy. |
| dis35a  | 18659 | 12 | Compatible | Comfortable with homosexuals as neighbors. |
| dis35d  | 17420 | 11 | Compatible | Desirability of Afro-Colombians as neighbors. |
| dis35e | 15899 | 10 | Compatible | Desirability of indigenous as neighbors. |
| domw14b | 6575 | 5 | Compatible | Termination of pregnancy in the case of incest or rape. |
| dvw1 | 20031 | 14 | Null | Approval of husband beating wife if she neglects chores. |
| pop112 | 30479 | 19 | Compatible | The greatest obstacle for the development of our country is rich people abusing of poorer people.  |
| rac1ca | 17555 | 22 | Null | Reason why those with dark skin are poorer (answer 1, culture). |
| rac3b | 15029 | 9 | Null | Would you let your children marry an indigenous person? |
| redist3 | 21657 | 15 | Strongly compatible | Most unemployed could find a job if they wanted. |
| vb50 | 92341 | 59 | Compatible | Men are better political leaders than women. |
| w14a | 98075 | 73 | Compatible | Abortion justified when mother's health is at risk. |

## **Appendix 4. Alternative Polarization Scores**

We calculate polarization at the regional level as the sum of polarization indices in all 19 Latin American countries. While these metrics measure polarization at different levels, they agree with how polarization has evolved in Latin America. All of them agree that polarization decreased from 2006 to 2010, increased from 2010 to 2016, and slightly decreased from 2016 to 2018.

Table A2. Average of polarization scores of 19 Latin American countries,

2006–2018, using four different metrics

|  |  |  |
| --- | --- | --- |
| Country | Survey wave | $$∆$$ |
| 2006 | 2008 | 2010 | 2012 | 2014 | 2016–17 | 2018–19 |
| IPI score (ours) | 26.2 | 24.5 | 22.3 | 30.0 | 30.5 | 35.6 | 33.4 | 7.2 |
| Standard deviation (rescaled to a 0–100 range) | 54.7 | 53.3 | 51.8 | 57.3 | 58.4 | 62.0 | 60.6 | 7.3 |
| Variance (not rescaled) | 6.13 | 5.87 | 5.54 | 6.79 | 7.01 | 7.90 | 7.51 | 1.4 |
| Effective antagonism (Esteban and Ray 1994) | 45.8 | 43.1 | 41.2 | 50.7 | 52.1 | 57.5 | 55.0 | 11.7 |
| Sum of extreme groups(Abramowitz and Saunders 2008) | 27.9 | 25.9 | 24.4 | 31.1 | 32.4 | 36.0 | 33.7 | 8.2 |
| Ordinal Disagreement(Herman and Taylor 1971) | 1.94 | 1.87 | 1.81 | 2.03 | 2.07 | 2.25 | 2.17 | 0.23 |

Individual scores for each country and wave can be calculated using our do files.

## **Appendix 5. Using the Effective Antagonisms Metric of Esteban and Ray (1994)**

As established by Esteban and Ray (1994), polarization can be understood as the sum of effective antagonisms felt by all individuals in a society. Adapting the formula presented in theorem 1 of their article to our setting, with only three groups (extreme left, moderates, and extreme right) and assuming α=0, we obtain:

$$P=K\left(2LR+LM+ML+MR+RM+2RL\right)$$

Where:

* K is an undefined constant.
* L, M, and R are the proportions of individuals who self-identify as extremely left, moderates or extremely right, respectively.
* Effective antagonism felt by group i towards group j is given by the multiplication of the size of i group with the size of the j group, and with their ideological distance. Thus, 2LR is 2\*L\*R and equal to 2RL, with 2 indicating that these groups are two steps away ideologically.

Minimum polarization is achieved when all individuals lie in the same group, so that P=0. Maximum polarization is achieved when L=R=0.5, which would simplify the expression to K(1). Thus, to normalize the range of this function, K should be equal to 1.

We can now express a special case of Esteban and Ray adapted to our setting:

$$P=4LR+2LM+2MR$$

We use this formula to offer alternative polarization scores for 19 Latin American countries in table A2, and to show that this formula does not conform to the concept of polarization presented in Fiorina et al. (2008) in Appendix 6 below.

## **Appendix 6. Existing Polarization Metrics Are Not Consistent with Fiorina et al. (2008)**

This section proves that three alternative metrics of polarization, standard deviation, excess kurtosis, and effective antagonisms, all fail to obey Fiorina et al.’s understanding that polarization is a “movement from the center toward the extremes” where the middle should “lose to *both* extremes” (2008, 557). The examples below are based on a variable that measures self-identified ideological position on a 1 to 10 left to right scale, as l1 in the LAPOP. However, the point we are making is more general than that.

1. Standard deviation

Suppose respondents are split between answering 5 or 6, both of which must be considered moderate positions in a 1 to 10 ideological scale. The standard deviation of such a sample will be 0.5. As the maximum standard deviation possible for this variable is 4.5, the sample described would have a polarization score of 11. This is not compatible with Fiorina et al. (2008)’s idea that there can be no polarization without extremes.

Now, imagine that respondents are equally divided between answering 1 and 6. Such a sample would find a standard deviation of 2.5, or about 56% of the maximal standard deviation possible (which is 4.5). This also fails to be compatible with Fiorina et al. (2008), as one of the extreme groups is entirely absent.

1. Excess kurtosis

Before discussing this type of polarization metric, it is important to clarify that kurtosis is not a test for single-peakedness nor a clear sign of bimodality. See Westfall (2014). Nonetheless, a distribution where the entire probability density falls on two separate, discrete peaks (bimodal) will be maximally platykurtic. We will use this extreme case.

Imagine that all respondents answer, in equal proportions, 1 or 3 in the 1 to 10 scale ideological variable described above. Kurtosis will be 1, and excess kurtosis (that is, sample kurtosis minus 3, the kurtosis of a normal distribution variable) will be −2. According to kurtosis measurements of polarization, opinions will be maximally polarized. Thus, this measure of polarization will betray Fiorina et al. (2008)’s idea that there can be no polarization without both extremes.

1. Effective antagonism

Using Esteban and Ray (1994) metric of polarization as derived in our Appendix 5:

$$P=4LR+2LM+2MR$$

Now, suppose one of the extremes is missing and respondents are equally divided between moderates and the extreme right, that is, L=0, M= 0.5 and R=0.5. Then:

$$P=K\left(0+0+2(.25)\right)=0.5$$

Polarization would be 0.5 in the absence of one of the extreme groups, which betrays Fiorina et al. (2008)’s conceptualization of polarization.

1. Herman and Taylor’s (1971) Ordinal Disagreement.

Consider the example given by Herman and Taylor (1971, 33), with 4 groups occupying ideologically ordered positions and consisting of 50%, 10%, 10%, and 30% of the relevant population resulting in an ordinal disagreement of 1.2. If all those positions are moderate (with ideological self-placements of 4, 5, 6, and 7 to LAPOP), we would be finding polarization despite an absence of extreme groups. Similarly, if the distribution fell entirely on self-placements of 5 and 6, which are necessarily moderate in our setting, ordinal disagreement would be nonzero.

This metric has other issues not covered here, such as the fact that it overestimates disagreement in fragmented party systems.

## **Appendix 7. Nonresponse to Ideological Item in LAPOP**

High levels of nonresponse to the ideological self-placement item in LAPOP (l1) could bring methodological and substantive doubts to our results. For this reason, we decided to measure the percentage of nonrespondents to this question in our dataset.

We find that, on average, 16.4% of interviewees asked by LAPOP to self-place their ideology from 2008 to 2019 did not answer this question, either because they don’t know or because they chose not to respond. When looking at wave averages, we can see that the level of nonresponse has been dropping over time and was below 10% in the last wave of our dataset.

Graph A1. Average percentage of nonrespondents to LAPOP’s l1 item, by survey wave



We recommend checking our methodological note below, and/or our .do file, to understand our procedure in detail.

**Methodological Note**

It is important to address some methodological issues about missing values and our averaging procedure. Nonresponse is a type of missing value, but not all missing values are due to nonresponse. Some individuals may not be asked this question (due to a split sample experiment, for instance) or the question may not have been asked in that country-year.

To identify who decided not to respond to this question, we checked the missing values subcategories, which LAPOP classifies as:

* .a Don’t know.
* .b No response.
* .c Not applicable
* .z Not asked in this country or year.

This suggests that nonresponse issues are related only to .a and .b types of missing values. However, we noticed (and later confirmed with survey administrators), that, on survey waves 2006, 2008, and 2010 the .c missing values to item l1 actually corresponds to .a and .b. We therefore adapted our coding to include .c as nonrespondents in those waves.

Our unit of analysis is country-year. Therefore, when evaluating Latin American averages (by wave or overall), we first calculate the average for each country-year and then a simple average of all countries (by wave or overall). Thus, each country has the same importance in determining the region average.

## **Appendix 8. Polarization Index Using Voters Only**

When only voters are included (using variable vb2, “Voted in Last Presidential Election”), results are qualitatively the same. At the regional level, the levels of polarization are similar as well as its evolution over time. The level and evolution is also similar in most countries, with Argentina been the only clear exception.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **wave** | **Delta** | **V-Shaped evolution?** |
| **country** | **2006** | **2008** | **2010** | **2012** | **2014** | **2016/17** | **2018/19** |
| Mexico | 24.8 | 21.4 | 24.5 | 24.4 | 35.2 | 29.6 | 24.8 | 0.0 | No |
| Guatemala | 14.4 | 25.5 | 18.9 | 24.8 | 26.8 | 37.0 | 39.7 | 25.3 | No |
| El Salvador | 41.7 | 43.2 | 29.9 | 45.9 | 40.0 | 36.2 | 38.0 | −3.6 | No |
| Honduras | 29.8 | 23.7 | 17.4 | 33.6 | 37.2 | 45.3 | 47.6 | 17.8 | Yes |
| Nicaragua | 32.1 | 51.9 | 43.7 | 53.4 | 53.2 | 56.3 | 47.5 | 15.4 | No |
| Costa Rica | 24.9 | 31.8 | 27.1 | 23.5 | 26.6 | 27.1 | 26.0 | 1.1 | No |
| Panama | 18.3 | 12.5 | 20.0 | 39.2 | 28.5 | 41.1 | 39.7 | 21.4 | Yes |
| Colombia | 27.7 | 27.1 | 25.9 | 26.7 | 32.0 | 30.2 | 32.5 | 4.8 | Yes |
| Ecuador | 24.3 | 25.8 | 22.0 | 27.0 | 28.6 | 31.6 | 25.8 | 1.5 | Yes |
| Bolivia | 17.5 | 17.6 | 12.3 | 17.7 | 14.1 | 25.5 | 27.7 | 10.2 | Yes |
| Peru | 17.3 | 18.2 |  | 14.8 | 15.1 | 26.0 | 27.4 | 10.1 | unclear |
| Paraguay |  | 18.5 | 15.0 | 35.5 | 39.1 | 41.6 | 38.9 | 20.4 | Yes |
| Chile | 24.0 | 21.0 | 23.8 | 21.1 | 23.0 | 24.3 | 23.3 | −0.7 | Yes |
| Uruguay | 26.3 | 29.1 | 25.6 | 27.1 | 30.5 | 24.5 | 31.5 | 5.2 | Yes |
| Brazil | 21.1 | 17.2 | 22.1 | 30.7 | 26.5 | 35.7 | 38.0 | 16.9 | Yes |
| Venezuela | 46.5 | 28.4 | 24.8 | 40.3 | 41.5 | 41.8 |  | −4.7 | Yes |
| Argentina |  | 9.2 | 9.7 | 14.5 | 16.4 | 19.5 | 20.8 | 11.6 | No |
| Dominican Republic | 39.0 | 38.8 | 41.1 | 53.6 | 44.1 | 56.4 | 53.5 | 14.5 | Yes |
| Haiti | 25.2 | 16.6 | 10.4 | 26.1 | 27.3 | 59.7 |  | 34.5 | Yes |
| **Average** | **26.8** | **25.1** | **23.0** | **30.5** | **30.8** | **36.3** | **34.3** | **10.6** | **Yes** |

**Reference for Appendix**

Westfall, Peter H. 2014. Kurtosis as Peakedness, 1905–2014. R.I.P. *The American Statistician* 68, 3: 191–95.

1. Sample sizes for the variable in the 22 countries and 7 waves used in the article, independent of ideology. Actual tests use smaller samples, as about a third of individuals are classified as left or right wingers. [↑](#footnote-ref-1)