The social bases to nuclear energy policies in Europe: priors, proximity, belief updating and attitudes to risk

Fabio Franchino, Università degli Studi di Milano, Milan, Italy

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Abstract

This article analyzes the social bases than underpin the widely different trajectories of nuclear energy policies across European countries. Employing a set of surveys carried out in the last forty years, I examine the conditional effects of ideological priors and proximity to a nuclear power plant on public attitudes toward nuclear energy, as well as the long- and short-term dynamics of belief updating after the occurrence of major accidents. Results highlight how proximity can strengthen, weaken or have no effect on the ideological component of these attitudes. Moreover, the publics of most countries with an experience in nuclear energy display the traits of a Bayesian dynamics of belief updating, especially in the vicinity of a plant. I also show the fairly exceptional traits of French public opinion.

Introduction

Any major nuclear energy accident has large consequences for nuclear energy policies in Europe, or maybe not. The aftermaths of the nuclear disaster in Fukushima of March 2011 resonated well beyond Japan. In autumn 2010, the German government decided to extend by twelve years a plan to end nuclear power generation by 2022. After the disaster, it made an impressive U-turn. The extension was suspended and seven of the seventeen operating reactors were temporarily disconnected from the electricity grid. In May, the extension was scrapped and, three months later, eight reactors were declared permanently shut down.[1] In Italy, a government plan to restart the nuclear energy programme, which begun in June 2008, was brought to a sudden stop after its overwhelming rejection in a referendum in June 2011. It was the first referendum that managed, since 1995, to reach the majority threshold of voter participation required to validate the outcome.[2] In Belgium, discussions to repeal a 2003 law on the gradual phasing-out of nuclear energy, already softened in 2009 by a decision to extend the lifetime of the oldest plants, came to a sudden halt.[3]

The disaster at Chernobyl in April 1986 had similar consequences. The victory of the anti-nuclear campaign at a referendum of November 1987 led to the end of nuclear energy policy in Italy. All the operating plants were permanently shut down.[4] In Belgium, a moratorium adopted in 1988 suspended the construction of the fifth reactor at the Doel nuclear power station and essentially stopped any future plan to expand capacity.[5] And the local government of North Rhine-Westphalia in Germany successfully manage to block

[1] Paul W. Thurner, 'Germany', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).
[2] Fabio Franchino, 'Leading and Lagging: Innovation, Delays and Coalition Politics in the Italian Nuclear Energy Policy', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).
[3] Marc Swyngedouw, 'Nuclear Energy Politics in Belgium: Big Business and Politics', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).
[4] Franchino.
[5] Swyngedouw.

the connection to the grid of a fast breeder reactor at Kalkar, a significant victory for the anti-nuclear movement.[6] Three additional plants, two of which connected only in 1985 and 1986, were shut down in 1988. In Austria, attempts to repeal a 1978 law, the first ever ruling out the use of nuclear energy, ended abruptly.[7]

Yet, notable are also the plans that did not change. In 1986, four new reactors were connected in France after the Chernobyl disaster, four more in 1987 and two in 1988. In this period, three new units were connected in Britain, three in Germany and two in Spain. The construction of new power plants in Civaux (France) and Sizewell (Britain) also began in 1988. That year manifesto of the French Socialist Party, winner of the elections, even took the strongest pro-nuclear stance ever.[8] Although it is early days, the Fukushima nuclear disaster seems to have delayed, but not altered significantly, the plan to build up to eight new plants announced by the British government in October 2010. Similarly, the pro-nuclear agenda of the Swedish and Dutch governments appears unaffected for the time being.[9] Four nuclear reactors are still under construction in Europe - two in Slovakia, one in France and one in Finland.

Nuclear energy policies in Europe vary widely across countries and time. There are enthusiastic and cagier endorsers, those that have experienced several policy reversals and others that even banned nuclear energy with a constitutional law. I will not attempt to explain the causes behind these different policy trajectories. Aside from common economic and environmental factors, they are determined by a combination of electoral pressures, intra-government politics and other hurdles, such as referendum or local government intervention.[10]

The objective of this article is to analyze the social bases to nuclear energy policies and, because of the large variation across space and time, European countries are ideal for this analysis. Significant social pressures underlie these policy dynamics, as most clearly emerge from the recurrent waves of anti-nuclear protests taking place across Europe.[11]

I shall focus here on three questions. How do left-right ideological priors shape the public opinion – i.e. the risk attitudes - toward nuclear energy across European countries? More importantly, how does proximity to an operating nuclear power plant condition the impact of these priors on risk attitudes? Finally, how do beliefs update across countries, under different priors and degrees of proximity, and over the short and the long period, in the wake of major nuclear power accidents? In other words, I will flesh out the conditional effects of priors and proximity on public attitudes toward nuclear energy across European countries as well as the long- and the short-term dynamics of belief updating after the occurrence of major accidents.

Results highlight important similarities and differences. The left-leaning publics of European countries express much stronger reservations toward nuclear energy than other sections of public but, while in some countries the issue becomes even more divisive in the vicinity of nuclear power stations, in others the divergence actually softens. In yet other countries, ideology and proximity do not interact significantly.

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[6] Thurner.

[7] Wolfgang C. Müller, 'Austria: Rejecting Nuclear Energy – From Party Competition Accident to State Doctrine', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).

[8] Sylvain Brouard and Isabelle Guinaudeau, 'Nuclear Politics in France: High Profile Policy and Low Salient Politics', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).

[9] Kees Aarts and Maarten Arentsen, 'Nuclear Power and Politics in the Dutch Delta', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming); Sören Holmberg and Per Hedberg, 'The Will of the People? Swedish Nuclear Power Policy', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming). In May 2012, the Dutch government coalition replaced the right-wing PVV with three small left-leaning parties. It remains to be seen what this change could bring.

[10] For an extended treatment, see *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).

[11] Swen Hutter, 'Anti-nuclear Protests in Western Europe', in *Phasing-out and Phasing-in: The Comparative Politics and Policies of Nuclear Energy in Europe*, ed. by Wolfgang C. Müller and Paul W. Thurner (Oxford University Press, forthcoming).

Moreover, while for most countries with an experience in nuclear energy, the views of left- and right-wing individuals are more stable over time and in the proximity of a plant than those of centrist subjects - displaying the traits of a Bayesian dynamics of belief updating -, for the other countries the anti-nuclear foundations of left-wing interviewees are the most stable, while the pro-nuclear views of rightist subjects are the least. I will also show how the French public is fairly exceptional.
The next section discusses the surveys I use to collect information on public attitudes toward nuclear energy, followed by a presentation of the measures of ideology and proximity. I introduce then the estimation strategy and analyse the results.

Public attitudes toward the risks of nuclear energy

Since 1978, Eurobarometer has surveyed public attitudes toward nuclear energy. Nine surveys, conducted between 1978 and 1996, ask the same question, while the last two, conducted in 2006 and 2008, employ different formats, which are nevertheless designed to gauge public assessment of the risks associated with nuclear energy.[12] The most used question is the following:

> *All new development in the industrial field implies efforts, time and money. It may also involve risk. Here are three opinions about the development of nuclear power stations, which use atomic energy for the production of electricity. Which of these three statements comes closest to your own opinion of the development of nuclear power?*
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> 1 It is worthwhile. 2 No particular interest. 3 The risks involved are unacceptable.

I have re-codified these answers separating those that are accommodating or indifferent toward nuclear energy from those considering its development unacceptably risky, because I am essentially interested in the determinants of rejection. Figure 1 shows how the share of the rejectionist pool has changed over the eleven surveys. Unsurprisingly, it has increased and became more homogeneous after both the Three Mile Island accident and the Chernobyl disaster. In the twenty years thereafter, the rejectionist pool has been shrinking but, interestingly, cross-country variation has remained higher over the medium-long term compared to the pre-Chernobyl period, indicating different trajectories in how public opinion across Europe has developed over time. After five years, public attitudes have settled back to the pre-1986 values in some countries, while, in others, the size of the rejectionist pool stayed higher.[13]

< Figure 1 >

Figure 2 shows the within-country variation in risk attitudes, that is, the standard deviation of the share of the rejectionist pool across the regions of each country.[14] The two nuclear power accidents have also increased the dispersion of the percentage of the rejectionist pool within countries, indicating greater national heterogeneity. In the medium-long term, heterogeneity has diminished. In other words, the accidents have led not only to more rejection, but also to greater divergence of opinion across citizens living in the different regions of a country. These aggregate data are interesting, but we should not infer much about individual attitudes to nuclear risk based solely upon these statistics to avoid incurring in an ecological fallacy. We move on now to the factors that could explain individual attitudes towards nuclear energy.

< Figure 2 >

[12] The Eurobarometer study numbers are: ZA0995 (1978, question code v48), ZA1208 (1982, v178), ZA1321 (1984, v73), ZA1544 (1986, v142), ZA1713 (1987, v339), ZA1751 (1989, v483), ZA2031 (1991, v170), ZA2347 (1993, v103), ZA2898 (1996, v332), ZA4507 (2006, v501) and ZA4743 (2008, v152). I am in debt to Sylvain Brouard and Isabelle Guinaudeau for identifying this series of surveys.

[13] If we limit the analysis to the nine countries surveyed in 1978, the patterns are very similar to those illustrated in Figures 1 and 2. Therefore, the greater dispersion that we find after the Chernobyl accident is not due to the increased number of surveyed countries. The drops in 2006 and 2006 surveys could also be due to the different scaling of the answers. We used the most anti-nuclear answers from the seven-point scale of the 2006 survey (1, strongly opposed to nuclear energy) and from the four-point scale (4, totally opposed to nuclear energy) of the 2008 survey.

[14] I employed the nomenclature of territorial units for statistics (level I for large countries and level II for smaller ones) to codify and standardize the regions across the years. Since coding has changed over time, the data may be prone to measurement error and should be interpreted with some caution.

Ideological priors, proximity and belief updating

Although almost solely U.S.-centred, several studies find a significant ideological component in the assessment of nuclear risk in both élites and general public. Individuals holding left-of-center views take a more critical stance.[15] Whether this holds true in other countries and time periods is another matter though. Anti-nuclear grass-root movements began to spread across Europe in the second half of the 1970s. For instance, *Verenigde Aktiegroepen voor de Kernstop*, established in 1974, was instrumental for the 1976 moratorium adopted by the Belgian government.[16] After the Three Miles Island accident the frequency and magnitude of anti-nuclear protests increased.[17] Protests took place in Montalto di Castro (Italy), Kalkar (Germany), and Zwentendorf (Austria). It is therefore no coincidence that the first Eurobarometer survey was carried out in 1978.

Yet, we should be cautious to map the left-right spectrum onto anti-pro nuclear energy views. In the late 1970s, we would be hard pressed to find a clear association between the ideological orientation of parties and their policy positions on nuclear energy. Both the Italian and French Communist parties strongly supported the development of nuclear energy, sharing this view with the Christian Democrats and the Gaullists respectively, while the Socialists in both countries were more lukewarm.[18] In Germany, there was a permissive consensus among the four major parties.[19] If distinctions were to be found, the Free Democrats actually voiced stronger reservations towards nuclear energy than the Social Democrats.[20] In Sweden, the Center Party and the (former Communist) Left Party joined forces in opposing the expansion in nuclear energy against a coalition of Social Democrats, Liberals and Conservatives.[21] The Netherlands represented the only clear-cut case. In the 1977 general elections, the Labour Party took a highly critical stance toward the development of nuclear energy, the Christian Democrats were more accommodating, while the conservative-liberal VVD remained the most outspoken supporter.[22] It remains however that nuclear policy was more divisive for left-of-center parties. The Greens for instance started competing in local and regional elections against the existing parties of the left. They won seats in both Germany and Italy.

Eurobarometer surveys include a question where interviewees are asked to place themselves on a one to ten left-right scale. I employ the answer to this question to measure an individual's ideological prior and I will show that this belief is a central component of the subjective assessment of the risks associated with nuclear energy. Individuals holding left-of-center views have a more critical stance toward this source of energy, while those with right-of-center orientation are more accommodating.[23] However, the substantive impact of these priors and how these beliefs are updated after a nuclear accident vary across countries and with the closeness of an individual's residence to an operating nuclear power plant.

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[15] Gerald T. Gardner and others, 'Risk and Benefit Perceptions, Acceptability Judgments, and Self-Reported Actions Toward Nuclear Power', *The Journal of Social Psychology*, 116 (1982), 179–197; Michael Greenberg and Heather Barnes Truelove, 'Energy Choices and Risk Beliefs: Is It Just Global Warming and Fear of a Nuclear Power Plant Accident?', *Risk Analysis*, 31 (2011), 819–831; Hank C. Jenkins-Smith, Neil J. Mitchell and Kerry G. Herron, 'Foreign and Domestic Policy Belief Structures in the US and British Publics', *Journal of Conflict Resolution*, 48 (2004), 287–309; James H. Kuklinski, Daniel S. Metlay and W. D. Kay, 'Citizen Knowledge and Choices on the Complex Issue of Nuclear Energy', *American Journal of Political Science*, 26 (1982), 615–642; Eric Plutzer, Ardith Maney and Robert E. O'Connor, 'Ideology and Elites' Perceptions of the Safety of New Technologies', *American Journal of Political Science*, 42 (1998), 190–209; Stanley Rothman and S. Robert Lichter, 'Elite Ideology and Risk Perception in Nuclear Energy Policy', *The American Political Science Review*, 81 (1987), 383–404.

[16] Swyngedouw.

[17] Hutter.

[18] Brouard and Guinaudeau; Franchino.

[19] Herbert P. Kitschelt, *Kernenergiepolitik: Arena Eines Gesellschaftlichen Konflikts* (Frankfurt: Campus, 1980).

[20] Thurner.

[21] Holmberg and Hedberg.

[22] Aarts and Arentsen.

[23] On how values affect issue attitudes see Jacoby 'Value Choices and American Public Opinion', *American Journal of Political Science*, 50 (2006), 706–723. and Schwartz, Caprara and Vecchione 'Basic Personal Values, Core Political Values, and Voting: A Longitudinal Analysis', *Political Psychology*, 31 (2010), 421–452.

Why should closeness be relevant? Proximity is probably one of the best measures of the objective risk of nuclear energy.[24] In 1990, the International Atomic Energy Agency (IAEA) introduced the international nuclear and radiological event scale classifying the safety significance of nuclear accidents. The severity of a nuclear event is determined by the highest of three scores on the degradation of the defence in-depth (i.e. the multiple and independent layers of safety systems of the reactor core) and the on- and off-site impact on people and the environment. The extent to which a nuclear event has local or wider consequences directly determine the safety significance and health hazard associated with a nuclear event.

Fortunately, Eurobarometer surveys include information on the region of residence of the interviewees. They use two territorial aggregations: a macroregional one, equivalent to either level one or two of the nomenclature of territorial units for statistics, and finer one, equivalent to either level two or three of the nomenclature. I have used information at the finest territorial level available and identified the geographical coordinates (latitude and longitude) of each unit through GeoHack. Next, I have used the information available from the IAEA power reactor information system to identify all the nuclear power plants with operating reactors the year preceding the date of the survey. Once the geographical coordinates of these plants have been determined, I have employed the great circle distance formula to calculate the distance between the region of residence of the interviewees and the closest operating plant. Proximity is simply the respective negative value of this distance. Objective risk should plausibly affect risk attitudes but its impact could be conditional on the prior beliefs of individuals. Left-wing subjects may display more rejectionist attitudes than right-wing ones, as they move closer to an operating plant.

Finally, how are these beliefs updated after the occurrence of a major accident? Since the Eurobarometer surveys were carried out before and after the Three Mile Island and Chernobyl accidents, they offer the opportunity to assess the dynamics of belief updating, conditional on priors and proximity. Studies in social cognition have long established that people interpret new information in view of their prior beliefs on the issue at hand. While they are likely to accept at face value evidence that confirms their beliefs, they subject disconfirming evidence to critical evaluation.[25] Poortinga and Pidgeon[26], for instance, show that the impact of negative events on risk attitudes towards genetically modified food is stronger on individuals holding intermediate attitudes.[27]

The mathematical formulation of this updating process is given by the well-known Bayes' theorem. The probability of rejecting nuclear energy, conditional of observing a nuclear accident, should be a function of the initial risk attitude toward nuclear energy (prior) and the support that the accident provides for rejection. Somewhat banally, given its significance to European citizens, we should therefore expect the Chernobyl accident to have the largest impact on beliefs (Poortinga and Pidgeon also find negative events to be more informative than positive ones). More interestingly, holding true the impact of ideological priors on beliefs, we should expect centrist individuals to display greater variance in risk attitudes across surveys.

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[24] On the impact of proximity to planned nuclear power stations on voting in referendum on nuclear energy see Giuseppe Pignataro and Giovanni Prarolo, *NIMBY Clout on the 2011 Italian Nuclear Referendum*, Quaderni - Working Paper DSE (Bologna: University of Bologna, 2011), p. 21. On how attitudes towards risk-taking influences political choices see Richard Nadeau, Pierre Martin and André Blais, 'Attitude Towards Risk-taking and Individual Choice in the Quebec Referendum on Sovereignty', *British Journal of Political Science*, 29 (1999), 523–539.

[25] See, for instance, Charles G. Lord, Lee Ross and Mark R. Lepper, 'Biased Assimilation and Attitude Polarization: The Effects of Prior Theories on Subsequently Considered Evidence.', *Journal of Personality and Social Psychology*, 37 (1979), 2098–2109.

[26] Wouter Poortinga and Nick F Pidgeon, 'Trust, the Asymmetry Principle, and the Role of Prior Beliefs', *Risk Analysis*, 24 (2004), 1475–1486.

[27] Belief updating is central to policy diffusion and learning as well, see Fabrizio Gilardi, 'Who Learns from What in Policy Diffusion Processes?', *American Journal of Political Science*, 54 (2010), 650–666; Fabrizio Gilardi, Katharina Fuglister and Stephane Luyet, 'Learning From Others: The Diffusion of Hospital Financing Reforms in OECD Countries', *Comparative Political Studies*, 42 (2009), 549–573; Covadonga Meseguer, 'Learning and Economic Policy Choices', *European Journal of Political Economy*, 22 (2006), 156–178; Covadonga Meseguer, *Learning, Policy Making, and Market Reforms*, 1st edn (Cambridge University Press, 2009); Covadonga Meseguer and Fabrizio Gilardi, 'What Is New in the Study of Policy Diffusion?', *Review of International Political Economy*, 16 (2009), 527.

Estimation

To estimate how proximity and ideology affect the propensity to reject nuclear energy, I employ a three level binomial model with a probit link function.[28] Interviewees are nested within countries, and countries are nested within surveys. I am interested in assessing how proximity, ideological priors and their interaction affect attitudes towards nuclear energy, across countries and time. The stochastic component of the model is $Y_{ijt} \sim Y_{Bern}(y_{ijt}|\pi_{ijt})$, where $\pi_{ijt} = Pr(Y_{ijt} = 1|\beta)$. The systematic component is

$$\pi_{ijt} = \Phi\left[\sum_{j=1}^{M}(\beta_{1j} I_{ijt} + \beta_{2j} P_{ijt} + \beta_{3j} I_{ijt} P_{ijt} + \boldsymbol{\beta} \cdot \boldsymbol{D} + \beta_{8j} C_j) + \sum_{t=1}^{T}(\beta_{9t} S_t)\right] \quad (1)$$

where π_{ijt} takes the value of 1 if interviewee i in country j at time t considers nuclear energy unacceptably risky and zero otherwise, for $i = 1, \dots, n_{jt}$, $j = 1, \dots, M$, $t = 1, \dots, T$. Φ is the cumulative distribution function of the standard normal distribution, I_{ijt} is the interviewee's left-right self-placement, while P_{ijt} is her proximity, in kilometers, to the closest operating plant. $\boldsymbol{D}$ is an $(\mathrm{n_{jt}} \times 4 \times \mathrm{M} \times \mathrm{T})$ array of four commonly used[29] individual-level demographic variables (education, gender, age and income), while $\boldsymbol{\beta}$ is a four-dimensional vector of their respective coefficients. I allow for the impact of the individual-level variables to vary across both countries and surveys. C_j and S_t are country- and survey-level random effects respectively. I have excluded the 2006 and 2008 surveys because the wording of the question and the scaling of the answers differ.[30] While the wording problem may be somewhat overlooked, the different scales would require me to choose, arbitrarily, a threshold value for measuring rejection. Finally, I employ MCMC-based Bayesian estimation because it allows the individual-level parameters to be estimated efficiently and separately for each country. I can therefore estimate not only how objective risk interacts with ideology for each country, but also the dynamics of this interaction over the short and long term, after a major nuclear accident. This is particularly important for the analysis of belief updating. The code and further details of the estimation procedure are discussed in the Appendix.

Results

Ideology and proximity

The results of the MCMC-based model are reported in the Appendix (Table A). I make use of two figures to show how ideology and proximity interact in affecting rejectionist attitudes towards nuclear energy. Figure 3 shows the marginal effect of changing ideological priors, from right (10) to left (1), on the probability of rejecting nuclear energy for interviewees residing at an increasing distance from the closest operating plant. The lines cover only the distances that are meaningful for the relevant country-years. These vary as a function of the size of the country and with new plants operating and old ones closing. Figure 4 instead shows the marginal effect of moving one standard deviation closer than the country-year proximity mean on the probability of considering nuclear energy unacceptably risky, over the left-right self-placement of the interviewees.

< Figure 3 >

< Figure 4 >

I have chosen the representative years 1978 and 1982, before and after the Three Mile Island accident, 1986, a few months after the Chernobyl disaster, and 1996, ten years after the accident. The narrow grey area on which the lines lay covers the 95 percent confidence intervals. The marginal effects are very precisely estimated because of the very large size of the sample.[31] In Figure 4, the slopes and intercepts of

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[28] I employ a probit link because the attitude to risk reflects an underlying interval variable. Hence, its cumulative distribution is normal.

[29] See, for instance, Thomas Dohmen and others, *Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey* (Berlin: DIW German Institute for Economic Research, 2005); Greenberg and Truelove, 819–831; Jenkins-Smith, Mitchell and Herron, 287–309.

[30] Hence, *T* = 9. The countries are Austria, Belgium, Denmark, Finland, France, Great Britain, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain and Sweden (*M* =16).

[31] To generate these figures, I implemented the code made available by Brambor, Clark and Golder 'Understanding Interaction Models: Improving Empirical Analyses', *Political Analysis*, 14 (2006), 63–82. I took 10,000 draws from the posterior distribution mean and the variance-covariance matrix. Note that I adapted the variance-covariance matrix to take into account the positive autocorrelation in the MCMC samples (see Appendix). The other variables are set at

these curves vary as a function of the different country-year means and standard deviations as well as different year effects. In Figure 3, only the intercepts vary as a result of the year effects.

Figure 3 shows that interviewees with self-declared left-of-centre views are significantly more likely to reject nuclear energy than interviewees with right-of-centre opinions. This result is very robust across countries, surveys and relevant distances. Not a single line crosses the horizontal axis. This, perhaps unsurprising, result confirms prior research.[32] Less obvious is however how ideology mediates the relation between objective and subjective risk.

If objective risk (proximity) were to have a positive impact on subjective risk, independent of priors, the curves in Figure 4 should lay above the horizontal axis. This holds true for one country only, Luxembourg. In 1996, a subject that moved 14 km closer, than the mean distance, to an operating plant was between 0.5 and 1.9 percentage points more likely to display rejectionist attitudes. This is a rather small effect, also because of the small size of the country. Figure 4 also shows that, for four countries (Netherlands, Britain, Spain and Sweden), proximity actually *decreases* the likelihood of rejecting nuclear energy. In 1996, British interviewees living 50 km closer to a plant, than the country mean, were between 1.6 and 3 percentage points *less* likely to reject nuclear energy. In all the other cases, the lines cross the horizontal axis, meaning than the relation between proximity and subjective risk is mediated by the ideological priors. I do the analysis by groups of countries.

For the largest group, including Belgium, Germany, Denmark, Italy, Finland and Portugal, proximity operates as a wedge separating left- from right-wing interviewees. The curves in Figure 4 are downward sloping from left to right and cross the horizontal axis. As left-wing subjects move closer to an operating plant, they are more likely to reject nuclear energy. As right-wing subjects do so, they are less likely to reject it. In other words, higher proximity intensifies the conflict between supporters and rejectionists. Take Germany in 1996 and a subject moving 80 km closer to a plant than the mean distance. If she held left-wing views, she was 10.7 percentage points *more* likely to reject nuclear energy. If she held right-wing views, she was 8.8 percentage points *less* likely to reject this energy.

The curves of these countries in Figure 3 are also downward sloping from left to right, indicating that ideology has a larger impact on attitudes as subjects move closer to a plant. Consider Belgium in 1996. For subjects residing 95 km from the closest plant, a leftward shift in ideology increased the likelihood of rejecting nuclear energy by only 11.6 percentage points, compared to an increase of 44.8 points for those just 16 km away. In Germany, ideology made little difference for interviewees living 250 km away from a plant. A leftward shift led to an increase of less than 6.7 percentage points in rejectionist attitudes, while, for those residing a few kilometres away, a similar shift led to a considerable 69 percentage point increase.

The Netherlands and Britain share some features with this group of countries. Here as well ideology has a larger impact on attitudes as subjects move closer to a plant (their curves in Figure 3 are downward sloping), but subjects are more supportive of this source of energy as they move closer to a plant, *regardless* of their ideology (their curves in Figure 4 are below the horizontal axis). In other words, proximity offsets the rejectionist inclinations of left-wing interviewees.

In the second largest group, including France, Austria, Ireland and Greece, proximity displays the opposite behaviour across the ideological spectrum. The curves in Figure 4 are upward sloping from left to right and cross the horizontal axis. As left-wing subjects move closer to an operating plant, they are less likely to reject nuclear energy. As right-wing subjects do so, they are more likely to reject it. Consider France in 1996 and a subject moving 86 km closer to a plant than the mean distance. If she held left-wing views, she was 8.4 percentage points *less* likely to reject nuclear energy. If she held right-wing views, she was 3.4 percentage points *more* likely to reject this energy. Because the effect on left-wing interviewees is larger than the one on right-wing interviewees and, in Austria and Ireland, the latter occurs only for extreme right-wing values, we can say that proximity alleviates the conflict between supporters and rejectionists in these countries. Except France, none of these countries has ever had an operating plant on its soil, but the nuclear energy issue has not been less important nevertheless. In Austria, for instance, anti-government,

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either their mode or mean values: an average age of seventeen when leaving full time education, female gender, age forty-four and income scale seven.

[32] Gardner and others, 179–197; Greenberg and Truelove, 819–831; Jenkins-Smith, Mitchell and Herron, 287–309; Kuklinski, Metlay and Kay, 615–642; Plutzer, Maney and O'Connor, 190–209; Rothman and Lichter, 383–404.

rather than anti-nuclear, views may have plausibly played an important role in the tight outcome of the 1978 referendum which impeded the connection to the grid of the Zwentendorf plant.[33] Several attempts to restart the programme followed, but they ultimately failed with the passing in 1999 of another law, this time of constitutional rank, ruling out the use of nuclear energy.

The curves of these countries in Figure 3 are also upward sloping from left to right, indicating that ideology has a smaller impact on attitudes as subjects move closer to a plant. For a French subject residing, in 1996, 350 km from the closest plant, a leftward shift in ideology increased the likelihood of rejecting nuclear energy by 86.4 percentage points, compared to an increase of only 27.5 points for those just 28 km away. Interviewees in Luxembourg also display a diminishing impact of ideology as they move closer to a plant but, recall, this does offset the rejectionist attitudes that they display, regardless of their left-right views, as they move closer.

Finally, Spain and Sweden make up a group apart. Proximity and ideology appear to be orthogonal to each other. We noted earlier that subjects in these countries are less likely to reject nuclear energy as they reside closer to a plant, regardless of their ideology (see Figure 4). Additionally, a left-ward shift in ideology has the same impact on attitudes regardless of proximity. Their curves in Figure 3 are almost flat. In 1996, a leftward shift in ideology increased the likelihood of Spanish interviewees rejecting nuclear energy by 34.8 percentage points if they resided 40 km closer to a plant, than the country mean, and by 37.4 points if they lived 350 km further away. Proximity does no matter much then.

Figure 5 summarizes these findings. We have calculated the marginal effects of a ten-to-one leftward move on the probability of rejecting nuclear energy at 50 and 150km away from the closest plant, taken the difference and positioned these values on the vertical axis of Figure 5.[34] The strength of the ideology-proximity interaction is greater for countries located further away from zero. Such interaction for instance is much stronger for Belgium and France than for Spain or Portugal.

< Figure 5 >

On the horizontal axis, we have grouped countries according to the nature of the interaction. In the first column are countries where proximity intensifies the left-right divide; in the last column, countries where proximity softens such divide. For countries in the two central columns, the marginal effect of proximity does not change sign across the ideological spectrum. Greater proximity leads to more rejection in Luxembourg and more support in the other four countries, regardless of the ideological views. The strength of the interaction differs though. It is larger for Luxembourg, the Netherlands and Britain, where proximity has a weaker effect on, respectively, the rejectionist or supportive attitudes of left-wing interviewees. It is close to zero for Spain and Sweden.

Dynamics of belief updating

Figures 6 and 7 display the dynamics of belief updating across countries and surveys. I calculated the marginal effects on the probability of rejecting nuclear energy over the nine surveys. To trace properly the updating dynamics, I compared attitudes in any given survey, say 1989, with the attitudes in the preceding survey, that is 1987. I can therefore make eight comparisons.[35] Positive values mean that the likelihood of rejecting nuclear energy in a given survey is greater than in the earlier survey. I consider subjects declaring left, center and right views and located one standard deviation closer and one farther than the country average proximity (Figure 6 and 7 respectively). Confidence intervals are not displayed because they fall within the borders of the makers.

< Figure 6 >

< Figure 7 >

The overall dynamics of belief updating show both the long and the short term effects of nuclear accidents over risk attitudes. Interviewees were between 5 and 10 percentage points more likely to reject nuclear energy after the Three Mile Island accident. Attitudes remained unchanged in 1984, then they took a

[33] Müller.

[34] These values are equivalent to $\beta_{3j}\Delta I \Delta P$ where β_{3j} is the coefficient of the interaction term of (1) for country *j*, and ΔI and ΔP are the changes in ideology and proximity respectively. They are with reference to the 1996 survey.

[35] I had to exclude the countries included only in the 1996 survey because of the lack of a term of comparison. Greece was included from the 1982 survey onwards only, Spain and Portugal from the 1986 survey onwards.

significant rejectionist turn in 1986. After the Chernobyl disaster, subjects were from 15 to over 20 percentage points further more likely to reject nuclear energy. The cumulative effect of these incidents was an impressive swing of 25-30 percentage points. After small adjustments in 1987 and 1989, a significant pro-nuclear energy shift in attitudes took place five years after the Chernobyl accident. In 1991, interviewees were over 20 percentage points less likely to reject nuclear energy than in 1989. In the next two surveys, European public opinion moderately swung back again. In other words, this period saw a major anti-nuclear swing in public opinion after the Chernobyl disaster and a major pro-nuclear reassessment of similar magnitude five years later. Regardless of the causes for such a re-evaluation, perhaps the recognition of higher safety of West-European plants, this dynamics does not indicate that negative events are more informative than positive ones.[36]

Similarities end here however. Updating differs across countries, ideological priors and proximity. Earlier I showed left-wing subjects to be significantly more likely to reject nuclear energy than right-wing ones, a Bayesian account of belief updating would therefore suggest individuals holding centrist views to display greater volatility in attitudes towards nuclear energy. I grouped in Figure 6a the countries displaying this dynamics. The solid diamonds indicate the marginal changes in attitudes of centrist interviewees across surveys and countries. Centrist interviewees display greater volatility than right- or left-wing subjects.[37] After the Chernobyl accident, a British centrist individual was 21.5 percentage points more likely to reject nuclear policy, compared to 15.8 points for a left-wing interviewee and 16.1 points for a right-wing one. In 1991, a centrist was 30.6 percentage points *less* likely to hold rejectionist views than two years earlier, compared to 25.7 and 20.3 points for left- and right-wing interviewees respectively.

This Bayesian dynamics of belief updating is weaker in Italy and Spain. Across the nine surveys, the attitudes of right-wing individuals have swung almost as widely as those of centrists. In other words, the pro-nuclear foundations of right-of-centre individuals are weaker. After the Chernobyl accident, an Italian centrist was 20.2 percentage points more likely to reject nuclear policy, while a right-winger was 21 points more likely to reject it. In the 1991 readjustment, a centrist was 30.4 percentage points *less* likely to hold rejectionist views than two years earlier, only slightly higher than the 28.7 points of a right-wing interviewee. Also in Germany and the Netherlands, the views of right-wing interviewees are somewhat less stable than those of left-wing interviewees, while the opposite is true in Belgium and Britain.

In Figure 6b we grouped the countries that do not display a Bayesian dynamics of belief updating. In France, leftist subjects display the highest volatility in attitudes to nuclear energy. After the Chernobyl accident, a French centrist individual was 21 percentage points more likely to reject nuclear policy, almost indistinguishable from the 20.9 points for a left-wing interviewee. In 1991, a centrist was 28.6 percentage points *less* likely to hold rejectionist views than two years earlier, less than the 30.8 points of a left-wing individual. In other words, the anti-nuclear foundations of left-of-centre individuals are based on very shaky grounds.

The opposite is true for the remaining countries of Figure 6b, none of which have ever had operating nuclear power plants on their soil. The anti-nuclear foundations of left-wing interviewees are the most stable, while rightist subjects display the highest volatility in attitudes toward nuclear energy. In 1986, a Danish centrist was 14.5 percentage points more likely to reject nuclear energy than two years earlier, but a right-winger was 21.3 points more likely to do so. In 1991, a centrist was 24 percentage points *less* likely to hold rejectionist views than two years earlier, lower than the 29.4 points of a right-wing interviewee.

Do these results hold as we move away from an operating plant? Figure 7 replicates the analysis for subjects living one standard deviation farther than the country average distance. In Belgium, Britain, Germany and the Netherlands, the Bayesian dynamics is preserved. The volatility of attitudes of centrist interviewees remains higher than that of subjects holding different views. In Italy and Spain, this is no longer the case. As a further sign of their weaker pro-nuclear foundations, the attitudes of right-wing individuals swing more widely than those of centrists

At higher distance, the anti-nuclear beliefs of left-of-centre individuals are the most stable in all countries, except France. Here, centrists display the greatest variation in attitudes, primarily as a result of the higher

[36] Cf. Poortinga and Pidgeon, 1475–1486.

[37] More specifically, the standard deviation of the marginal effects across surveys is larger for centrist than for right- or left-wing interviewees. Standard deviations are shown in the Appendix (Tables B1 and B2).

stability of opinion of left-wing interviewees. It remains however that the most stable attitudes are those of right-wing subjects in France, regardless of proximity.
In sum, a Bayesian dynamics of belief updating emerges where it matters more, that is as individuals move closer to a plant and in countries which have or have had nuclear energy, France excluded.[38]

Discussion and conclusion

Several factors come into place when a government takes a decision on nuclear energy. Contrasts within the coalition, electoral pressures and the threat of a referendum can singly or jointly shape a country's policy. European countries display the full variety of possible trajectories, from constitutional ban to heavy reliance on this source of energy, from steady development to flips and turns. Yet, each government has to deal with the underlying social attitudes toward the risks associated with nuclear energy - how they intensify or alleviate in the vicinity of nuclear power plant and how they change over time after the occurrence of major accidents.
The governments in Belgium and Germany, for instance, not only face increasingly polarized public opinion in the vicinity of nuclear plants but the views of left- and right-wing individuals are also particularly entrenched over time and space. Italian governments also face, to a lesser degree, a polarized public opinion in the vicinity of plants, but the pro-nuclear views of right-wing individuals are more weakly rooted, over time and space, than the anti-nuclear views of left-wingers. These attitudes shed at least some light on the several turns that this policy has taken in these countries.
There is also clear entrenchment of anti-nuclear left and pro-nuclear right-wingers in the Netherlands and Britain as well. The views of moderates swing more widely, regardless of how close they reside to a plant. But what makes life easier for British and Dutch governments is the overall more supportive attitudes of individuals living closer to a plant, regardless of their political views. This holds true for Spain as well, although the pro-nuclear views of right-wing individuals are more wavering as distance increases.
French governments have instead a pretty cushy life. Not only proximity alleviates the divergence of opinions about nuclear energy, but the anti-nuclear attitudes of left-wing individuals have shaky foundations over time, especially as we move closer to a plant. France is the only country with nuclear energy where the views of left-leaning individuals swing more widely over time than those of moderates as proximity increases. Needless to say, pro-nuclear support is instead very solidly grounded in the right-leaning public.
Countries without nuclear energy (Denmark, Luxembourg, Greece, Portugal and Ireland) display a dynamics of belief updating that is the mirror image of France's. The pro-nuclear views of right-wing individuals are quite precarious, over time and space, while anti-nuclear views are more solidly established in the left-leaning public. Additionally, the governments in Denmark and Luxembourg face increasingly either polarized or rejectionist public opinion in the vicinity of plants.
In conclusion, this analysis of the public attitudes toward the risks associated with nuclear energy allows us to understand fairly accurately the broader social constraints within which European governments operate and sheds a good amount of light on the widely different long-term trajectories that this policy has taken in European countries.

Appendix

WinBugs code

Below is the WinBUGS code modeling the likelihood function and priors. The model allows for heteroscedasticity. The initial estimation was run with starting values of the coefficients drawn randomly from a uniform distribution $U(-1,1)$. The estimation mixed three simultaneous chains for 80,000 iterations, discarding the first 50,000 as a burn-in and keeping alternate iterations. It resulted in a total of 15,000 saved iterations per chain. It was performed in WinBUGS 1.4.3. Examination of the trace and density plots as well as convergence diagnostics, such as the Rhat, indicates that the model has converged. Full convergence diagnostics are available upon request.

```
model
```

[38] This may be because the policy is not actually perceived as salient in France, see Brouard and Guinaudeau.

```
        {
        # priors for level 1 individual variables
                for (j in 1 : 16) { b1[j] ~ dnorm(0,tau_b1[j])}
                for (j in 1 : 16) { tau_b1[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b1[j] <- 1/tau_b1[j]}
        #
                for (j in 1 : 16) { b2[j] ~ dnorm(0,tau_b2[j])}
                for (j in 1 : 16) { tau_b2[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b2[j] <- 1/tau_b2[j]}
        #
                for (j in 1 : 16) { b3[j] ~ dnorm(0,tau_b3[j])}
                for (j in 1 : 16) { tau_b3[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b3[j] <- 1/tau_b3[j]}
        #
                for (j in 1 : 16) { b4[j] ~ dnorm(0,tau_b4[j])}
                for (j in 1 : 16) { tau_b4[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b4[j] <- 1/tau_b4[j]}
        #
                for (j in 1 : 16) { b5[j] ~ dnorm(0,tau_b5[j])}
                for (j in 1 : 16) { tau_b5[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b5[j] <- 1/tau_b5[j]}
        #
                for (j in 1 : 16) { b6[j] ~ dnorm(0,tau_b6[j])}
                for (j in 1 : 16) { tau_b6[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b6[j] <- 1/tau_b6[j]}
        #
                for (j in 1 : 16) { b7[j] ~ dnorm(0,tau_b7[j])}
                for (j in 1 : 16) { tau_b7[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_b7[j] <- 1/tau_b7[j]}
        # priors for level 2 country variables
                for (j in 1 : 16) { u1[j] ~ dnorm(0,tau_u1[j])}
                for (j in 1 : 16) { tau_u1[j] ~ dgamma(1,0.1)}
                for (j in 1 : 16) { sigma2_u1[j] <- 1/tau_u1[j]}
        # priors for level 3 survey variables
                for (t in 1 : 9) { u2[t] ~ dnorm(0,tau_u2[t])}
                for (t in 1 : 9) { tau_u2[t] ~ dgamma(1,0.1)}
                for (t in 1 : 9) { sigma2_u2[t] <- 1/tau_u2[t]}
        # likelihood
        # loop over interviewees
                for (i in 1 : 65955)
        {
                  risk[i] ~ dbern(p[i]);
                  probit(p[i]) <- delta[i]
                  delta[i] ~ dnorm(mu[i], 1.0)I(-4, 4)
                  mu[i] <-
b1[country[i]]*left_right[i]+b2[country[i]]*proximity[i]+b3[country[i]]*left_right[i]*proximity[i]+
b4[country[i]]*education[i]+b5[country[i]]*gender[i]+b6[country[i]]*age[i]+b7[country[i]]*income[i]
+u1[country[i]]*cons[i]+u2[year[i]]*cons[i]
        # log-likelihood
                  llh[i] <- risk[i]*log(p[i]) + (1-risk[i])*log(1-p[i]);
         }
           sumllh <- sum(llh[]);
         }
```

Standard error of the MCMC mean estimates of the parameters of interest

For the analysis of interactions, I require a correctly estimated variance-covariance matrix. Positive autocorrelation in the MCMC samples causes underestimation of the standard error of the estimates of my parameters of interest. I employ the following Bayesian procedure to correct the standard error for the mean estimate $\bar{\theta}_i$. Its variance is

$$\widehat{Var}(\bar{\theta}_i) = \frac{1 + 2\sum_{k=1}^{\infty} \rho_k(\theta_i)}{n} \cdot \frac{\sum_{t=1}^{n}(\theta_i^t - \bar{\theta}_i)^2}{(n-1)}$$

The first term is the inverse of the effective sample size, where n is the total sample size and $\rho_k(\theta_i)$ is the autocorrelation of lag k for θ_i. Following the Bayesian procedure, I first found a cut-off point k after which the autocorrelations are very close to zero, and then summed all the $\rho_k$up to that point. The cut-off point k is such that $\rho_k < 2s_k$, where $s_k$is the estimated standard deviation:

$$s_k = 2\sqrt{\frac{1 + 2\sum_{j=1}^{k-1} \rho_k^2(\theta_i)}{n}}$$

I summed up the autocorrelations up to a maximum of 100 lags. I implemented this procedure to produce a correct variance-covariance matrix of the parameters of interest of each of the three chains. The three matrices were then simply summed up and divided by three. The resulting variance-covariance matrix was then employed for the analysis of interactions.

Table A: Ideology, Proximity and Attitudes to Nuclear Risk

Variables		Estimate	95% Credibility interval	
Ideology	France	-0.068	(-0.113,	-0.024)
	Belgium	-0.161	(-0.223,	-0.100)
	Netherlands	-0.218	(-0.265,	-0.168)
	Germany	-0.232	(-0.266,	-0.200)
	Italy	-0.141	(-0.176,	-0.106)
	Luxembourg	-0.033	(-0.102,	0.034)
	Denmark	-0.253	(-0.293,	-0.215)
	Ireland	0.013	(-0.050,	0.079)
	Great Britain	-0.185	(-0.241,	-0.128)
	Greece	0.031	(-0.052,	0.104)
	Spain	-0.099	(-0.139,	-0.059)
	Portugal	-0.069	(-0.127,	-0.008)
	Norway	-0.006	(-0.147,	0.136)
	Finland	-0.156	(-0.265,	-0.044)
	Sweden	-0.197	(-0.287,	-0.106)
	Austria	0.020	(-0.188,	0.233)
Proximity	France	-0.005	(-0.007,	-0.003)
	Belgium	0.004	(-0.003,	0.010)
	Netherlands	-0.000	(-0.004,	0.003)
	Germany	0.005	(0.003,	0.007)
	Italy	0.000	(-0.000,	0.001)
	Luxembourg	0.001	(-0.004,	0.006)
	Denmark	0.001	(-0.000,	0.003)
	Ireland	-0.001	(-0.003,	0.000)
	Great Britain	-0.001	(-0.004,	0.002)
	Greece	-0.001	(-0.002,	0.000)
	Spain	-0.001	(-0.001,	-0.000)
	Portugal	0.000	(-0.001,	0.001)
	Norway	-0.002	(-0.004,	-0.000)
	Finland	0.000	(-0.003,	0.004)
	Sweden	-0.001	(-0.003,	0.002)
	Austria	-0.008	(-0.015,	-0.000)
Ideology × Proximity	France	0.001	(0.000,	0.001)
	Belgium	-0.001	(-0.003,	-0.000)
	Netherlands	-0.000	(-0.001,	0.001)
	Germany	-0.001	(-0.001,	-0.001)
	Italy	-0.000	(-0.000,	-0.000)
	Luxembourg	0.000	(-0.001,	0.001)
	Denmark	-0.000	(-0.001,	-0.000)
	Ireland	0.000	(-0.000,	0.000)
	Great Britain	-0.000	(-0.001,	0.000)
	Greece	0.000	(-0.000,	0.000)
	Spain	0.000	(-0.000,	0.000)
	Portugal	-0.000	(-0.000,	0.000)

	Norway	0.000	(	0.000,	0.001)
	Finland	-0.000	(	-0.001,	0.000)
	Sweden	-0.000	(	-0.001,	0.001)
	Austria	0.001	(	-0.001,	0.002)
Education	France	-0.020	(	-0.038,	-0.002)
	Belgium	-0.028	(	-0.049,	-0.007)
	Netherlands	-0.051	(	-0.067,	-0.035)
	Germany	-0.009	(	-0.024,	0.006)
	Italy	-0.025	(	-0.043,	-0.008)
	Luxembourg	-0.019	(	-0.053,	0.014)
	Denmark	0.005	(	-0.010,	0.021)
	Ireland	0.038	(	0.010,	0.065)
	Great Britain	0.006	(	-0.013,	0.026)
	Greece	-0.061	(	-0.080,	-0.042)
	Spain	0.004	(	-0.020,	0.027)
	Portugal	0.000	(	-0.024,	0.025)
	Norway	0.016	(	-0.036,	0.070)
	Finland	0.036	(	-0.012,	0.084)
	Sweden	0.060	(	0.015,	0.105)
	Austria	0.040	(	-0.027,	0.108)
Gender	France	0.402	(	0.311,	0.492)
	Belgium	0.321	(	0.219,	0.424)
	Netherlands	0.347	(	0.259,	0.435)
	Germany	0.251	(	0.175,	0.328)
	Italy	0.427	(	0.332,	0.522)
	Luxembourg	0.477	(	0.315,	0.641)
	Denmark	0.604	(	0.514,	0.696)
	Ireland	0.038	(	-0.072,	0.148)
	Great Britain	0.361	(	0.277,	0.446)
	Greece	0.310	(	0.207,	0.414)
	Spain	0.237	(	0.103,	0.371)
	Portugal	0.118	(	-0.001,	0.237)
	Norway	0.553	(	0.280,	0.830)
	Finland	0.455	(	0.194,	0.717)
	Sweden	0.746	(	0.483,	1.009)
	Austria	0.100	(	-0.171,	0.376)
Age	France	-0.008	(	-0.011,	-0.005)
	Belgium	-0.003	(	-0.006,	0.001)
	Netherlands	-0.005	(	-0.008,	-0.002)
	Germany	-0.004	(	-0.007,	-0.002)
	Italy	-0.003	(	-0.006,	-0.000)
	Luxembourg	0.002	(	-0.003,	0.007)
	Denmark	-0.002	(	-0.005,	0.001)
	Ireland	0.001	(	-0.002,	0.005)
	Great Britain	-0.004	(	-0.007,	-0.001)
	Greece	0.006	(	0.003,	0.010)
	Spain	0.002	(	-0.002,	0.006)

	Portugal	0.009	(	0.006,	0.013	)
	Norway	0.008	(	-0.000,	0.016	)
	Finland	-0.009	(	-0.016,	-0.002	)
	Sweden	-0.008	(	-0.015,	-0.000	)
	Austria	-0.001	(	-0.010,	0.009	)
Income	France	-0.055	(	-0.071,	-0.040	)
	Belgium	-0.046	(	-0.066,	-0.026	)
	Netherlands	-0.032	(	-0.046,	-0.019	)
	Germany	-0.006	(	-0.018,	0.005	)
	Italy	-0.015	(	-0.032,	0.003	)
	Luxembourg	-0.014	(	-0.038,	0.011	)
	Denmark	-0.017	(	-0.032,	-0.002	)
	Ireland	0.028	(	0.008,	0.049	)
	Great Britain	-0.040	(	-0.054,	-0.026	)
	Greece	-0.023	(	-0.040,	-0.006	)
	Spain	0.000	(	-0.023,	0.023	)
	Portugal	0.060	(	0.040,	0.079	)
	Norway	-0.007	(	-0.049,	0.034	)
	Finland	-0.059	(	-0.104,	-0.015	)
	Sweden	-0.046	(	-0.097,	0.006	)
	Austria	-0.030	(	-0.092,	0.032	)
France		0.027	(	-0.295,	0.356	)
Belgium		0.528	(	0.095,	1.005	)
Netherlands		1.311	(	0.932,	1.695	)
Germany		1.115	(	0.800,	1.433	)
Italy		0.516	(	0.186,	0.860	)
Luxembourg		0.260	(	-0.176,	0.751	)
Denmark		1.334	(	0.970,	1.704	)
Ireland		-0.318	(	-0.851,	0.123	)
Great Britain		0.490	(	0.096,	0.907	)
Greece		0.202	(	-0.249,	0.724	)
Spain		0.027	(	-0.302,	0.364	)
Portugal		-0.597	(	-1.077,	-0.146	)
Norway		0.073	(	-0.591,	0.845	)
Finland		-0.029	(	-0.645,	0.564	)
Sweden		-0.056	(	-0.603,	0.453	)
Austria		0.066	(	-0.697,	0.958	)
Survey 1978		0.056	(	-0.163,	0.266	)
Survey 1982		0.240	(	0.019,	0.450	)
Survey 1984		0.230	(	0.011,	0.438	)
Survey 1986		0.775	(	0.557,	0.984	)
Survey 1987		0.566	(	0.347,	0.776	)
Survey 1989		0.727	(	0.506,	0.937	)
Survey 1991		-0.069	(	-0.289,	0.138	)
Survey 1993		0.041	(	-0.177,	0.248	)
Survey 1996		0.200	(	-0.017,	0.407	)
N		65,955				

Log-likelihood	-30,020.16
Chain length	80,000
Burn-in	50,000
Thinning parameter	2
Sample size/chain	15,000

Table B1: Standard Deviation of Marginal Effects across Surveys (closer-to-plant subjects)

	Left	Center	Right
Belgium	0.13686243	**0.15124296**	*0.12462434*
Germany	*0.0849834*	**0.14922892**	0.11814201
Britain	0.12238469	**0.15107684**	*0.10544253*
Netherlands	*0.07765968*	**0.14744423**	0.12081181
Italy	*0.11080306*	**0.14780759**	0.14367401
Spain	*0.13654913*	**0.15754525**	0.1525066
France	**0.15051448**	0.14354076	*0.11019343*
Denmark	*0.03129552*	0.11378157	**0.14682133**
Luxembourg	*0.09588394*	0.11032057	**0.12373733**
Greece	*0.09266763*	0.10142888	**0.11013231**
Portugal	*0.13593313*	0.1517329	**0.15872342**
Ireland	*0.12239603*	0.12432304	**0.12620651**

Note: Largest deviations in bold, smallest in italics.

Table B2: Standard Deviation of Marginal Effects across Surveys (farther-from-plant subjects)

	Left	Center	Right
Belgium	*.14168201*	**.15150431**	.14729683
Germany	*.13292389*	**.15058088**	.14672103
Britain	*.11531066*	**.15153135**	.12509806
Netherlands	*.07563933*	**.14482267**	.12923687
Italy	*.11738901*	.13877332	**.15052398**
Spain	*.10760303*	.14749141	**.15796264**
France	.13192571	**.14620545**	*.08475729*
Denmark	*.04022766*	.10658459	**.15159784**
Luxembourg	*.10416302*	.12656997	**.1433762**
Greece	*.0736328*	.09854665	**.12331475**
Portugal	*.14244236*	.15055605	**.15608312**
Ireland	*.10512385*	.1173883	**.12853319**

Note: Largest deviations in bold, smallest in italics.

Figure 1. Risk attitudes across countries and surveys

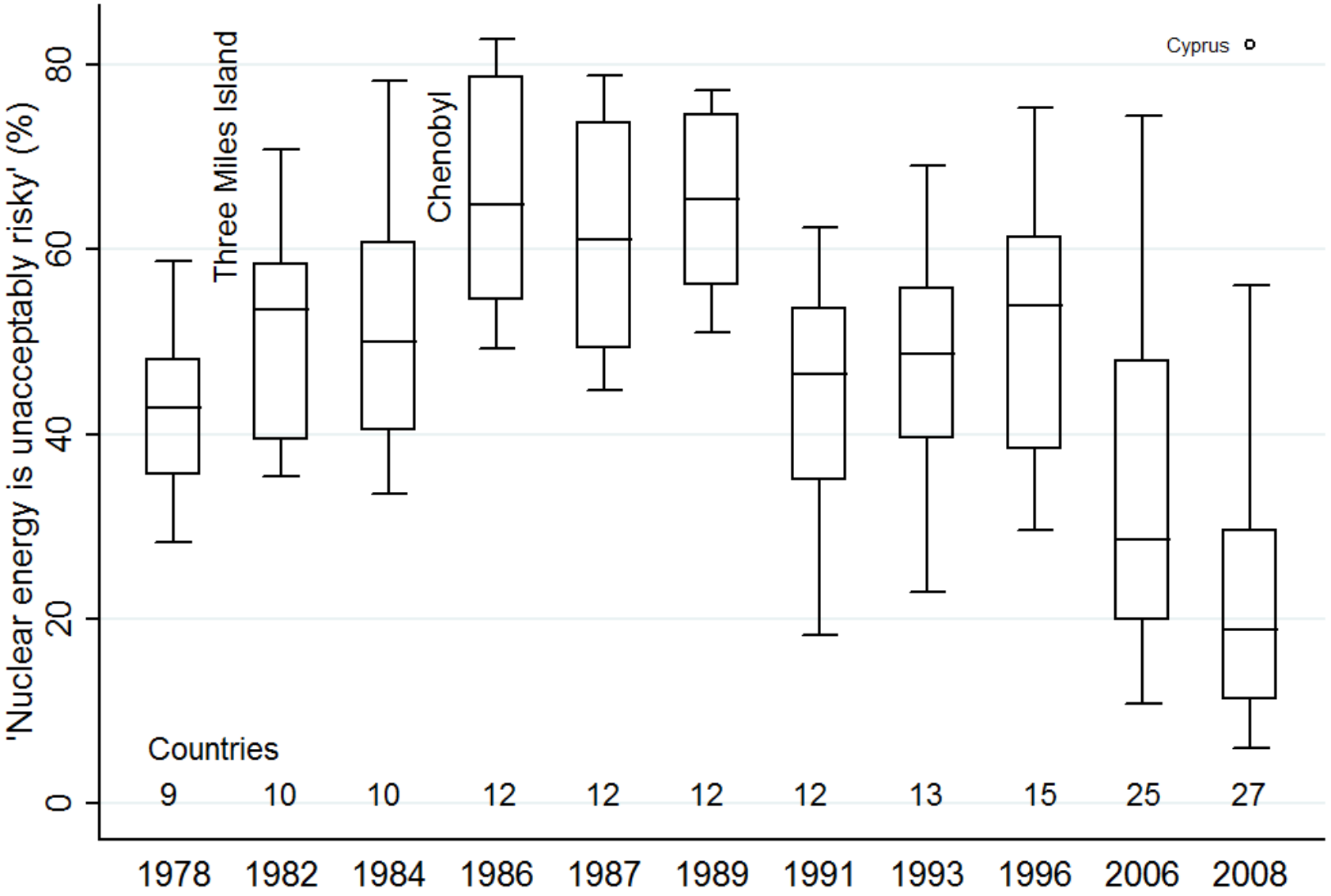

Figure 2. Within-country variation in attitudes to nuclear risk

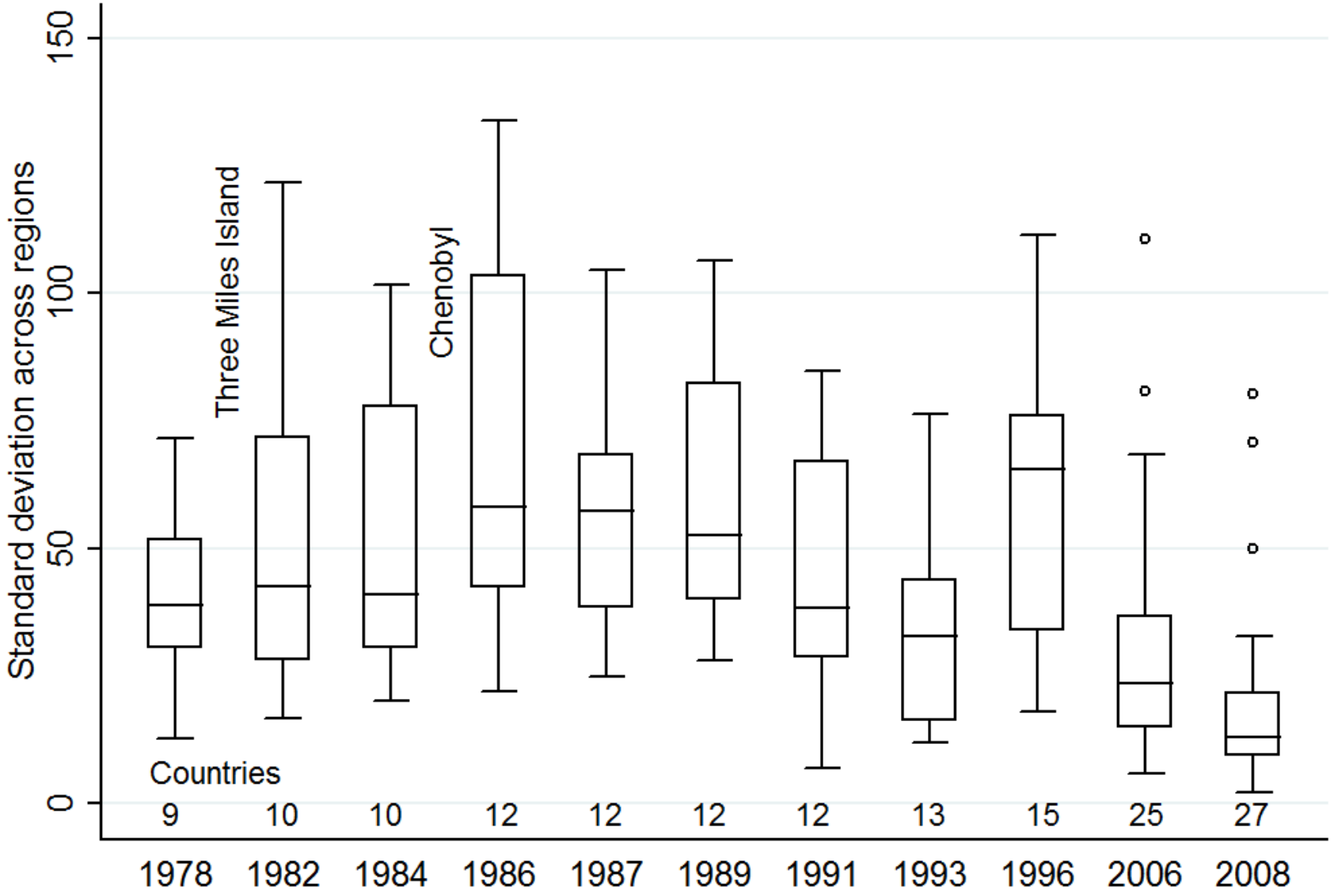

Figure 3. Marginal effects of a leftward shift in ideological priors

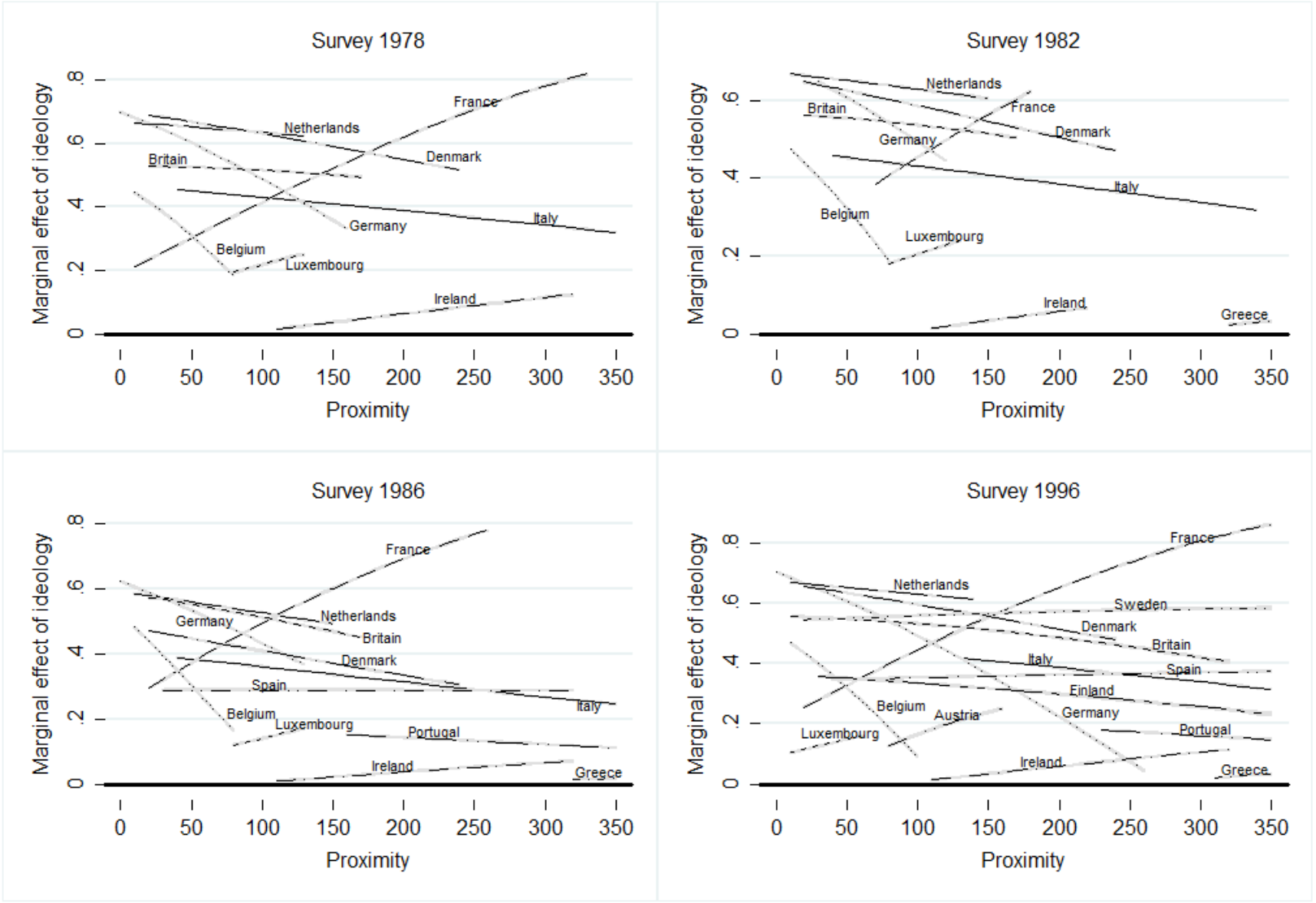

Figure 4. Marginal effects of an increase in proximity

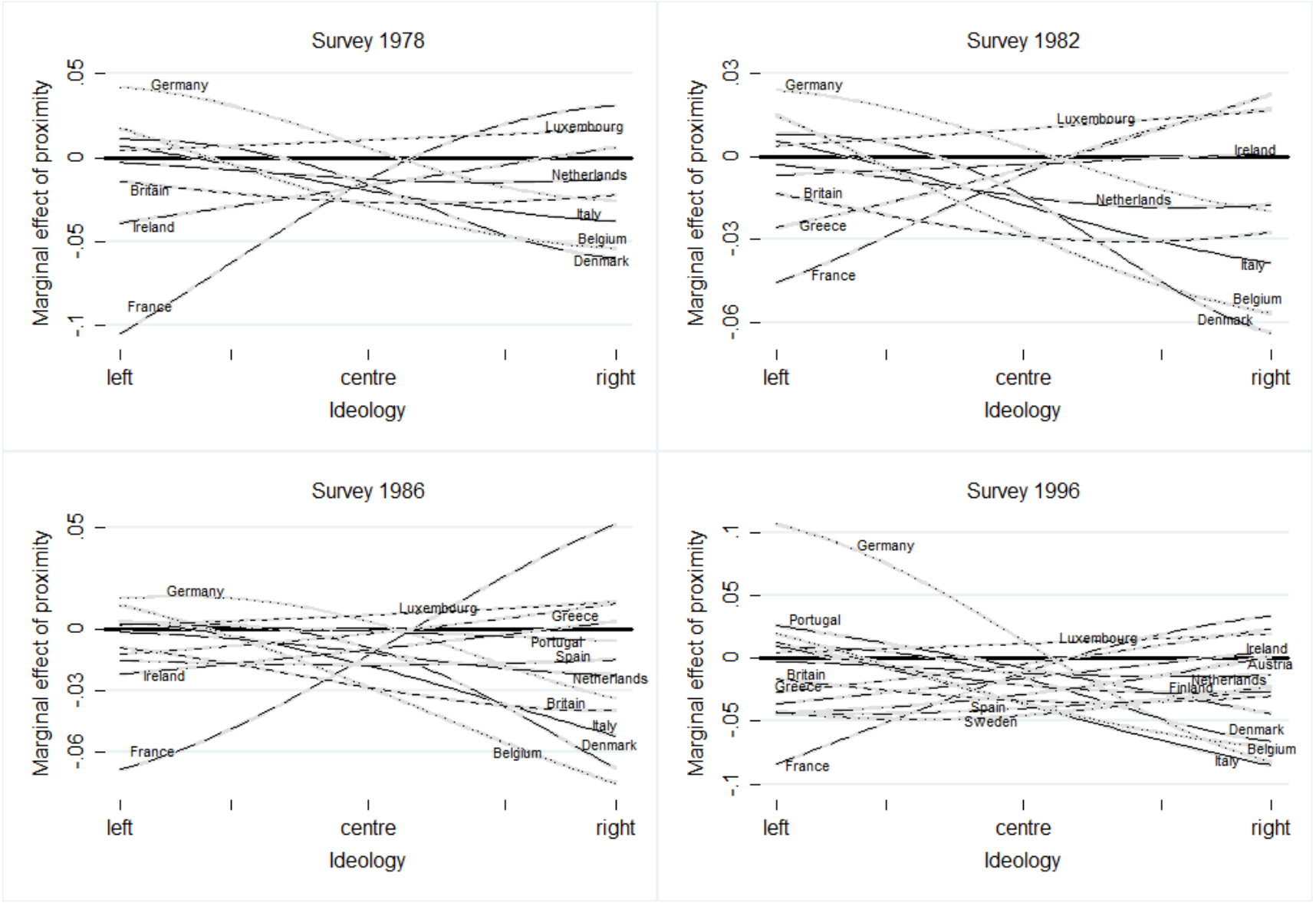

Figure 5: Ideology-proximity interactions across countries

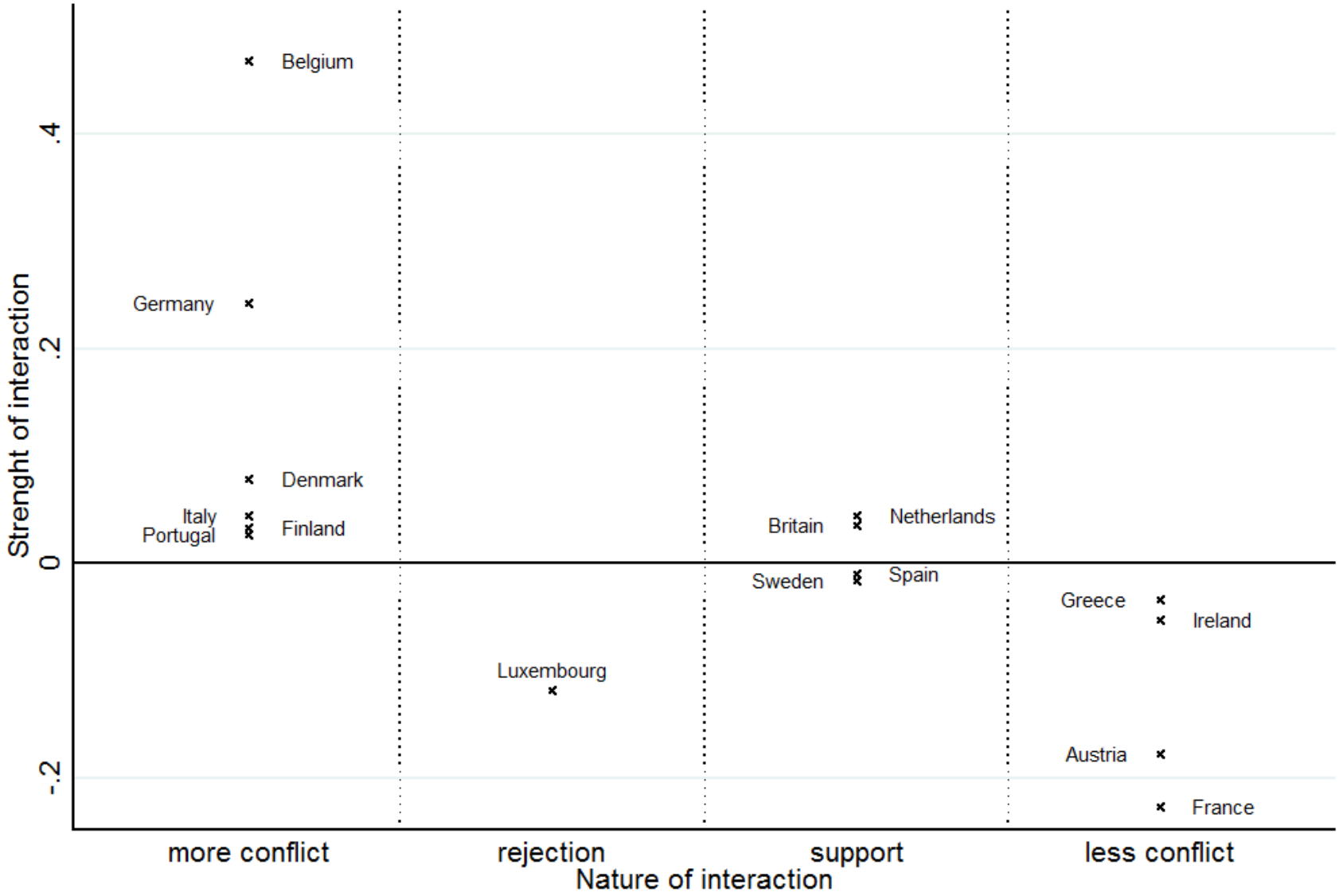

Figure 6a: Dynamics of belief updating of closer-to-plant subjects

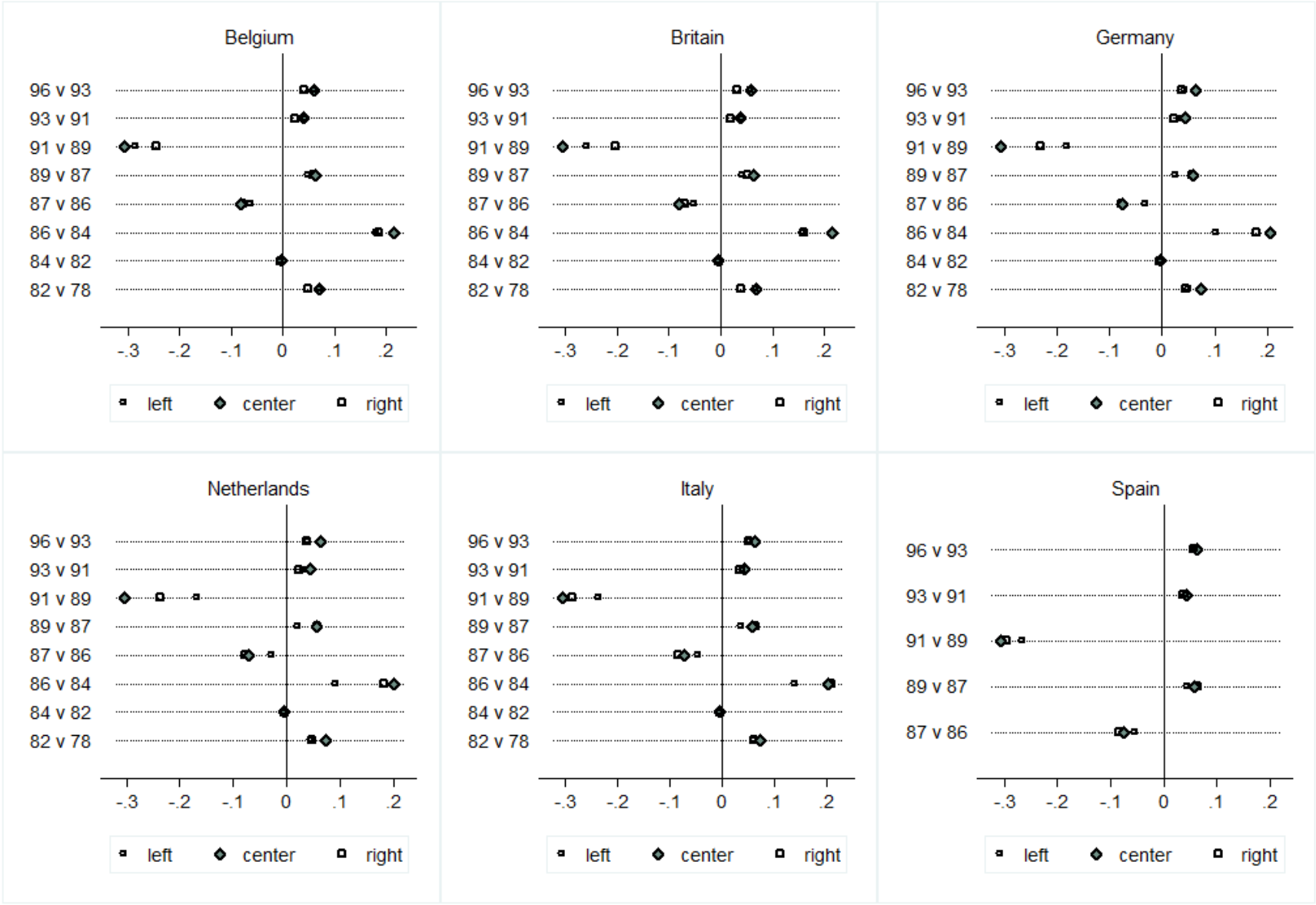

Figure 6b: Dynamics of belief updating of closer-to-plant subjects

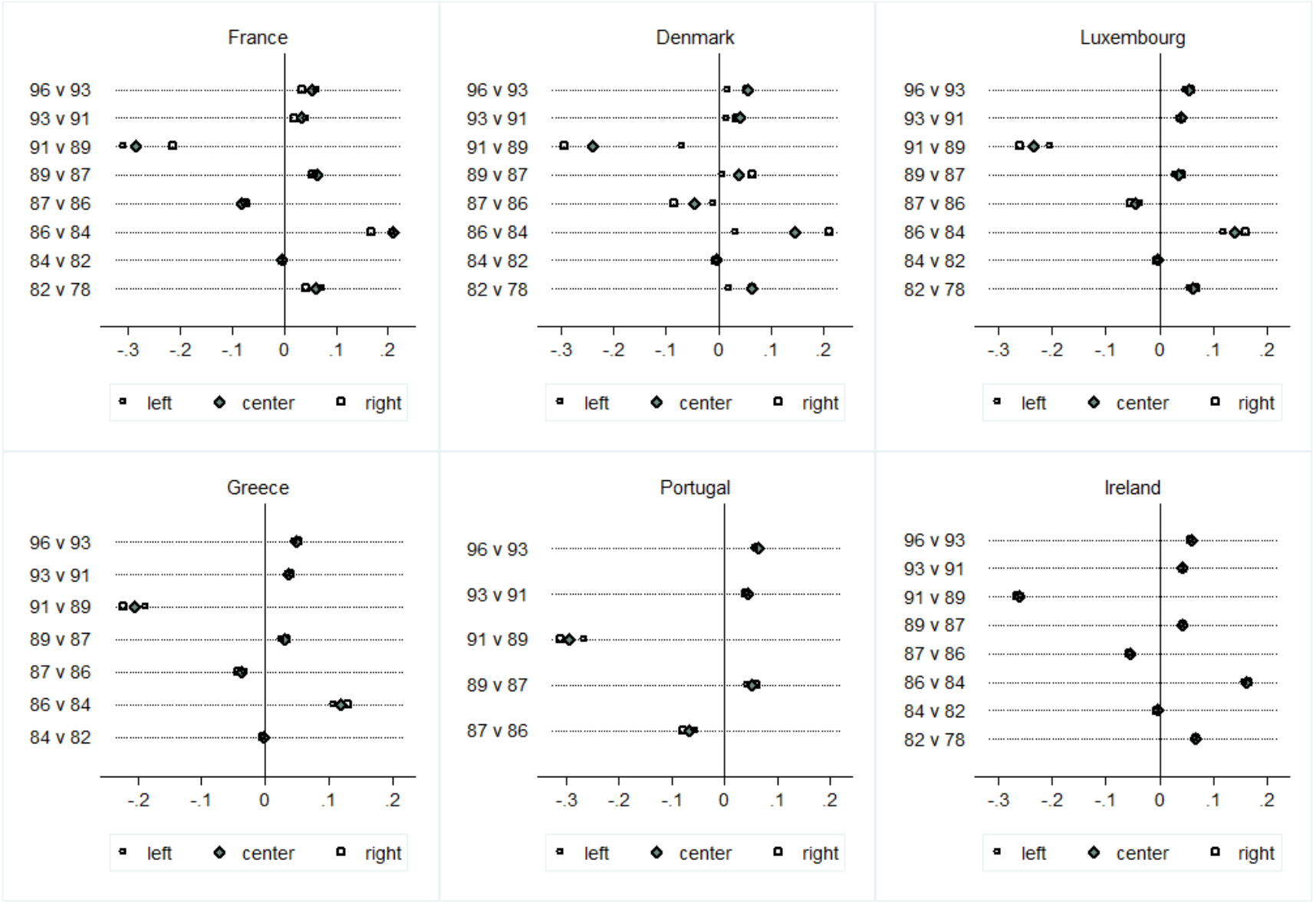

Figure 7a: Dynamics of belief updating of farther-from-plant subjects

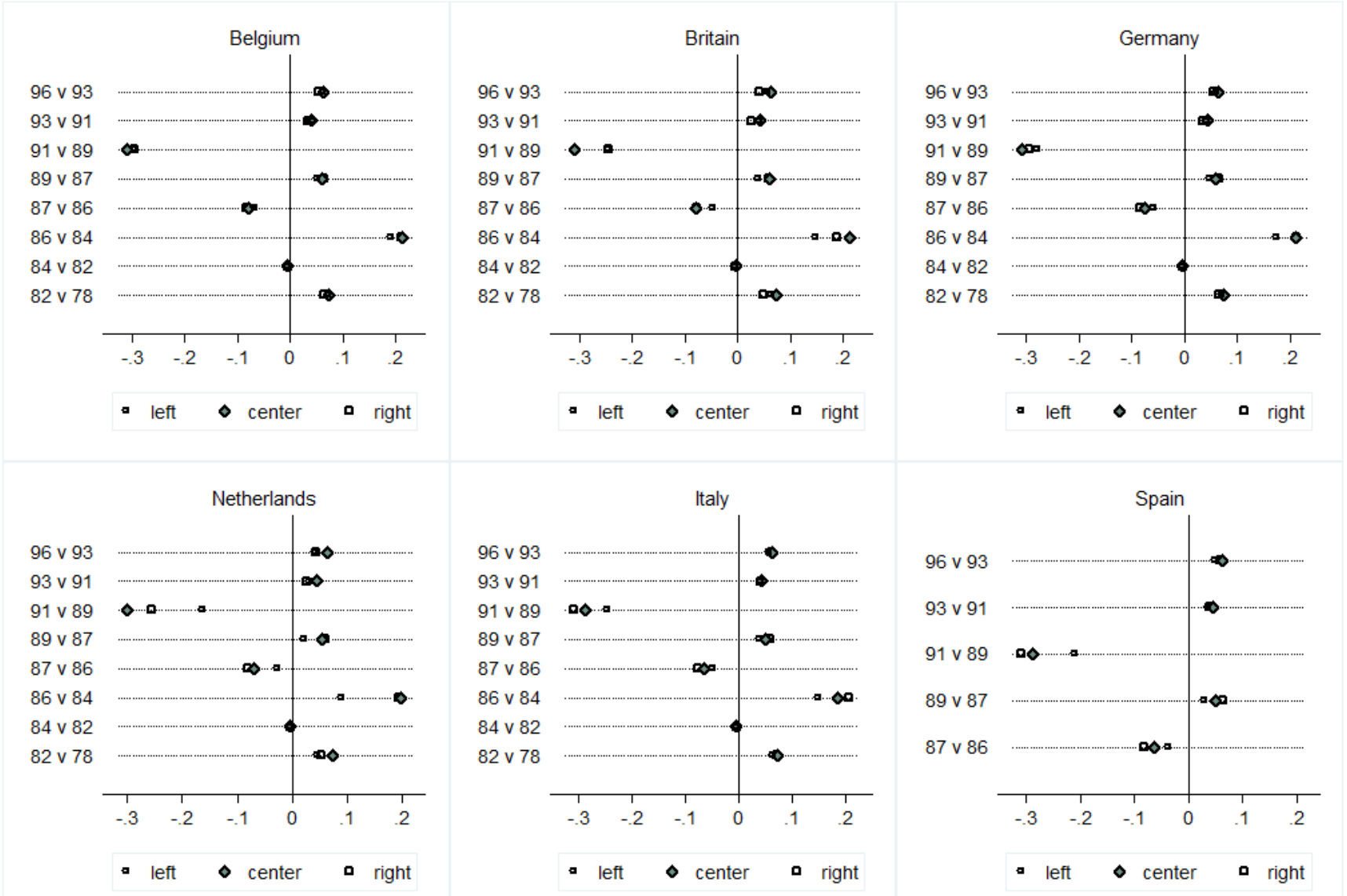

Figure 7b: Dynamics of belief updating of farther-from-plant subjects