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Abstract

This study uses psychological models of skill acquisition to explain how social trust is formed. We view trust as being shaped by four factors: crystallized, cognitive, contact, and context. We combine these four factors into a 4C-component analytical model by establishing links between them and explaining the rationale behind their individual and joint effects on trust. The proposed model is tested with the PIAAC public-use data. Both theoretical and empirical elaborations suggest that context is the strongest driver of trust formation. Good contexts also spur more trust when individuals already possess crystallized knowledge and can display faith in others. Such knowledge can be learned if it is missing, but how efficiently depends on the quality of one's cognitive system, frequency of contacts with others, and the distance between one's actual knowledge of trust and the optimal trust level for the given context.

Keywords: social trust; trust formation; psychology of skill acquisition; PIAAC

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Research has recently equated social trust with a skill that brings a return to individuals and is worth investing in (Keeley, 2007; OECD, 2001). This approach reverses the conventional understanding of trust as a relatively stable attribute, shaped early in the socialization process (Fukuyama, 2000) and remaining largely constant throughout one's life. New perspectives on trust building suggest that trust can be learned or forgotten and may fluctuate depending on factors that conventionally determine an individual's stock of knowledge or skills.

This research applies psychological models of skill acquisition to social trust formation processes. We argue that if trust is a skill, then the psychological base models of learning can provide valuable insights into how trust develops and establish factors that determine trust levels among individuals. Our study offers a set of four predictors that may largely explain cross-individual and cross-country variations in trust levels. We distinguish between crystallized, cognitive, contact, and contextual components of trust. We combine the four components into a 4C-component analytical model by establishing links between them and explaining the rationale behind their individual and joint effects on trust. The proposed model is tested with the PIAAC data while using a conventional definition of trust, faith in people.

Literature Overview

According to psychological models of skill acquisition, a skill formation starts with general knowledge that experience gradually transforms into more specialized knowledge, a so called skill (Anderson, 1982). The brain records general knowledge through mental representations that specify actions required to adequately perform a task (McCormick, 1976) and that are augmented with (a) preconditions for carrying out each action and (b) a representation of each action's outcomes (Taatgen, Huss, Dickison and Anderson, 2008). These mental representations are stored in the declarative memory so that the action's knowledge is available upon request (Anderson, 1987). The procedural memory maps the retrieved knowledge onto an action (Anderson, 2007; Taatgen et al., 2008).

Selecting a mental representation to map onto an action is a complex process largely governed by the environment or context (Prinz, 1997). The environment cues a needed mental representation that is then retrieved from one's memory (Prinz, 1997). The individual interacts with the environment through the perceptual system by collecting perceptual input (Prinz ,1997). The brain uses this perceptual input to align the observed contextual conditions with the preconditions and outcomes of available mental representations (Taatgen et al., 2008). The mental representation whose preconditions and expected outcomes match the perceptual input is selected for mapping onto an action (Taatgen, 2005; Taatgen et al., 2008).

When a match is found, the brain creates a primitive rule, also called a production, that links the perceived input to the action. The production specifies (1) the circumstances under which it can be applied, and (2) an action (what should be done when this production is applied). Since action choice requires numerous mental operations (the retrieval of mental representation (knowledge) from declarative memory, adding it to the procedural memory, testing this

knowledge for applicability, and linking this knowledge to the action), the brain combines several productions to simplify this process and directly associates perception and action. Productions that fire in sequence are united into a single production through a production compilation mechanism (Anderson, 1982, 2004). For instance, if the first production uses perception to make a request to declarative memory, whereas the second production uses the retrieved fact to perform an action, then the production compilation process encodes the two operations into a single rule that links the perception directly to the action (Taatgen et al., 2008). The action choice is now faster since the process of retrieving knowledge from the declarative memory is bypassed (Anderson, 1982; Taatgen, 2005; Taatgen et al., 2008).

The new production, which links the contextual properties to the action, will be used only when it has a high utility value (Taatgen et al., 2008). The first time a production is created, its utility value is set to zero, but it usually increases whenever this production is recreated (Anderson, 1982; Taatgen et al., 2008). Once the new production is recreated enough times, its utility value nears the old production's utility value, ensuring that the new production is likely to persist (Anderson, 1982; Taatgen et al., 2008). The utility value accumulates slowly (as it is a learning process), because the new production must be recreated many times, and it represents a function of how frequently the production is recreated.

Therefore, psychology defines skills as a set of environmentally structured productions (Taatgen et al., 2008). This environment-driven approach to action choice has two limits concerning the action's definition. First, information about the context is unavailable or one is unable to evaluate sufficient contextual properties. The choice of action is then governed by the individual's internal state/understanding of the world (Taatgen, 2007). Psychological models of skill acquisition use the minimal control principle to balance the context with the individual's

internal worldview. When possible, control is derived from the environment/context, or bottom up. The top down approach, derived from the internal state/worldview, is used only when necessary (Taatgen, 2007). The second problem is that the declarative memory might lack a mental representation with the preconditions and outcomes that match the perceived input. In this case, experiments show that participants simply discover the relevant knowledge of action by drawing analogies from their existing knowledge (Anderson, 1982) or by taking a random action (Taatgen et al., 2008). If they perceive that this action brings them closer to the goal, a new record is created with the original perceptual state as a precondition and the resulting perceptual state as a post-condition (Taatgen et al., 2008).

In sum, the psychological models of skill acquisition suggest that individuals select the knowledge of action largely based on the contextual properties in which they are placed. When missing, the needed knowledge can be learned with the learning process's efficiency depending on one's current stock of knowledge, quality of one's cognitive system, and frequency with which the new knowledge is recreated.

Analytical Model

We use the psychological understanding of skill acquisition to explain how trust emerges. Our main premise is that exhibiting a certain level of trust is an action. If this is the case, one can argue that trust is influenced by four forces, with each forming a corresponding component of trust:

(1) A Crystallized Component (the first CC) represents one's knowledge of various trust levels that can be exhibited towards others under certain circumstances. It takes the form of mental representations stored in one's declarative memory or its buffers. This

knowledge derives both from cultures prevalent in one's society and one's personal experience with trusting others.

(2) A Contextual Component (the second CC) consists of the contextual properties that individuals perceive and use for matching preconditions and outcomes of mental representations to determine which knowledge should be mapped onto an action.

(3) A Cognitive Component (the third CC) refers to the individual's general cognitive abilities to perceive, process, and record information, such as declarative memory, procedural memory, processing speed, etc. This component is expected to predefine the quality and the speed of one's mental operations and hence the efficiency of an individual's matching and learning processes.

(4) A Contact Component (the fourth CC) reflects the frequency with which the individual is in contact with others in the given context. Since we focus on trust towards other people, we believe that the interaction with others determines how frequently the new operator is recreated that links the context's perceived properties to the optimal trust action.

The trust formation process can be modeled by combining the four C-components as follows (see Figure 1). An individual needs to choose the level of trust to display towards other individuals in a certain context. The contextual properties are observable. The individual is endowed with a cognitive system of a certain quality and with a crystallized component consisting of mental representations that each store knowledge about how much trust to exhibit towards other people. Formed through cultural and personal experiences with others, each of the available mental representations is augmented with (a) the preconditions under which a certain

level of trust should be displayed and (b) the representation of expected outcomes that exhibiting this level of trust under the given circumstances leads to.

Figure 1 near here

In deciding how much to trust others, the individual evaluates their context and collects information about the context's properties. This perceptual input is matched with the preconditions and outcomes of mental representations already crystallized by the brain. A mental representation is selected when preconditions and expected outcomes match the perceived input. The mental representation's inherent trust level is displayed by creating a new production that links the context's current properties to a certain level of social trust. Through contacts with others, the new production is recreated as many times as this context requires to establish trust. This augments the new production's utility value and makes this particular trust level the automatic response to the given contextual characteristics. If no match is found, the individual randomly selects a trust level to display. This trust level derives from the individual's worldview and their experience with trusting others. The individual analyzes the action's results by juxtaposing the outcomes of having displayed a randomly selected trust level with their personal goals. If the chosen level of trust brings the individual closer to their goals, a new record or operator is created with the original perceptual state as a precondition and the resulting perceptual state as a post-condition. If this is not the case, the random selection process is repeated until a match is found.

We use the trust formation description above to establish links between the four components and explain peculiarities in their joint impact on trust.

Proposition 1: We expect the context to be the strongest predictor of social trust levels. The principle of minimal control is the key rationale behind this expectation, according to which the contextual component's properties are more important in forming trust than the individual's internal representation of the world. One's understanding of the world, as shaped by the culture or experience with others, can influence trust formation when information about the context is unavailable or one is unable to evaluate sufficient contextual properties.

Proposition 2: We expect that context impacts trust more strongly when individuals already trust others. Our point of departure is that good contexts activate mental representations containing high trust levels. In order for the brain to activate such a mental representation, it must already exist in the declarative memory or its buffers. If the brain has not yet crystallized a mental representation of the trust level required for this context, it may take longer before the right trust level is reached and stored as a new record. Establishing a new record can be a slow process, since it involves learning by randomly selecting trust levels and analyzing each action's consequences. Random selection may involve errors and is unlikely to lead immediately to the optimal trust level. For any given context, activating existing mental representations hence produces a more optimal trust level than choosing a trust level through random selection. When placed in a good context, individuals who display high trust are more likely to choose the right trust level than individuals who lack such experience.

Proposition 3: We expect the trust building process to be more efficient for individuals who possess the knowledge of trust that is closer to the optimal trust level for the given context. Any new knowledge of trust is usually derived by drawing analogies from the individual's existing knowledge (Keil, 1989; Wittenbrink, Hilton and Gist, 1998). This means that a sudden leap from distrust to complete trust is unlikely to occur for individuals who lack experience in

displaying high trust levels towards other people. Rather, trust levels gradually increase as more and more trust is displayed.

Proposition 4: We expect that the context's impact on trust is stronger for individuals with a more developed cognitive system. Action choice includes numerous mental operations (perceiving the context's current state, processing the perceived information, matching the perceived contextual characteristics to mental representations' preconditions and outcomes, creating a new production, etc.). As such, an individual's general cognitive abilities may determine how fast and how well the brain performs mental operations that underlie the matching, coupling, mapping, and learning processes required to create a new production. Mental operations are usually faster and more efficient for individuals who possess better cognition. Hence, improving contexts will have a greater impact on trust for such individuals.

Proposition 5: We expect that the context's positive impact on trust is stronger for individuals who interact more frequently with others in this context. This is because a new production is used when it has a high utility value. The production's utility value is a function of how often the new production is recreated. This, in turn, depends on the number of incidents that require trust in the given context. Since we define social trust as trust towards other individuals, the need to trust others obviously emerges when individuals interact with each other. We propose that the new context's impact on trust is stronger for individuals with more social contacts.

We use the above propositions to postulate the following hypotheses:

Hypothesis 1: The contextual component is expected to be the strongest determinant of trust.

Hypothesis 2: The context's positive impact on trust is expected to be stronger for individuals who have a more developed crystallized component.

Hypothesis 3: The context's positive impact on trust is expected to be weaker for individuals who have a larger distance between the current knowledge of trust and the optimal trust level.

Hypothesis 4: The context's positive impact on trust is expected to be stronger for individuals who have a more developed cognitive system.

Hypothesis 5: The context's positive impact on trust is expected to be stronger for individuals who have a more developed contact component.

Data and Methods Description

To test our hypotheses, we utilize the public-use data from the Programme for the International Assessment of Adult Competencies (PIAAC) conducted in 2012. This database is unique because it provides a great number of skill relevant variables while also containing the measure of social trust (see https://www.oecd.org/site/piaac/surveyofadultskills.htm for a more detailed description of the PIAAC survey). Our sample includes Belgium (Flanders), the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Russian Federation, the Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland), and the USA. Australia, Austria and Canada are excluded from the analysis since data for many variables used in the analysis are not made available in the public-use dataset for these countries.

We utilize the following set of variables to empirically test our hypotheses (see Table 1 for descriptive statistics).

Table 1 near here

Dependent Variable

We limit our trust operationalisation to the faith in others measured through the extent to which the respondents agree with the statement that they can only trust a few people completely. The response scale varies from 1 "strongly agree" to 5 "strongly disagree."

Independent Variables

The crystallized component is operationalised through one's current stock of knowledge to trust and one's attitudes towards acquiring new knowledge. The knowledge to trust variable is approximated by the individual's participation in volunteering since volunteering helps an individual develop the knowledge of reciprocity, cooperation, empathy for others, an understanding of the common interest and common good and, as a result, trust (Brehm and Rahn, 1997; Newton, 1999a, 1999b; Paxton, 2002; Putnam, 1995, 2000). One's participation in volunteering is measured through the question asking how often the respondent did voluntary work in the last 12 months. The responses vary from 1 "never" to 5 "every day." One's attitudes towards acquiring knowledge approximate how the individual acquires new knowledge of trust. This measure represents a synthetic variable constructed through summing up the responses to six questions about the extent to which the respondent agrees with the following statements: (1) When I learn or read about new ideas, I try to relate them to real life situations to which they might apply, (2) I like learning new things, (3) When I come across something new, I try to relate it to what I already know, (4) I like to get to the bottom of difficult things, (5) I like to figure out how different ideas fit together, and (6) If I do not understand something, I look for additional information to make it clearer. The final construct has values ranging between 6 and

30, with higher values corresponding to a greater subjective propensity to learn or to integrate new information.

The cognitive component is operationalised through general intelligence and formal education. The general intelligence variable is measured by averaging the cognitive test results in the areas of literacy and numeracy, as in Blau and Kahn (2005). Each of the two constructs is calculated as a mean for ten possible values that the PIAAC survey provides. The education variable captures one's investment in formal education and is operationalised through a dummy that takes the value of one if the respondent has completed more than high school.

The contact component captures the frequency of interactions with other individuals. Since the PIAAC survey does not provide any questions relevant to meeting people outside job, we limit the contact variable to one's contacts at workplace. Additionally, we select only those contacts in which the individual has an active role while also distinguishing between positive and negative types of contacts. Positive contacts are measured through a synthetic variable constructed by summing up responses to questions about the frequency with which the respondents declare (1) instructing, training or teaching people, individually or in groups, (2) making speeches or giving presentations in front of five or more people, and (3) planning the activities of others. Negative contacts combine active interactions with other individuals involving, however, certain resistance on the part of others, such as (1) selling a product or selling a service, (2) advising people, (3) persuading or influencing people, and (4) negotiating with people either inside or outside one's firm or organization. Each of the questions has a response scale varying from 1 "never" to 5 "every day."

The contextual component is operationalised through the quality of a country's political context, a respondent's job context, and working hours flexibility. The political context variable

reflects the quality of the country's institutional environment. Formal institutions are deemed to be conducive to establishing trust, since they enforce third-party agreements (Herreros and Criado, 2008), enable individuals to pursue redress and restitution when cheated (Rothstein and Stolle, 2001), and serve as a safety net (Farrell, 2005). We operationalize this variable through the extent to which the respondent agrees with the statement "People like me do not have any say about what the government does." The response scale ranges between 1 "strongly agree" and 5 "strongly disagree."

The job context narrows the concept of environment to workplace. Workplace characteristics reflect the attributes of an individual's environment and provide the individual with experiences that can be interpreted as general social norms, thereby influencing trust towards other people (Grund and Harbring, 2009). The job context variable is operationalised through the question in which the respondents need to self-rate their satisfaction with job by choosing between the value of 1 "extremely dissatisfied" and 5 "extremely satisfied."

Working hours flexibility is expected to capture the degree of control at the workplace (as in Grund and Harbring, 2009). More regulation of working hours reflects more control at the workplace, whereas control may teach individuals not to rely on trust (only), but on institutional mechanisms as mistrust is a dominant pattern (Grund and Harbring, 2009). This variable is operationalized through the question asking the extent to which the individual can choose or change working hours. The response scale varies from 1 "not at all" to 5 "to a very high extent."

Control Variables

We control for the conventional determinants of trust (as in Christoforou, 2004; Hall, 1999; Van Oorschot and Arts, 2005), such as respondents' employment status, age, health condition, living

with a spouse or partner, the presence of children in the household, and immigration status. One's employment status is captured by a dummy that takes the value of one if the respondent declares having a paid job. The respondents' age is measured in ten-year bands. Health condition is measured through a question asking respondents to self-rate their health status by using a scale varying between 1 "poor" and 5 "excellent." The living with a spouse or partner variable is a dummy that takes the value of one if the respondent declares living with a spouse or partner. The presence of children in the household dummy takes the value of one if the respondent declares that the household has at least one child. Immigration status is captured by a dummy variable that takes the value of one if the respondent was born in the country where the survey was conducted. We also include mother's level of education to capture the quality of one's early socialization processes.

Methods Used in the Analysis

We use a multilevel analysis as our main method since it accounts for our data's hierarchical structure (Kreft and de Leeuw, 1998; Snijders and Bosker, 1999). This is necessary to prevent the un-modeled country information from ending up all being pooled into the single individual error term or recognize the fact that the regression coefficient on individual-level variables may not apply equally to all countries (Luke, 2004). The base model takes the following form:

$$Trust_{ij} = \gamma_{00} + \gamma_{10}Crystalyzed\_C_{ij} + \gamma_{20}Cognitive\_C_{ij} + \gamma_{30}Contact\_C_{ij} + \gamma_{40}Context\_C_{ij} + \gamma_{50}X + m_{0j} + \varepsilon_{ij} \quad (1)$$

Here, *Trust* is social trust scores, *Crystalyzed_C* is the measure of the crystallized component, *Cognitive_C* is the measure of cognitive component, *Contact_C* is the operationalisation of the contact component, *Context_C* is the contextual trust component. *X* is

the set of individual-level control variables; *m* is the country-level variance, whereas ε is the individual- level variance.

We further augment the base model by including interaction terms between the contextual component and the three other trust components as follows:

$$Trust_{ij} = \gamma_{00} + \gamma_{10}Crystalyzed\_C_{ij} + \gamma_{20}Cognitive\_C_{ij} + \gamma_{30}Contact\_C_{ij} + \gamma_{40}Context\_C_{ij} + \gamma_{50}D\_to\_Crystalyzed\_C_{ij} + \gamma_{60}Crystalyzed\_C*Context\_C_{ij} + \gamma_{70}\ Cognitive\_C*Context\_C_{ij} + \gamma_{80}Contact\_C*Context\_C_{ij} + \gamma_{90}D\_to\_Crystalyzed\_C*\ Context\_C_{ij} + \gamma_{100}X + m_{0j} + \varepsilon_{ij}, \quad (2)$$

where *Trust* is trust scores, *Crystalyzed_C, Cognitive_C, Contact_C,* and *Context_C* are the measures of the four trust components as described above. *D_to_Crystalyzed_C* is the measure of the distance between the respondents' crystallized component and the optimal values on the crystallized component. It is calculated as: [(Optimal level - Respondent's value on the crystallized component items) / Respondent's value on the crystallized component items]. Norway's mean values for the crystallized component items are considered to be optimal levels. The calculated values on the distance variables are rescaled to change between 0 "minimal distance" to 1 "maximum distance." *Crystalyzed_C*Context_C, Cognitive_C*Context_C Contact_C*Context_C,* and *D_to_Crystalyzed_C* Context_C* are the interaction terms between the contextual component and the four other variables that are (sequentially) included in the base model. Again, *X* is the set of individual-level control variables; *m* is the country-level variance and ε is the individual-level variance. The STATA *gllamm* command is utilized to calculate the model's parameters. Since social trust is an ordinal variable, the *ologit* link is specified together with the *binomial family* sub-options. Additionally, we include the GLLAMM *adapt* option, which causes adaptive quadrature to be used instead of ordinary quadrature.

Empirical Results

The base model's results are consistent with the conventional understanding of trust formation processes (see Table 2). Employment and better health condition are both associated with higher trust levels (Hall, 1999; Van Oorschot and Arts, 2005). Trust increases with age (Christoforou, 2004). Trust levels are also higher for individuals who are married or live with a partner and for individuals who were born in the country where the survey was conducted (Christoforou, 2004; Van Oorschot and Arts, 2005). Trust is more difficult to form among individuals with children (Hall, 1999; Van Oorschot and Arts, 2005). We also find a negative association between mother's education level and one's trust scores.

Augmenting the base model with the four components provides support for the 4C-component model of trust formation (see Table 3). Individuals who participate in volunteer activities have a greater understanding of trust and tend to exhibit higher trust levels. Surprisingly, individuals inclined towards acquiring new knowledge have lower trust levels. More able individuals or individuals with better formal education prove to be more trusting. Positive contacts, even through job tasks, lead to higher trust levels, whereas negative contacts relate to lower trust levels. The three contextual variables capturing the general political and job environments prove to be strong positive determinants of social trust.

Table 2 and Table 3 near here

The model's fit changes the most when the contextual variables are included. This is commensurate with Hypothesis 1 and suggests that the context is the driving force behind trust formation among individuals. Positive changes in the context's quality are a lower constraint to

substantial trust changes. Only when the context improves do individuals considerably increase their trust level. These results do not change after applying the selected strategies of robustness check, such as (1) overcoming limitations of the PIAAC survey regarding available operationalisations through constructing a single measure for each of the four components (see Annex A), (2) controlling for sample size variations (see Annex B), or (3) controlling for endogeneity in the relationship between the four components and social trust (see Annex C).

Our analysis also shows strong interaction effects between the context and the three other components (see Table 4). We view this as evidence that learning to trust has an upper constraint, which is formed by the crystallized, cognitive, and contact components and which determines the individual's responses to contextual improvements. When one's current knowledge includes trusting others a lot, considerable changes in the context spur considerable changes in trust levels. When such knowledge is missing, even substantial improvements in the context only modestly impact one's trust scores, which is commensurate with Hypothesis 2. Our results also suggest that the final change in trust levels may depend on the distance between the individual's current knowledge to trust and the level of trust which is optimal for good contexts. As the distance increases, the positive change in trust levels due to contextual improvements declines. This is in line with Hypothesis 3.

Additionally, the context's overall impact on trust scores proves greater for more able individuals with higher cognitive abilities or better educational backgrounds, which is commensurate with Hypothesis 4. Finally, the frequency of contacts significantly influences contextual variables' impact on trust, with both positive and negative contacts enhancing this impact, which is in line with Hypothesis 5. One should note that the negative contacts' role in trust emergence is relatively small compared to that of positive contacts.

Table 4 near here

To further analyze the components' joint effect on social trust, we group countries according to their four components' values and link them to trust levels. To facilitate this country comparison and overcome limitations of the PIAAC survey regarding available operationalisations, we use the STATA predict option for factor analysis and construct a single measure for each of the four components. This option allows us to capture the commonalities in the variation of sub-measures selected for each trust facet and to combine them into a single construct that better reflects the rationale behind each trust component (see Annex A for the regression with the trust components' single measures).

Applying the hierarchical cluster analysis to the single measures allows us to distinguish between six country groups (see Figure 2). The first encompasses Scandinavian countries and the USA, where all of the four components take high values, resulting in the sample's highest trust level. The second group consists of Ireland and the UK with high values on the crystallized and contact components, relatively lower values on the cognitive and contextual components, and trust reaching only moderate levels. The third group includes Japan and Korea with low crystallized item values and a limited frequency of contacts. However, these countries are characterized by good cognition levels and educational attainments and relatively strong political and occupational environments, leading to average trust levels. The fourth group includes Southern European countries (Spain and Italy), where each of the four components have low values, resulting in the sample's lowest trust level. The fifth group has continental European countries (Belgium, Germany, and the Netherlands) and Estonia, which are characterized by a

rich tradition of volunteering and job tasks that offer frequent contacts. The cognitive and contextual components predominantly take average values, resulting in average trust levels. The sixth group includes post-socialist economies (the Czech Republic, the Russian Federation, Poland, and the Slovak Republic) together with France. These countries lack a tradition of volunteering and have job sectors offering fewer contacts but are characterized with average values on the cognitive and context components, resulting in an average trust level. Figure 3 presents a four dimensional visualization of this country grouping, whereas Table 5 reports the four components' average values by country group.

Figure 2 and Figure 3 near here

Table 5 near here

To analyze how the three trust components can constrain an increase in a country's trust levels when the context improves, we conduct a prediction exercise in which we assign the highest value to the contextual component's items and keep the three other components' measures at their actual levels. The predictions are made using the STATA gllapred option (for more details see Rabe-Hesketh and Skrondal, 2008). This procedure presupposes first conducting a multilevel analysis of actual trust scores and then calculating the marginal cumulative probability. We calculate a mean value of such predictions for each country and report them in Table 6 as compared to the actual trust score. To simplify the visualization of our results, we create a binary variable for trust by assigning the value of one when the initial trust measure takes the value of four or five and otherwise assigning the value of zero.

Table 6 about here

Our results reveal two things. First, when everyone has the same high value for the context, the initially found cross-country and cross-group differences in trust levels almost vanish. This confirms that context drives trust formation processes. Second, even if everyone in the selected countries has equally positive perceptions of government effectiveness or the quality of work contexts, trust scores still remain slightly heterogeneous across the six groups. This supports our proposition that the development of the three other components impacts social trust responsiveness when the context improves. With the four components' best values, group one has the highest predicted trust scores whereas group four, with the lowest component values, has the lowest predicted trust scores. Interestingly, our results indicate that groups with a developed or relatively developed tradition of volunteering (group two and group five), combined with a high frequency of contacts, will improve trust scores to a greater extent than groups lacking a volunteer tradition, but with relatively good investments in formal education (group three and group six). Nonetheless, both types of groups remain behind Scandinavian countries and the USA in their predicted trust levels.

Overall, both our country grouping and the prediction exercise suggest that the four components must all have good values to lead to high trust levels. When there are imbalances in their level of maturation, the highest trust level cannot be attained. Countries with more developed crystallized and contact components have more opportunities to promote trust formation by improving their context than do countries lacking a volunteer tradition, but with good investments in the population's cognitive development.

Conclusion

This study offers a new trust formation model by utilizing psychology's skill acquisition framework. Accordingly, trust consists of four components: (1) the crystallized component, the current stock of knowledge regarding trust levels to display towards others, (2) the cognitive component, the quality of one's cognitive system, (3) the contact component, the frequency with which one interacts with others, and (4) the contextual component, the environmental quality where decisions about trust levels are made.

Our theoretical and empirical work suggests that context is the most important predictor of trust. Positive changes in the context's properties are needed to significantly increase trust in society. However, contextual improvements lead people to be more trusting when they are already knowledgeable about displaying high trust levels. If such knowledge is missing, then trust can be learned, just as a skill. The efficiency of the learning process is determined by the distance between the current knowledge of trust and the optimal level of trust. Additionally, learning to trust in a new institutional context is easier for more intelligent individuals and is a function of how often individuals are in contact with others.

This study has considerable policy implications. Our model can be used to analyze the consequences of the current immigration phenomenon in Europe. According to our model, one can expect that immigrants from weak political and legal environments will upgrade their trust levels when they move to more advanced EU societies. But the new level of trust is still likely to be below the typical trust levels for these countries' native population. To ensure social cohesion in countries accepting many new residents, it is essential to overcome barriers to immigrants' social trust, such as lower levels of education, weak contact patterns in the new place of

residence and reluctance in trusting others, common for many economically underdeveloped or developing countries. Governments should simultaneously address the four trust factors to increase trust levels among immigrants.

Further research is needed to validate our model. Longitudinal data is necessary to test how dynamically the four factors impact trust formation. It is also essential to clarify what contextual characteristics (institutional, social, political, or other) are important for trust building and how each of these characteristics can change the trust formation process's trajectory.

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Table 1. Descriptive Statistics for the Key Variables Used in the Analysis

VARIABLES	N	Minimum	Maximum	Mean	Std. Deviation
Social trust	98,729	1.000	5.000	2.300	1.138
Knowledge to trust	98,729	1.000	5.000	1.600	1.011
Attitudes towards knowledge	98,729	6.000	30.000	21.580	4.542
General intelligence	98,729	37.870	426.120	271.558	45.547
Formal education	98,729	0.000	1.000	0.560	0.496
Positive contacts	98,729	3.000	15.000	5.731	3.429
Negative contacts	98,729	4.000	20.000	9.412	5.346
Political context	98,729	1.000	5.000	2.720	1.266
Job context	98,729	1.000	5.000	3.330	0.841
Working hours flexibility	98,729	1.000	5.000	2.110	1.392
Employed	98,729	0.000	1.000	0.670	0.469
Age	98,729	1.000	5.000	3.040	1.420
Subjective health status	98,729	1.000	5.000	2.600	1.070
Living with a spouse or a partner	98,729	0.000	1.000	0.670	0.470
Children in the household	98,729	0.000	1.000	0.610	0.487
Born in the country	98,729	0.000	1.000	0.910	0.292
Mother's education level	98,729	0.000	1.000	0.559	0.496

Table 2. Social Trust Base Model

VARIABLES	(1)	(2)
Employed (1=yes)		0.140***
		(0.013)
Age		0.053***
		(0.006)
Subjective health status		0.174***
		(0.006)
Living with a spouse or a partner		0.122***
		(0.016)
Children in the household		-0.153***
		(0.017)
Born in the country		0.179***
		(0.021)
Mother's education level		-0.111***
		(0.012)
Constant		
Cut 1	-1.146***	-1.289***
	(0.104)	(0.052)
Cut 2	0.817***	0.748***
	(0.104)	(0.052)
Cut 3	1.419***	1.366***
	(0.104)	(0.052)
Cut 4	3.218***	3.203***
	(0.105)	(0.054)
Log likelihood	-166523.72	-133567.48
Between-class variance	0.234	0.268
	(0.069)	(0.051)
Number of level 2 units	20	20
Number of level 1 units	98,729	98,729

Note: Standard errors in parentheses.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

Table 3. A 4C-Component Model of Trust Formation

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
The crystallized component						
Knowledge to trust	0.143***					0.091***
	(0.006)					(0.006)
Attitudes towards knowledge	0.011***					-0.021***
	(0.001)					(0.002)
Distance to knowledge to trust		-0.427***				
		(0.017)				
Distance to attitudes towards knowledge		-0.475***				
		(0.057)				
The cognition component						
General intelligence			0.005***			0.004***
			(0.000)			(0.000)
Formal education			0.290***			0.210***
			(0.018)			(0.019)
The contact component						
Positive contacts				0.054***		0.033***
				(0.002)		(0.002)
Negative contacts				-0.003*		-0.012***
				(0.002)		(0.002)
The context component						
Political context					0.395***	0.369***
					(0.005)	(0.005)
Job context					0.102***	0.101***
					(0.009)	(0.009)
Working hours flexibility					0.046***	0.032***
					(0.005)	(0.005)
Constant						
Cut 1	-0.825***	-1.683***	0.434***	-1.041***	-0.587***	0.027
	(0.076)	(0.052)	(0.055)	(0.043)	(0.061)	(0.077)
Cut 2	1.222***	0.366***	2.501***	1.007***	1.548***	2.187***
	(0.076)	(0.052)	(0.055)	(0.043)	(0.061)	(0.078)
Cut 3	1.844***	0.988***	3.129***	1.627***	2.188***	2.835***
	(0.076)	(0.052)	(0.056)	(0.044)	(0.062)	(0.078)
Cut 4	3.691***	2.836***	4.983***	3.472***	4.075***	4.739***
	(0.078)	(0.054)	(0.058)	(0.046)	(0.063)	(0.079)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-132140.31	-132081.33	-132552.61	-132584.80	-129509.90	-127442.24
Between-class variance	0.278	0.222	0.229	0.229	0.430	0.403
	(0.056)	(0.028)	(0.029)	(0.029)	(0.029)	(0.033)
Number of level 2 units	20	20	20	20	20	20
Number of level 1 units	98,729	98,729	98,729	98,729	98,729	98,729

Note: Standard errors in parentheses. The list of controls includes the full set of variables from the social trust base model.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

Table 4. Analysis of Interaction Effects between the Four Trust Components

VARIABLES	Interaction terms
Interactions between the context and crystallized components	
Political context * Knowledge to trust	0.013***
	(0.004)
Political context * Attitudes towards knowledge	0.004***
	(0.001)
Job context * Knowledge to trust	0.005
	(0.004)
Job context * Attitudes towards knowledge	0.004***
	(0.001)
Working hours flexibility * Knowledge to trust	0.007*
	(0.004)
Working hours flexibility * Attitudes towards knowledge	0.002**
	(0.000)
Interactions between the context and the distance to the crystallized component	
Political context * Distance to knowledge	-0.038***
	(0.013)
Political context * Distance to attitudes	-0.019
	(0.090)
Job context * Distance to knowledge	-0.028
	(0.017)
Job context * Distance to attitudes	-0.105*
	(0.058)
Working hours flexibility * Distance to knowledge	-0.032*
	(0.018)
Working hours flexibility * Distance to attitudes	-0.080
	(0.087)
Interactions between the context and cognitive components	
Political context * General intelligence	-0.000
	(0.001)
Political context * Formal education	0.024**
	(0.012)
Job context * General intelligence	0.001***
	(0.000)
Job context * Formal education	0.070***
	(0.009)
Working hours flexibility * General intelligence	0.001***
	(0.000)
Working hours flexibility * Formal education	0.065***
	(0.012)
Interactions between the context and contact components	
Political context * Positive contacts	0.007***
	(0.001)
Political context * Negative contacts	0.003***
	(0.001)
Job context * Positive contacts	0.009***
	(0.001)
Job context * Negative contacts	0.005***
	(0.001)
Working hours flexibility * Positive contacts	0.003***
	(0.001)
Working hours flexibility * Negative contacts	0.000

	(0.001)

Note: Standard errors in parentheses.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

Table 5. The Four Components' Mean Values, by Country Group

		Group 1 Denmark Finland Norway Sweden USA	Group 2 Ireland UK	Group 3 Japan Korea	Group 4 Italy Spain	Group 5 Belgium Estonia Germany Netherlands	Group 6 Czech Rep. France Poland Russian Fed Slovak Rep.
The Crystallized Component	Knowledge to trust	1.9 (High)	1.7 (High)	1.5 (Low)	1.4 (Low)	1.7 (High)	1.4 (Low)
	Attitudes towards knowledge	23.2 (High)	22.0 (High)	17.6 (Low)	22.4 (High)	20.8 (Average)	21.7 (Relatively Average)
The Cognitive Component	General intelligence	277 (High)	265 (Relatively Low)	280 (High)	250 (Low)	277 (Average)	271 (Average)
	Formal education	0.81 (High)	0.74 (Relatively Low)	0.82 (High)	0.56 (Low)	0.78 (Average)	0.83 (High)
The Contact Component	Positive contacts	6.8 (High)	6.0 (High)	5.5 (Relatively Low)	5.2 (Low)	5.6 (Relatively high)	5.0 (Low)
	Negative contacts	10.7 (High)	10.0 (High)	8.8 (Low)	8.2 (Low)	9.6 (Relatively High)	8.6 (Low)
The Contextual Component	Political context	3.2 (High)	2.6 (Relatively Low)	2.8 (Relatively High)	2.2 (Low)	2.7 (Average)	2.7 (Average)
	Job context	2.4 (High)	1.9 (Average)	1.8 (Average)	1.6 (Low)	2.1 (Average)	1.8 (Average)
	Working hours flexibility	2.5 (High)	1.9 (Relatively Low)	2.3 (Relatively High)	1.8 (Low)	2.2 (Average)	1.8 (Low)

Table 6. Marginal Cumulative Probabilities of Trusting Other People Derived from the 4C-Component Trust Model

Countries	Trust scores			
	Actual	Predicted		
		Clustered by country	Clustered by country group	
Group 1	**0.348**	**0.418**	**0.414**	
Denmark	0.463	0.415	0.415	
Finland	0.342	0.426	0.422	
Norway	0.354	0.417	0.415	
Sweden	0.357	0.420	0.417	
USA	0.224	0.411	0.403	
Group 2	**0.172**	**0.410**	**0.409**	
Ireland	0.166	0.413	0.413	
UK	0.178	0.407	0.405	
Group 3	**0.160**	**0.379**	**0.381**	
Japan	0.190	0.398	0.400	
Korea	0.129	0.360	0.362	
Group 4	**0.156**	**0.375**	**0.377**	
Italy	0.099	0.378	0.379	
Spain	0.212	0.371	0.375	
Group 5	**0.190**	**0.397**	**0.397**	
Belgium	0.183	0.404	0.405	
Estonia	0.095	0.374	0.372	
Germany	0.157	0.404	0.403	
Netherlands	0.323	0.407	0.409	
Group 6	**0.125**	**0.392**	**0.389**	
Czech Rep.	0.072	0.398	0.396	
France	0.107	0.399	0.394	
Poland	0.164	0.390	0.386	
Russian Fed	0.185	0.377	0.377	
Slovak Rep.	0.098	0.394	0.393	

The models used for calculating the predictions are as:

Trust = 0.105Knowledge + 0.010Attitudes_towards_knowledge + 0.004General_intelligence + 0.298Formal_education +0.033Positive_contacts – 0.007Negative_contacts + 0.334Political_context + 0.141Job_context + 0.031Working_hrs_flexibility + 0.486Employed + 0.070Age + 0.152Health_status + 0.026Living_with_a_spouse_or_partner – 0.079Presence_of_children + 0.069Born_in_the_country – 0.209Mother's_formal_education (clustered by country).

Trust = 0.103Knowledge + 0.005Attitudes_towards_knowledge + 0.005General_intelligence + 0.231Formal_education +0.031Positive_contacts – 0.008Negative_contacts + 0.351Political_context + 0.164Job_context + 0.033Working_hrs_flexibility + 0.535Employed + 0.079Age + 0.157Health_status + 0.062Living_with_a_spouse_or_partner – 0.120Presence_of_children + 0.017Born_in_the_country – 0.242Mother's_formal_education (clustered by country group).

Annex A. Robustness Check: The Four Components' Single Measures

VARIABLES	(1)	(2)	(3)	(4)	(5)
The crystallized component	0.391***				0.159***
	(0.016)				(0.017)
The cognition component		0.420***			0.351***
		(0.011)			(0.012)
The contact component			0.206***		0.079***
			(0.009)		(0.010)
The context component				0.432***	0.347***
				(0.014)	(0.015)
Control variables	Yes	Yes	Yes	Yes	Yes
Log likelihood	141758.22	-136201.55	-142398.79	-131832.62	-133308.62
Between-class variance	0.226	0.216	0.290	0.266	0.284
	(0.055)	(0.037)	(0.054)	(0.039)	(0.042)
Number of level 2 units	20	20	20	20	20
Number of level 1 units	98,729	98,729	98,729	98,729	98,729

Note: Standard errors in parentheses. The list of controls includes the full set of variables from the social trust base model.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

Annex B. Robustness Check: Variations in the Sample Size

VARIABLES	(1)	(2)	(3)
The crystallized component			
Knowledge to trust	0.078***	0.080***	0.093***
	(0.007)	(0.007)	(0.009)
Attitudes towards knowledge	-0.020***	-0.023***	-0.024***
	(0.002)	(0.002)	(0.002)
The cognition component			
General intelligence	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)
Formal education	0.310***	0.322***	0.188***
	(0.025)	(0.024)	(0.028)
The contact component			
Positive contacts	0.028***	0.032***	0.029***
	(0.002)	(0.003)	(0.003)
Negative contacts	-0.011***	-0.009***	-0.014***
	(0.002)	(0.002)	(0.002)
The context component			
Political context	0.376***	0.393***	0.366***
	(0.007)	(0.006)	(0.008)
Job context	0.091***	0.096***	0.110***
	(0.009)	(0.009)	(0.013)
Working hours flexibility	0.025***	0.028***	0.032***
	(0.006)	(0.006)	(0.007)
Control variables	Yes	Yes	Yes
Log likelihood	-86723.956	-100005.380	-59917.114
Between-class variance	0.386	0.437	0.371
	(0.033)	(0.031)	(0.036)
Number of level 2 units	20	20	20
Number of level 1 units	66,682	77,941	46,123

Note: Standard errors in parentheses. The list of controls includes the full set of variables from the social trust base model. In Column (1), we restrict our sample to the employed individuals since many of our operationalisations are employment-related. In Column (2), we restrict our sample to people aged between 20 and 65 to avoid a bias caused by the fact that the majority of young people between 16 and 20 are still being educated and hence those in the labor market might not be representative of the young population (Hanushek, Woessman, & Zhang, 2011). In Column (3), we follow Kuckulenz and Zwick (2003) and restrict our analysis to male employees since the effects of learning for women require a different modelling approach.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

Annex C. Robustness Check: Controlling for the Endogeneity Problem

VARIABLES	(1)	(2)	(3)	(4)
The crystallized component				
Knowledge to trust	1.262***	0.076***	0.078***	0.057***
	(0.151)	(0.003)	(0.005)	(0.012)
Attitudes towards knowledge	-1.093***	0.002	0.001	-0.044***
	(0.330)	(0.001)	(0.001)	(0.003)
The cognition component				
General intelligence	0.015***	0.004***	0.003***	0.005***
	(0.004)	(0.000)	(0.000)	(0.000)
Formal education	1.078	0.688***	0.049**	0.037
	(0.314)	(0.084)	(0.019)	(0.025)
The contact component				
Positive contacts	0.165***	0.029***	0.011**	0.027***
	(0.051)	(0.001)	(0.005)	(0.004)
Negative contacts	0.103***	-0.005***	-0.011**	-0.101***
	(0.036)	(0.001)	(0.005)	(0.007)
The context component				
Political context	0.465***	0.227***	0.242***	0.473***
	(0.086)	(0.003)	(0.004)	(0.038)
Job context	0.233***	0.048***	0.128***	0.964***
	(0.063)	(0.003)	(0.007)	(0.076)
Working hours flexibility	0.234***	0.028***	0.049***	2.304***
	(0.076)	(0.003)	(0.004)	(0.168)
Observations	60,132	98,729	48,311	89,646

Note: Robust standard errors in parentheses. Column (1) contains the results of an instrumental variable (IV) regression, in which the knowledge to trust variable is instrumented with an individual's working hours per week and countries' mean values for respondents' altruism levels. The altruism variable is operationalised through the question asking the extent to which respondents agree that it is important to help other people and care about others' well-being. The European Social Survey (ESS) data from the year 2012 are used as a source for altruism. Column (2) reports the results for an IV regression, in which the cognition component is instrumented with the mother's immigration background and the respondent's genetics measured through the mother's level of education (Cunha & Heckman, 2008). Column (3) instruments the contact component with the following set of PIAAC variables: the respondent's work experience length in years, managerial responsibilities, the intensity of computer use at work, the need for further training, the size of job company, and the respondent's job industry code. Column (4) instruments the contextual component with the Freedom House civil liberties index (as in Fidrmuc, 2003) and countries' morale culture calculated as the average of responses to two ESS questions about the extent to which the individual considers it wrong to (1) make an exaggerated or false insurance claim and (2) buy something they think might be stolen. In addition, we include a dummy specifying whether the respondent has a paid job.
* p < .10, ** p < .05, *** p < .01 (two-tailed tests).

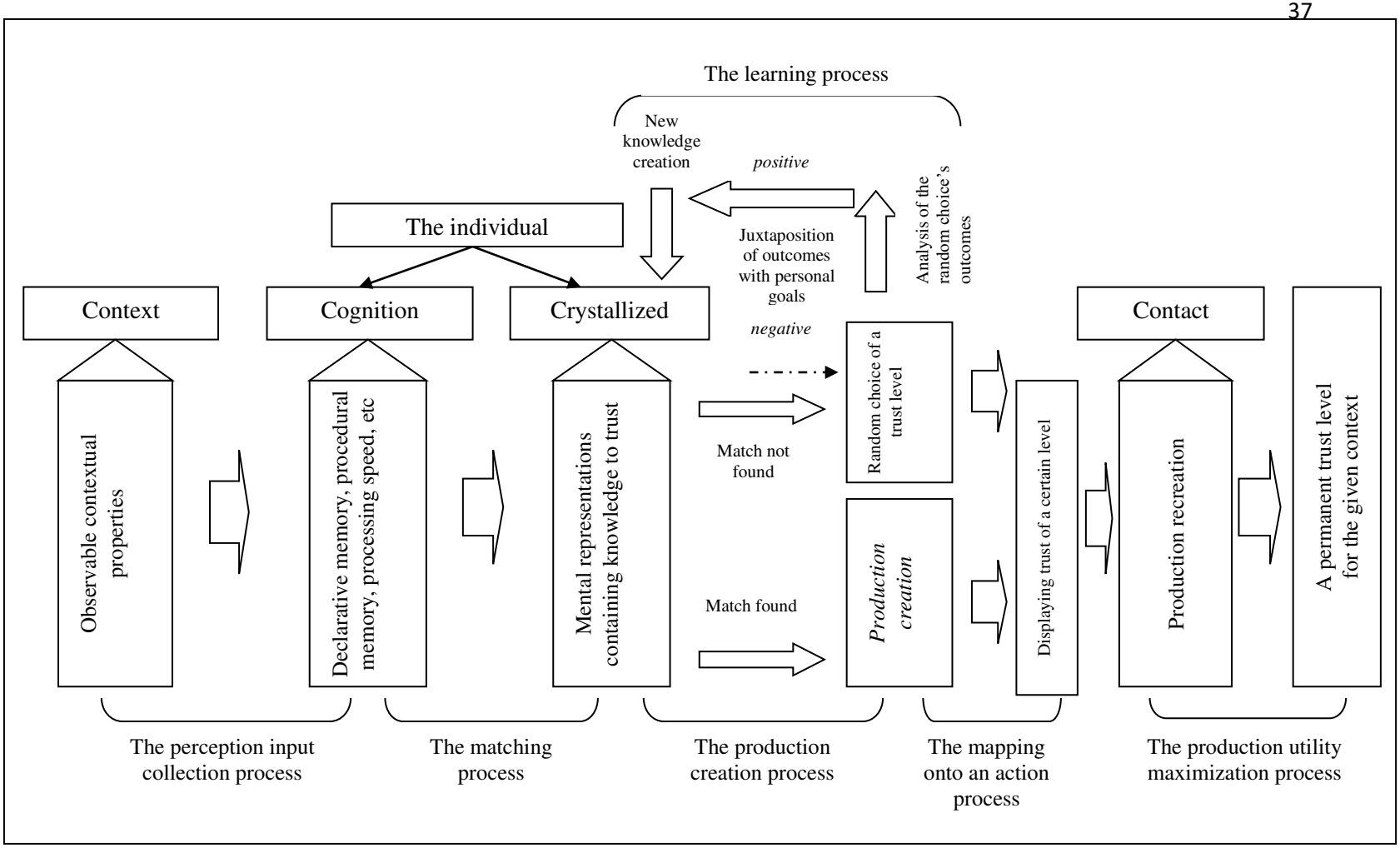

Figure 1. A 4C-Component Model of Trust Formation

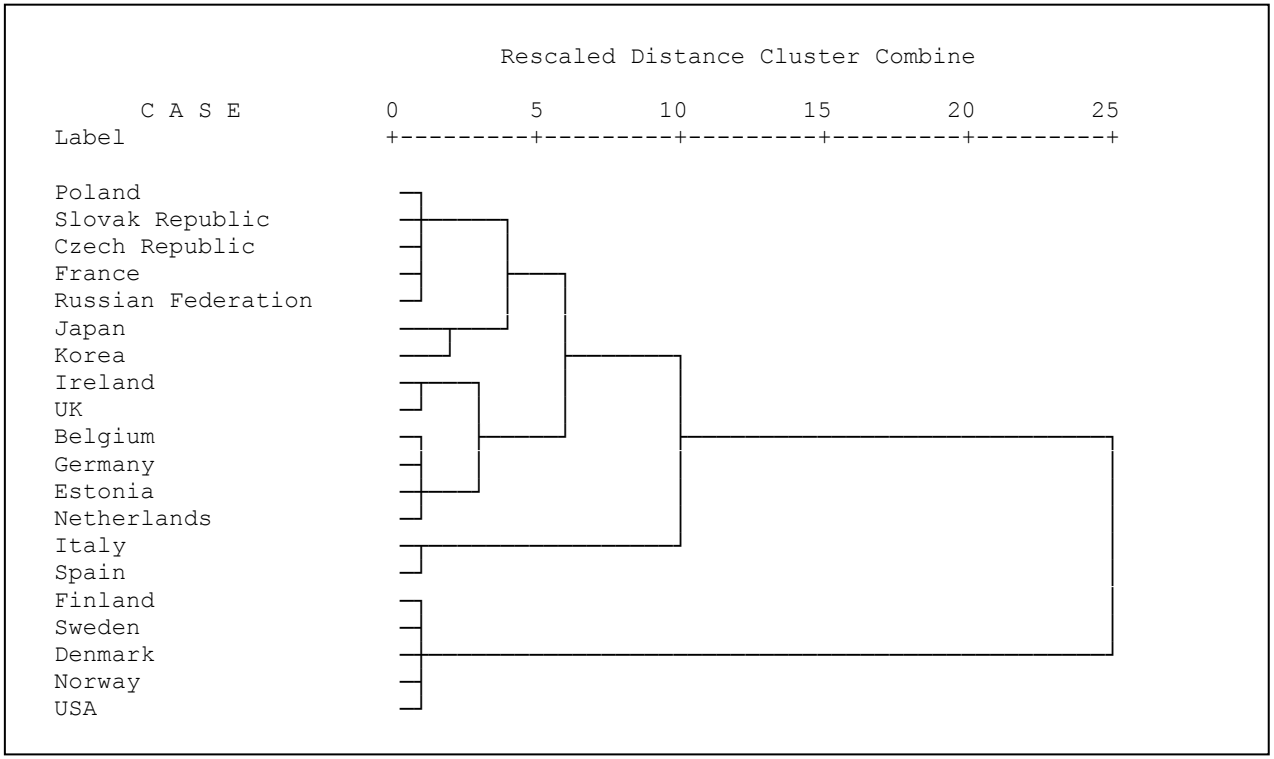

Figure 2. Grouping of Countries Included in the Sample, Derived from the Hierarchical Cluster Analysis

Note: Dendrogram using Ward Method.

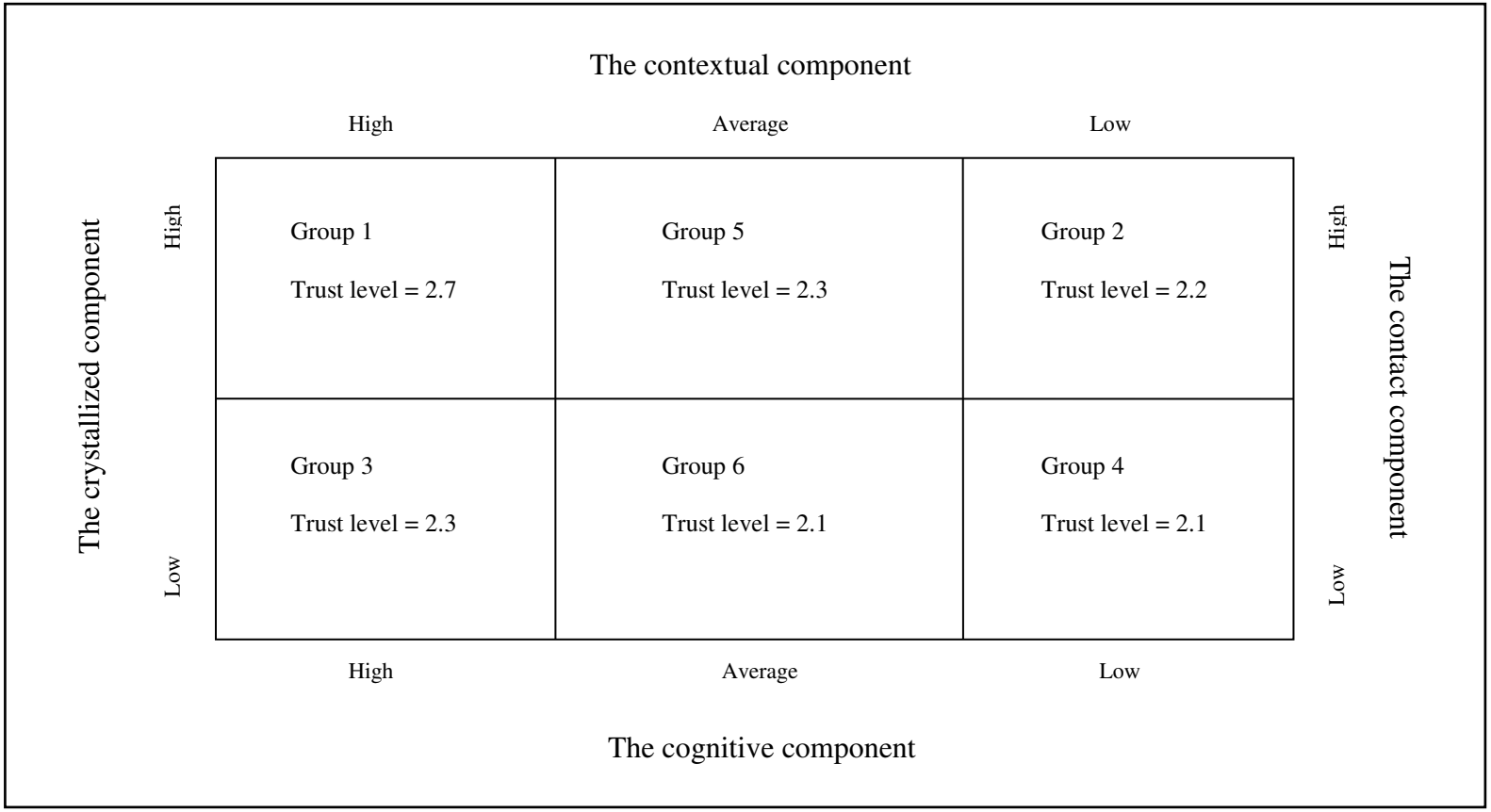

Figure 3. A Four Dimensional Visualization of Country Grouping