INFORMAL FAMILY TIES AND NATIONAL INNOVATION CAPACITY: CROSS-COUNTRY EVIDENCE FROM ECONOMIC COMPLEXITY INDEX

MỐI LIÊN KẾT GIA ĐÌNH PHI CHÍNH THỨC VÀ NĂNG LỰC ĐỔI MỚI SÁNG TẠO QUỐC GIA: BẰNG CHỨNG XUYÊN QUỐC GIA TỪ CHỈ SỐ PHỨC TẠP KINH TẾ

Nguyen Thi Thuy[1]*, Ngo Thi My Hoa[2]

[1]The University of Danang - University of Economics, Vietnam
[2]Warwick Business School, The University of Warwick, United Kingdom

*Corresponding author: nguyenthithuy@due.edu.vn

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Abstract - Although the role of formal institutions in shaping national innovation capacity is widely recognized, existing findings on the role of informal institutions, remain inconclusive. Family ties may represent an important informal institution associated with national innovation capacity because they may influence innovation through three key mechanisms: openness to external knowledge and collaboration, attitudes toward risk-taking, and the meritocratic allocation of resources. Using the Economic Complexity Index (ECI) as a structural proxy for innovation-related productive capabilities, this study examines the relationship between family ties and national innovation capacity across countries. The results show that family ties are negatively associated with national innovation capacity. This study contributes to the literature by identifying family ties as a country-level factor linked to innovation capacity. It also distinguishes bonding social capital (family ties) from broader bridging social capital, and highlights the usefulness of ECI in capturing productive capabilities that underpin national innovation capacity.

Key words - Informal family ties; national innovation capacity; Economic Complexity Index; social capital; informal institutions

Tóm tắt - Mặc dù vai trò của thể chế chính thức trong việc định hình năng lực đổi mới sáng tạo quốc gia đã được thừa nhận rộng rãi, ảnh hưởng của thể chế phi chính thức vẫn chưa có kết luận thống nhất. Nghiên cứu này xem xét mối liên kết gia đình, một thể chế phi chính thức, có thể ảnh hưởng đến năng lực đổi mới sáng tạo quốc gia thông qua ba cơ chế: mức độ cởi mở đối với tri thức và hợp tác bên ngoài, thái độ đối với chấp nhận rủi ro và phân bổ nguồn lực dựa trên năng lực. Sử dụng Chỉ số Phức tạp Kinh tế (ECI) làm đại diện cho đổi mới sáng tạo, kết quả cho thấy mối liên kết gia đình có quan hệ tiêu cực với năng lực đổi mới sáng tạo. Nghiên cứu góp phần xác định vai trò của mối liên kết gia đình ở cấp quốc gia, phân biệt vốn xã hội gắn kết với vốn xã hội kết nối, và nhấn mạnh tính hữu ích của ECI trong đo lường năng lực đổi mới sáng tạo.

Từ khóa - Mối liên kết gia đình; năng lực đổi mới sáng tạo quốc gia; Chỉ số Phức tạp Kinh tế; vốn xã hội; thể chế phi chính thức.

1. Introduction

National innovation capacity, defined as an economy's ability to generate and commercialize a sustained flow of innovation [1], is a key driver of long-run economic growth. As innovation enhances competitiveness and economic prosperity, identifying its determinants has important policy implications. In this regard, existing literature emphasizes the role of formal institutions in fostering innovation capacity in various contexts [1], [2]. However, informal institutions may also play a significant role. Shane argues that innovation depends not only on R&D investment but also on societal values that support innovative activity [3]. Consistent with this view, a growing body of research has documented a significant relationship between a nation's culture and its level of innovativeness [4] - [9]. However, most studies focus on Hofstede's cultural dimensions, and the results are inconclusive.

Family ties, which are defined as "cultural patterns of family loyalties, allegiances and authorities" [10], are widely recognized as one of the most fundamental informal institutions shaping how individuals perceive obligations, make decisions, and interact with others in society [10], [11], [12] and thus affect economic outcomes [13] - [18]. We expect family ties to be linked to national innovation capacity through three key mechanisms: attitudes toward risk-taking, the meritocratic allocation of resources, and openness to external collaboration and knowledge.

First, innovation requires risk-taking and tolerance for uncertainty. Strong family ties may reduce incentives to pursue uncertain opportunities because family-based support and intergenerational resource pooling can provide social insurance [10], [19]. Family ties may also be associated with lower generalized social trust, which is important for interacting beyond close kinship networks and engaging in risky innovative activities [20]. Second, innovation capacity depends on the efficient allocation of talent and productive resources. Prior studies show that talent allocation matters for innovation, productivity, and economic growth [21], [22]. In societies with stronger family ties, access to finance, jobs, managerial positions, and entrepreneurial resources may depend more on kinship networks than on merit-based criteria, leading to inefficient resource allocation. Third, innovation depends on the recombination of diverse knowledge [23]. Openness to external collaboration and access to heterogeneous knowledge are therefore essential for innovation [24] - [28]. Strong family ties may be associated with more closed kinship-based networks and fewer interactions with

external partners [29], [30], [31], thereby weakening knowledge recombination and lowering innovation-related productive capabilities.

We test this hypothesis using cross-country regressions, using ECI as a structural proxy for innovation-related productive capabilities, and controlling for economic and institutional factors: intellectual property rights protection *(ipr),* trade openness *(open),* quality of political institutions (including democracy *(democra)* and rule of law *(rle)),* economic development *(lnGNI),* income inequality *(inequality)*, country land area *(lnLand),* year dummies, and continent dummies. ECI captures the productive knowledge embedded in a country's export structure and reflects its capacity to combine and apply capabilities in producing sophisticated goods [32]. It is based on diversity, which refers to the range of products a country exports, and ubiquity, which captures how many countries can produce those products. Countries with high ECI scores export diverse and relatively rare products, indicating complex productive capabilities that underpin innovation. Compared with conventional innovation indicators, ECI captures realized capabilities, reflects tacit knowledge and process improvements, and relies on observable trade data, while its strong correlation with R&D, researchers, and patents supports its validity as a proxy for innovation-related productive capabilities [32], [33]. We find a significantly negative relationship between ECI and family ties.

We also conduct several robustness checks. First, to address potential multicollinearity, we re-estimate the models by excluding control variables with high VIF values, including either rule of law (*rle)*, economic development (*lnGNI)*, the Europe region dummy, democracy (*democra)*, or all four variables together. Second, we include Hofstede's cultural dimensions, social trust, and both sets of variables in additional robustness regressions. Third, we exclude the years 2020 and 2021 to mitigate the potential effects of the COVID-19 period. Finally, we use the Global Innovation Index (*GII*) as an alternative measure of innovation capacity. Across all these robustness checks, the results consistently show a negative and significant relationship between family ties and national innovation capacity.

This study makes three main contributions. First, it identifies family ties as a specific informal institution that is associated with national innovation capacity. While prior studies have examined the role of formal institutions and cultural dimensions in explaining innovation outcomes, this paper highlights the relationship between family ties, representing kinship-based social structures and a capability to generate and commercialize innovation across countries. Second, the study distinguishes bonding family-based social capital from bridging social capital. Strong family ties may provide support and security within the family, but they may also reduce openness to outsiders, weaken generalized trust, and limit collaboration across broader social and professional networks. This distinction helps explain why family-based solidarity may not necessarily translate into stronger national innovation capacity. Third, the paper uses the Economic Complexity Index to capture productive capabilities, rather than relying only on conventional innovation-output measures such as patents or innovation rankings. By doing so, the study provides a broader assessment of innovation capacity as the ability of an economy to accumulate, recombine, and deploy complex productive knowledge.

2. Theoretical framework and hypothesis development

The role of family ties in national innovation capacity can be examined through institutional theory. Institutions, comprising formal institutions such as the constitution, laws, and regulations and informal institutions such as values and norms, are often described as the "rules of the game" that define acceptable behavior by promoting compliance through incentives and sanctions [34], [35]. Differences in institutions, therefore, have a significant impact on the variation in innovation capacity across countries. This section focuses on how informal institutions, particularly family ties, affect economic outcomes, drawing implications for the potential impact of family ties on cross-country differences in innovation capacity.

2.1. The role of informal institutions in national innovation capacity

National innovation capacity, reflecting the real and potential capabilities of a country to convert knowledge into innovation, or to be more specific, to produce and trade a new flow of technologies, is a key driver of long-term economic growth and wealth creation [1], [36] - [38]. National innovation capacity has been argued to be determined by formal institutions, resource commitments, policies that support innovation, and the linkages between them [1]. Although formal institutions have received extensive attention in explaining innovation capacity, recent research increasingly emphasizes the role of informal institutions.

Shane states that "countries may not be able to increase their rates of innovation simply by increasing the amount of money spent on research and development or industrial infrastructure; they also may need to change the values of their citizens to those that encourage innovative activity" [3, p. 59]. Consistent with this view, many empirical studies have documented a significant relationship between a nation's culture and its level of innovativeness. Using Hofstede's cultural values, such as individualism, power distance, uncertainty avoidance, or masculinity, these studies find that the cultural values affect innovation [4] - [9]. However, the empirical results of these relationships are inconclusive. For example, Natário et al. find that two cultural dimensions, including power distance and uncertainty avoidance, are related to innovation frameworks such as doctorates in science and engineering, business R&D expenses, and the level of collaboration for innovating [39]. In contrast, Cox and Khan find that individualistic, feminine, pragmatic, and indulgent societies will be more innovative than their counterparts, while power distance and uncertainty avoidance are not related to innovation capacity [9].

2.2. The role of family ties in economic exchanges and outcomes

Family ties constitute one of the significant social values since family is a fundamental social institution in society. In several subsequent studies, family ties are understood as the family bond in different types of families, ranging from nuclear to extended ones [13], [14], [15], [17]. These systems differ in how much intergenerational cooperation they involve and to what degree parental authority shapes family life. In nuclear families, children typically become independent from their parents and leave the household around marriage (or earlier). By contrast, extended families often include three co-residing generations who cooperate closely while remaining under the authority of the parental generation. In many other studies (e.g., [10], [11], [12]), the family-ties variable is measured based on subjective perception of the strength of family ties, mostly using the answers to some questions from the World Values Survey.

The organization of a family and the relationships within the family determine value formation, economic outcomes, and thus influence national institutions [11]. Early discussions of why family ties matter go back to Banfield's work in 1958. He argued that strong ties among family members promote a closer social network, whereas weak family ties encourage individuals to identify themselves with a wider community [29]. Empirical studies find the link between family ties and various social, political, and economic outcomes. Todd (1985) finds that different types of families are associated with levels of diffusion or resistance to important societal changes such as Protestantism or political ideology [13]. Other consequences of variance in family structure such as European employment rate [14]; establishment and growth of corporations [15]; regional disparities in household size, educational attainment, social capital, labor force participation, sectoral structure, wealth and inequality [16]; and urbanization [17]; the country-level choice of the type of pension system [18], have also been noted.

In sum, while there are many studies investigating the relationship between cultural values and innovation, to our knowledge, limited research has directly examined the role of family ties in national innovation capacity, although family ties may affect several factors that are associated with innovation capacity.

2.3. Hypothesis development

We expect that family ties are negatively related to innovation capacity across countries through three mechanisms: attitudes toward risk-taking, the meritocratic allocation of resources, and openness to external knowledge flows and collaboration.

First, investment aimed at generating innovation is inherently risky. Therefore, risk-taking and a stronger tolerance for uncertainty are critical for enhancing national innovation capacity. However, strong family ties may reduce individuals' incentives to take risks. In societies characterized by stronger family ties, social risks tend to be internalized within the family through the pooling and redistribution of resources across generations [19]. Younger generations generally receive substantial support from older family members, which can reduce the pressure to pursue uncertain opportunities and, consequently, may become an obstacle to innovation and the development of new ideas [10], [30]. In addition, family ties are negatively associated with social trust [20], whereas social trust encourages individuals to take risks, engage with others beyond close kinship networks, and learn through experience about the trustworthiness of their wider community [20], [40], [41], all of which foster innovation. Taken together, these arguments suggest that stronger family ties may be negatively associated with national innovation capacity.

Second, innovation requires not only sufficient investment in research, education, technology, and entrepreneurship, but also the efficient allocation of talent and productive resources. Prior studies show that the allocation of talented individuals has important consequences for innovation, productivity, and economic growth [21], [22]. From this perspective, innovation capacity depends on whether opportunities, finance, education, and managerial positions are allocated based on ability and productivity rather than family background or personal connections. In countries with stronger family ties, kinship networks may privilege family members and close relatives, while potentially excluding capable outsiders from access to key resources. Therefore, stronger family ties may lower national innovation capacity by distorting the merit-based allocation of talent and resources.

Third, innovation depends on the ability of individuals and organizations to access, recombine, and commercialize diverse knowledge, rather than merely on economic resources or general institutional development [23]. According to current literature, innovation emerges when different knowledge components are combined in new ways. Prior studies emphasize that openness to external collaboration and access to heterogeneous knowledge through direct and indirect networks are essential for recombining knowledge and thus creating innovation [24] - [28], [42], [43]. However, strong family ties may limit such openness. In societies characterized by strong family ties, individuals tend to trust and rely more heavily on family and kinship networks, whereas weaker family ties may encourage individuals to identify with and participate in broader social and professional communities [29], [30]. As a result, societies characterized by strong family ties may foster relatively closed networks that restrict interactions with external partners and limit access to diverse knowledge. This reduced openness to external collaboration can weaken knowledge recombination and, consequently, lower national innovation capacity.

Therefore, we propose the following hypothesis:

There is a negative relationship between family ties and national innovation capacity across countries.

3. Data and Measurement

3.1. Family ties

Following prior studies cited [11], [44], [45], we measure family ties using individual-level responses from the World Values Survey (WVS) [46] and European Value

Survey (EVS) [47]. We employ a family-values index based on five survey items aggregated at the country level as a proxy for family ties. The first item asks respondents to rate the importance of family in their lives on a scale from 1 ("very important") to 4 ("not important at all"). The second asks whether respondents agree with the statement: "Regardless of what the qualities and faults of one's parents are, one must always love and respect them," coded as 1 if they agree and 2 otherwise. The third item asks whether parents have responsibilities toward their children; responses are coded 1 if the respondent strongly agrees, 2 if agrees, and 0 if disagrees. The fourth asks whether independence is an important quality for children, coded as 1 if the respondent agrees and 0 otherwise. The fifth asks whether obedience is an important child quality, coded as 1 if the respondent agrees and 0 otherwise. Next, for each country, we compute the mean response to each item across individuals to obtain five country-level item means used to construct the family-ties measure. We report the average value of each item by country in Appendix 1.

We construct the family-ties variable using two approaches adopted from prior studies. The first approach extracts the first principal component from a principal component analysis of the five country-level family-value measures, denoted *Fties_I*. The second approach calculates the average of the five normalized measures, denoted *Fties_II*. For the second measure, we first recode the first four items so that higher values consistently indicate stronger family ties. Because the five survey items use different response scales, ranging from 1-4, 1-2, and 0-2, we normalize all five variables to a common 0-1 scale before calculating the average.

We collect data from the last four waves. First, we use the World Values Survey time-series dataset for 1981-2022, which combines data from the WVS and EVS across seven waves. We retain observations from 1999 onward, beginning with WVS Wave 4 and the corresponding EVS Wave 3. Although the WVS and EVS are broadly compatible, they differ in country coverage, wave coverage, and question availability. Therefore, it is necessary to combine data from these two datasets and from several waves. For example, the second and third items used to construct the family-ties measure are available only in WVS Waves 4 and 5 and EVS Waves 3 and 4. Consistent with prior studies, we construct family ties as a time-invariant variable at the country level. Therefore, although the dependent variable covers the 2020-2023 period, the family-ties measure constructed from survey data covering 1999-2022 remains appropriate for the analysis. Bertrand and Schoar suggest that family ties are relatively stable over time [44].

3.2. National Innovation Capacity

National innovation capacity refers to a country's ability to generate, absorb, and commercialize new knowledge, technologies, products, and processes over time [1]. Early empirical studies often measured innovation using single indicators, such as patent counts or research and development (R&D) expenditure [33]. However, both indicators have important limitations. Patent measures capture only codified innovation, which is affected by differences in patenting practices and strategic patenting behaviors. R&D expenditure reflects innovation inputs rather than outcomes and may not adequately capture differences in innovation efficiency across countries [33]. Recognizing these limitations, more recent research conceptualizes national innovation capacity as a multidimensional construct shaped by institutions, policies, and productive capabilities [1]. Accordingly, several composite innovation indicators, such as the EIS, GII, NII-CASTED, and the innovation pillar of the Global Competitiveness Report, have been developed to capture multiple dimensions of innovation systems. While these measures provide broader coverage of innovation-related factors, they may also be sensitive to indicator selection and weighting methodologies.

Following Sweet and Maggio, this study employs the Economic Complexity Index as a structural proxy for innovation-related productive capabilities [33]. ECI captures the productive knowledge embedded in a country's export structure and reflects its ability to combine and apply capabilities in the production of sophisticated goods [32]. ECI is constructed from two key concepts: diversity and ubiquity. Diversity refers to the range of products a country exports, while ubiquity captures the number of countries capable of producing those products. Economies with high ECI scores tend to export a diverse set of products that few other countries can produce, indicating the presence of complex productive capabilities. As Hausmann et al. argued, "what countries make reveals what they know" [32], ECI provides a useful structural indicator of the productive capabilities that underpin innovation.

Compared with conventional innovation indicators, ECI offers several advantages for cross-country analysis. First, it captures realized productive capabilities rather than innovation inputs or legal protection outcomes alone. Second, it reflects broader forms of innovation, including tacit knowledge, process improvements, and capability accumulation that may not be observable through patent statistics [32]. Third, because it is derived from observable trade data, it avoids some of the subjectivity associated with composite innovation indices. ECI is also strongly correlated with conventional indicators of innovation performance, including R&D expenditure, the share of researchers in the labor force, and patenting activity [33], supporting its validity as a structural proxy for innovation-related productive capabilities.

Nevertheless, ECI has several limitations [32]. Because it is derived from international trade data, it reflects export structures rather than a country's full domestic production capabilities. In addition, ECI captures only tradable goods and does not account for services, non-tradable activities, informal innovation, or innovation that do not appear in export structures. Accordingly, ECI should be interpreted as a structural proxy for innovation-related productive capabilities embedded in export activities rather than a comprehensive measure of national innovation capacity.

Data on ECI are obtained from the Observatory of Economic Complexity (OEC), which calculates the index

using international trade data from the UN COMTRADE database. Annual country-level ECI scores for the period 2020-2023 are employed in this empirical analysis. Using data over multiple years allows us to mitigate the potential influence of short-term fluctuations in these variables. Because we are unable to construct a time-varying proxy for family ties, our empirical results should be interpreted as reflecting cross-country variation rather than within-country changes over time.

3.3. Control variables

Motivated by prior works [1], [39], [48], [49], [50], this paper includes a set of macroeconomic and institutional control variables that may influence countries' innovation capacity. These controls include intellectual property rights protection *(ipr)*, trade openness *(open),* quality of political institutions *(democra* and *rle),* economic development *(lnGNI),* income inequality *(inequality),* and country land area *(lnLand).* Data for these control variables are primarily obtained from the World Bank databases for the period 2020-2023 [51]. The missing GNI per capita data are collected manually from the Trading Economics website. The measure of political institutions *(democra)* is drawn from the Polity IV project of Marshall and Jaggers [52], while the measure of intellectual property rights protection is drawn from the Property Rights Alliance's database [53].

Intellectual property rights protection *(ipr):* Intellectual property rights protection refers to the extent to which intellectual property is legally safeguarded against infringement. This paper employs the IPR index, ranging from 0 to 10, with higher values indicating stronger protection of intellectual property rights, and developed by the Property Rights Alliance for the period 2020-2023. Stronger intellectual property protection is widely considered to promote innovation by providing incentives for knowledge creation, technological development, and investment in research and development [46], [54].

Quality of political institutions (*democra and rle*): Political institutional quality is captured using two indicators: democracy and rule of law. Democracy *(democra)* is measured using the Polity IV index developed by Marshall and Jaggers, which ranges from -10 (full autocracy) to +10 (full democracy) [52]. This index is widely used in empirical research to assess the quality of political institutions and regime characteristics [55], [56]. Rule of law *(rle)* is commonly used as a proxy for the effectiveness of formal institutions [56]. The rule of law index is derived from the Worldwide Governance Indicators constructed by Kaufmann et al. and reported by the World Bank [57]. According to the World Bank, this index captures the extent to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement, property rights protection, and the effectiveness of the legal system [51].

Trade openness *(open)*: Trade openness is measured as the ratio of total trade to GDP. This variable reflects a country's integration into the global economy. Greater openness may facilitate innovation by increasing exposure to international knowledge flows, technological diffusion, and competitive pressures in global markets [58].

Country land area *(lnLand):* This variable controls for the availability of natural resources, which can influence a country's production structure and innovation pathways [46]. We then take the logarithmic transformation of land area to create the *lnLand* variable.

Economic development *(lnGNI):* Economic development is captured by the logarithmic transformation of Gross National Income per capita (*lnGNI*). Higher income levels are generally associated with stronger human capital accumulation, greater investment in research and development, and more advanced technological capabilities, all of which support higher levels of innovation capacity [56].

Income inequality *(inequality):* Income inequality is measured using the Gini coefficient. Inequality may influence national innovation capacity by shaping the distribution of resources, access to education, and opportunities for human capital development across society [59].

Continent dummy: Continent fixed effects are also included to capture regional similarities among countries, such as shared cultural roots, legal origins, and patterns of human migration. Therefore, we classify countries into six regional groups: Europe, Asia, Africa, North America, South America, and Oceania.

4. The empirical model specification

To examine the relationship between family ties and national innovation capacity, we estimate a series of ordinary least squares (OLS) regressions using data for the period 2020-2023, with standard errors clustered at the country level. The baseline empirical model is specified as follows, i indexes countries and t indexes years:

$$ECI_{it} = \alpha + \beta Fties_i + \gamma X_{it} + \theta \mathrm{lnLand}_i + \pi f_j + \varepsilon_{it}.$$

ECI_{it} is the Economic Complexity Index of country i in year t, which is used as a structural proxy for national innovation-related productive capabilities. $Fties_i$ captures the strength of family ties in country i, which is treated as time invariant (*Fties_I* or *Fties_II*). The coefficient of interest is β, which measures the relationship between family ties and innovation capacity after accounting for control variables such as macroeconomic and formal institutional determinants. Because the family ties variable is time invariant, our analysis captures cross-country differences in innovation capacity associated with variation in family ties across countries, rather than within-country changes in innovation capacity over time.

X_{it} denotes a vector of control variables for country (i) in year (t), including intellectual property rights protection *(ipr)*, trade openness *(open),* quality of political institutions *(democra* and *rle),* economic development *(lnGNI),* income inequality *(inequality*). Country land area (lnLand) is included separately because it is time-invariant. f_j denotes a vector of fixed effects including year fixed effects and continent fixed effects, and ε_{ij} is the error term. Year fixed effects are included to account for global shocks, technological trends, and time-specific factors that affect all countries simultaneously. The inclusion of continent fixed effects helps mitigate concerns related to

broad regional heterogeneity. However, the model may still be subject to omitted-variable bias arising from unobserved country-level factors, such as human capital, R&D capacity, or other institutional characteristics.

5. Results

5.1. Summary of statistics

Table 1 reports descriptive statistics over the four-year period of all variables by country. The average level of national innovation capacity, measured by the Economic Complexity Index (*ECI*), is 0.547, with values ranging from -1.024 to 2.140, indicating substantial cross-country variation in innovation capabilities. *Fties_I (Fties_II)* exhibit a mean of -0.195 (0.686) and range from -4.081 to 2.924 (0.487 to 0.837), suggesting dispersion in the strength of bonding within families across countries. Control variables also display considerable variation. Economic development, trade openness, and institutional quality vary widely, reflecting a diverse sample of both developed and developing economies.

Table 1. *Summary of statistics*

Country	Freq	Fties_I (PCA)	Fties_II (average)	ECI	ipr	lnGNI	Open	lnLand	democra	inequality	rle
Albania	4	1.300	0.753	-0.295	4.15	8.64	75.58	10.22	6.22	0.294	53.77
Algeria	4	1.777	0.799	-0.968	3.99	8.45	45.53	14.68	3.72	0.276	43.79
Argentina	4	0.154	0.704	0.034	4.76	9.43	30.37	14.82	6.81	0.407	52.13
Armenia	4	0.604	0.732	-0.140	4.47	8.41	92.57	10.26	5.47	0.272	54.26
Australia	4	-0.382	0.665	-0.310	7.83	11.03	45.00	15.86	8.81	0.343	83.20
Austria	4	-2.716	0.556	1.557	7.93	10.71	113.04	11.32	8.18	0.305	86.07
Bangladesh	4	-0.175	0.662	-1.024	3.21	9.01	29.69	11.78	5.96	0.329	40.84
Belgium	4	-0.107	0.699	1.244	7.56	10.67	173.82	10.33	7.58	0.264	80.50
Brazil	4	1.618	0.796	0.332	5.48	9.07	35.66	15.94	6.81	0.515	49.55
Canada	4	-0.587	0.661	0.910	7.43	10.72	64.58	15.99	8.92	0.317	82.99
Chile	4	1.188	0.761	-0.209	6.10	9.54	64.74	13.52	8.10	0.450	69.46
China	4	-2.625	0.581	1.112	6.28	9.43	36.93	16.05	2.14	0.357	47.65
Colombia	4	1.622	0.798	0.199	5.41	8.79	40.67	13.92	6.70	0.528	48.00
Croatia	4	-0.592	0.671	0.774	5.30	9.65	106.19	10.93	6.50	0.291	63.94
Denmark	4	-3.430	0.487	1.120	7.43	11.03	118.79	10.60	9.20	0.281	91.41
El Salvador	4	2.695	0.825	-0.046	4.28	8.26	79.35	9.94	5.35	0.388	43.20
Finland	4	-2.433	0.586	1.469	7.64	10.74	82.86	12.62	9.27	0.276	92.22
France	4	0.061	0.710	1.368	7.31	10.56	67.24	13.21	8.03	0.313	75.13
Georgia	4	0.514	0.696	0.014	3.99	8.54	104.08	11.15	5.21	0.339	60.53
Germany	4	-3.171	0.543	1.844	7.63	10.72	81.25	12.76	8.74	0.324	84.63
Greece	4	-0.806	0.659	0.345	5.49	9.86	89.54	11.77	7.77	0.331	64.72
Hungary	4	-1.131	0.628	1.431	6.47	9.61	164.42	11.42	6.61	0.293	61.52
India	4	0.979	0.746	0.579	5.39	7.60	44.77	14.91	6.94	0.355	54.88
Indonesia	4	0.782	0.702	0.006	4.50	8.25	39.99	14.45	6.56	0.356	54.80
Ireland	4	-0.065	0.689	1.266	7.37	11.04	235.97	11.14	9.09	0.299	83.51
Italy	4	-0.333	0.679	1.303	6.61	10.39	63.13	12.60	7.70	0.349	67.15
Japan	4	-3.184	0.538	2.140	7.73	10.52	40.03	12.81	8.25	0.329	83.05
Lithuania	4	-4.081	0.551	0.810	5.95	9.75	153.82	11.04	7.23	0.365	78.08
Mexico	4	1.241	0.767	1.112	6.06	9.18	80.37	14.48	5.51	0.440	39.02
Moldova	4	-0.306	0.705	-0.121	4.84	8.23	93.40	10.40	6.09	0.258	52.58
Morocco	4	1.401	0.765	-0.403	5.95	8.08	84.82	13.01	5.04	0.395	50.07
Netherlands	4	-3.033	0.556	1.075	7.39	10.80	166.35	10.42	8.96	0.258	87.32
New Zealand	4	-1.353	0.614	0.434	7.08	10.63	49.41	12.48	9.46	0.257	86.77
Norway	4	-2.368	0.526	0.572	7.11	11.42	74.71	12.81	9.80	0.277	91.58
Pakistan	4	2.265	0.817	-0.605	4.42	7.39	28.84	13.56	4.00	0.296	41.68
Peru	4	1.553	0.801	-0.656	5.23	8.74	51.92	14.06	6.09	0.411	48.71
Philippines	4	1.581	0.740	0.693	5.40	8.21	65.37	12.61	6.64	0.374	46.04
Poland	4	0.600	0.735	1.120	5.99	9.68	110.91	12.63	6.97	0.285	63.77
Portugal	4	0.266	0.729	0.543	6.64	9.95	89.38	11.43	7.86	0.346	76.59
Romania	4	-0.134	0.690	1.044	6.34	9.43	85.31	12.35	6.43	0.340	64.57
Serbia	4	0.248	0.703	0.739	4.78	8.90	114.77	11.34	6.31	0.336	54.09
Slovenia	4	-1.210	0.625	1.510	6.07	10.09	163.99	9.91	7.65	0.242	73.12
South Africa	4	1.163	0.747	0.061	6.22	8.67	59.19	14.01	7.05	0.630	57.54
Spain	4	0.399	0.731	0.851	6.73	10.21	69.20	13.12	8.05	0.341	73.28
Sweden	4	-2.552	0.532	1.591	7.63	10.92	96.71	12.92	9.33	0.295	87.26
Switzerland	4	-2.096	0.591	1.988	7.58	11.33	132.61	10.58	9.00	0.337	87.81
Uganda	4	2.229	0.829	-0.802	4.46	6.80	36.64	12.21	4.62	0.427	44.49
Uruguay	4	0.127	0.698	0.087	5.19	9.76	53.52	12.07	8.76	0.426	73.19
Zimbabwe	4	2.924	0.837	-0.893	3.81	7.13	53.43	12.87	3.01	0.503	35.13
Total	**196**	**-0.195**	**0.686**	**0.547**	**5.97**	**9.52**	**83.27**	**12.56**	**7.03**	**0.347**	**65.01**

5.2. Correlation matrix

Table 2 reports the pairwise correlations among the variables used in the analysis. Overall, the results indicate that the family-ties variable is negatively correlated with national innovation capacity (*ECI*) ($r = -0.69$, p-value < 0.01), providing preliminary support for the hypothesized negative relationship between strong family ties and national innovation capacity. ECI is strongly correlated with other control variables. The table also shows the strong and significant correlations between *Fties_I* and control variables such as *ipr (*-0.63*), lnGNI (*-0.76*), rle (*-0.77), and *democra (*-0.57). The correlation coefficients among several pairs of control variables are also very high and significant, such as *rle* and *ipr* (0.80), *rle* and *lnGNI* (0.89), and *democra* and *lnGNI* (0.81). These high correlations raise potential multicollinearity concerns.

Table 2. *Correlation matrix*

	ECI	Fties_II (average)	Fties_I (pca)	ipr	lnGNI	open	lnland	democra	inequality	rle
ECI	1.00									
Fties_II (average)	-0.68	1.00								
	0.00									
Fties_I (PCA)	-0.69	0.98	1.00							
	0.00	0.00								
ipr	0.73	-0.62	-0.63	1.00						
	0.00	0.00	0.00							
lnGNI	0.71	-0.76	-0.76	0.79	1.00					
	0.00	0.00	0.00	0.00						
open	0.49	-0.36	-0.38	0.34	0.42	1.00				
	0.00	0.00	0.00	0.00	0.00					
lnland	-0.19	0.23	0.22	0.03	-0.12	-0.64	1.00			
	0.01	0.00	0.00	0.65	0.10	0.00				
democra	0.55	-0.60	-0.57	0.69	0.81	0.32	-0.16	1.00		
	0.00	0.00	0.00	0.00	0.00	0.00	0.02			
inequality	-0.34	0.50	0.49	-0.24	-0.42	-0.42	0.44	-0.27	1.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
rle	0.66	-0.78	-0.77	0.80	0.89	0.44	-0.23	0.87	-0.46	1.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

5.3. Family Ties and National Innovation Capacity

The estimation, shown in Table 3, begins with a baseline model that includes only family ties (*Fties_I* or *Fties_II*), year fixed effects, and continent fixed effects (Models 1 and 3). We then estimate a full specification that incorporates the complete set of control variables (Models 2 and 4).

The coefficients of the family-ties variables in Models 1 and 3 are negative and highly significant, with $\beta = -0.236$ and -4.432, respectively, with p-values below 0.01. This indicates that stronger family ties are associated with lower national innovation capacity. This finding provides initial support for our hypothesis, suggesting that societies characterized by strong kinship-based social structures tend to exhibit lower levels of innovation capacity. The coefficients of the family-ties variables in Models 2 and 4 remain negative and statistically significant, with $\beta = -0.099$ and -1.838, respectively, with p-values below 0.01 after adding control variables.

Table 3. *Family ties and national innovation capacity*

Model	(1) Fties PCA_based measure - baseline	(2) Fties_ PCA based measure - full controls	(3) Fties Average measure - baseline	(4) Fties Average measure - full controls
VARIABLES	ECI	ECI	ECI	ECI
Fties_I	-0.236***	-0.099***		
	(-7.14)	(-3.20)		
Fties_II			-4.432***	-1.838***
			(-7.00)	(-3.45)
ipr		0.295***		0.301***
		(5.84)		(6.04)
lnGNI		0.097		0.082
		(1.05)		(0.90)
open		0.002**		0.002**
		(2.20)		(2.24)
lnLand		0.023		0.025
		(0.84)		(0.91)
democra		-0.002		-0.024
		(-0.06)		(-0.66)
inequality		1.822***		1.876***
		(3.42)		(3.62)
rle		-0.005		-0.003
		(-0.70)		(-0.46)
Year_2021	0.022	0.069	0.022	0.071
	(0.20)	(0.83)	(0.20)	(0.85)
Year_2022	0.029	0.078	0.029	0.082
	(0.28)	(0.96)	(0.28)	(1.02)
Year_2023	0.030	0.043	0.030	0.046
	(0.28)	(0.52)	(0.28)	(0.55)
Continent_2	0.481***	0.868***	0.444***	0.877***
	(3.44)	(9.21)	(3.28)	(8.72)
Continent_3	0.929***	0.954***	0.955***	1.009***
	(6.90)	(6.01)	(7.29)	(6.61)
Continent_4	1.075***	0.852***	1.063***	0.889***
	(8.23)	(6.06)	(7.80)	(6.51)
Continent_5	0.011	-0.172	-0.029	-0.138
	(0.07)	(-0.62)	(-0.19)	(-0.49)
Continent_6	0.364***	0.257*	0.407***	0.323**
	(3.38)	(1.71)	(3.95)	(2.21)
Observations	196	196	196	196
R-squared	0.6296	0.8016	0.6222	0.8001

*T-statistics reported in parentheses are based on clustered standard errors at the country level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

In terms of economic significance, we focus on the full model specifications reported in Models 2 and 4. In Model 2, the coefficient of *Fties_I* is -0.099, indicating that a one-unit increase in family ties is associated with a 0.099-point decrease in the Economic Complexity Index (*ECI*), holding other factors constant. Since the family-ties measure ranges from -4.081 to 2.924, moving from the lowest to the highest level of family ties implies a decrease in *ECI* of approximately 0.693 points [-0.099 × (2.924 - (-4.081))]. This effect is economically substantial. It is larger than the sample mean of ECI, which is 0.547, and accounts for approximately 21.9% of the total observed range of *ECI*, from -1.024 to 2.140. These results suggest that stronger family ties are not only

statistically significant but also economically meaningful in explaining cross-country differences in national innovation capacity. A similar level of economic significance is observed in Model 4.

The magnitude of these coefficients decreases after the inclusion of control variables, suggesting that part of the relationship between family ties and innovation capacity may operate through economic and institutional channels. The explanatory power of the models ranges from approximately 60% in baseline models to 80% in full models, indicating that the included variables account for a substantial proportion of the cross-country variation in national innovation capacity.

Regarding the control variables, the coefficients of intellectual property protection, income inequality, and trade openness are positive and statistically significant, which is consistent with prior literature. By contrast, the coefficients of other control variables, including GNI per capita, rule of law, land area, and democracy, are not statistically significant. However, as discussed in Section 5.2, the control variables are highly correlated with others and with the independent variable. Such multicollinearity may affect both the estimated signs and the statistical significance of the coefficients. As the sign and the level of significance of *Fties_I* or *Fties_II* remain the same in baseline and full models, the concern that multicollinearity may change the impact of family ties on national innovation may not be a serious problem. However, because the family-ties variable is our key independent variable, we address potential multicollinearity concerns in Section 5.4.1.

5.4. Robustness checks

5.4.1. Multicollinearity

As discussed in Section 5.2, Correlation matrix, our model may face multicollinearity due to high correlation among variables. In this section, we run VIF tests for Models 2 and 4 in Table 3. The VIF values in Model 2 (and the results are highly similar in Model 4, and thus we do not report VIF results for this model) for the *rle*, *lnGNI*, EU region (continent dummy), and *democra* are high (15.05, 8.85, 8.76, 7.08), which are consistent with the high correlation coefficients reported in Table 2.

To address the multicollinearity problems, we run alternative regressions reported in Table 4. We drop *rle* in Model 1, *lnGNI* in Model 2, *democra* in Model 3, EU countries in Model 4, and all four variables in Model 5. It should be noted that the signs and significance levels of several control variables, including GNI per capita, trade openness, rule of law, and democracy, change across model specifications. Such instability suggests that multicollinearity among the control variables may be a concern. However, the coefficients on the *Fties_I* measure are all negative and significant with p-values <0.01. The results indicate that the negative relationship between family ties and national innovation capacity across countries is robust.

Table 4. *Addressing the multicollinearity concerns*

Model	(1) Excluding rule of law	(2) Excluding log GNI per capita	(3) Excluding democracy	(4) Excluding European countries	(5) Excluding four highly collinear control variables
VARIABLES	ECI	ECI	ECI	ECI	ECI
Fties_I	-0.089***	-0.112***	-0.099***	-0.344***	-0.202***
	(-3.07)	(-3.43)	(-3.20)	(-4.60)	(-4.11)
ipr	0.283***	0.305***	0.295***	0.291***	0.280***
	(5.57)	(6.24)	(5.84)	(4.64)	(4.41)
lnGNI	0.078		0.097	-0.278**	
	(1.01)		(1.05)	(-2.35)	
open	0.002**	0.002**	0.002**	0.003	0.001
	(2.12)	(2.47)	(2.20)	(1.09)	(0.51)
lnland	0.026	0.032	0.023	0.008	-0.006
	(1.04)	(1.30)	(0.84)	(0.26)	(-0.20)
democra	-0.027	0.003	-0.002		
	(-1.38)	(0.08)	(-0.06)		
inequality	1.967***	1.757***	1.822***	2.090***	2.164***
	(4.00)	(3.13)	(3.42)	(3.58)	(3.88)
rle		-0.003	-0.005		
		(-0.41)	(-0.70)		
Year dummy	Yes	Yes	Yes	Yes	Yes
Continent dummy	Yes	Yes	Yes	Yes	Yes
Observations	196	196	196	100	100
R-squared	0.8008	0.7994	0.8016	0.8019	0.7854

*T-statistics reported in parentheses are based on clustered standard errors at the country level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

5.4.2. Controlling for other cultural values, social trust, or excluding 2020 and 2021

Prior research suggests that cultural values regarding hierarchy, individual autonomy, uncertainty tolerance, and gender roles shape knowledge creation, risk-taking, and cooperation, all of which are essential for innovation processes [3], [8], [17], [43]. Hofstede's cultural dimensions, including individualism (IDV), power distance (PD), masculinity (or Motivation towards Achievement and Success-MAS), and uncertainty avoidance (UAI), are among the most widely used country-level indicators in comparative studies. These dimensions capture persistent informal institutions that may influence both family structures and innovation capacity, raising the possibility that the estimated effect of family ties reflects broader cultural characteristics rather than kinship-based social organization per se. The results in Model 1 of Table 5, remain qualitatively consistent with the main findings, indicating that the relationship between strong family ties and lower national innovation capacity persists after controlling for Hofstede's cultural dimensions.

Social trust captures the extent to which individuals trust people outside their immediate family and close networks [38], [39]. This variable is close but theoretically distinct from family ties, which represent bonding social capital rooted in kinship networks. Prior literature suggests that strong family ties often substitute for

generalized trust in societies with limited institutional development [39], [43]. Consequently, the observed effect of family ties on innovation capacity could potentially reflect low levels of societal trust rather than the influence of kinship-based social structures. Table 5 shows that the coefficient on social trust is statistically insignificant in Model 2, while positive and significant in Model 3 when both Hofstede's cultural dimensions and social trust variables are added. At the same time, the magnitude and significance of the family ties coefficient remain largely unchanged after including social trust, reinforcing the interpretation that the negative relationship between the family-ties variable and innovation capacity is not reducible to broader societal trust.

Model 4 reports the results after excluding 2020 and 2021 to mitigate the potential effect of the COVID-19 pandemic. The negative relationship between Fties and ECI remains unchanged, indicating that the association between family ties and innovation capacity is robust.

Table 5. *Controlling for other cultural values, social trust, or excluding 2020 and 2021*

Model	(1) Controlling for Hofstede cultural dimensions	(2) Controlling for generalized social trust	(3) Controlling for cultural dimensions and social trust	(4) Excluding 2020-2021
VARIABLES	ECI	ECI	ECI	ECI
Fties_I	-0.140***	-0.102***	-0.123***	-0.103**
	(-4.77)	(-2.80)	(-4.42)	(-2.62)
ipr	0.234***	0.297***	0.206***	0.431***
	(5.30)	(5.51)	(4.65)	(4.96)
lnGNI	0.022	0.094	0.044	0.012
	(0.24)	(0.98)	(0.50)	(0.10)
open	0.002**	0.002**	0.004***	0.002
	(2.13)	(2.06)	(2.87)	(1.54)
lnLand	0.042	0.025	0.050	0.022
	(1.34)	(0.92)	(1.63)	(0.57)
democra	0.006	-0.003	0.040	0.036
	(0.14)	(-0.07)	(0.82)	(0.67)
inequality	1.457**	1.805***	1.371**	1.310
	(2.17)	(3.37)	(2.16)	(1.63)
rle	0.008	-0.005	0.004	-0.012
	(0.88)	(-0.61)	(0.45)	(-1.13)
IDV	0.002		0.000	
	(0.90)		(0.01)	
PD	0.007***		0.008***	
	(3.26)		(3.83)	
MAS	0.009***		0.010***	
	(4.07)		(4.88)	
UAI	0.001		0.003	
	(0.43)		(1.17)	
socialtrust		-0.001	0.007***	
		(-0.26)	(3.19)	
Year dummy	Yes	Yes	Yes	Yes
Continent dummy	Yes	Yes	Yes	Yes
Observations	188	196	188	98
R-squared	0.8217	0.8017	0.8287	0.8002

*T-statistics reported in parentheses are based on clustered standard errors at the country level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

5.4.3. Another measure of national innovation capacity: GII

To further assess the robustness of the results, Table 6 reports specifications in which ECI is replaced by the Global Innovation Index (GII), a multidimensional measure of national innovation capacity. In Model 1, we estimate a baseline model that includes only the family-ties variable, year dummies, and continent dummies as independent variables. The coefficient of family ties is negative and statistically significant. However, in the fully specified model reported in Model 2, the coefficient becomes insignificant at the 10% level.

Table 6. *Robustness checks using the Global Innovation Index (GII)*

Model	(1) Baseline	(2) Full controls	(3) Excluding rule of law	(4) Excluding four highly collinear controls
VARIABLES	GII	GII	GII	GII
Fties_I	-4.079***	-0.609	-1.104***	-4.116***
	(-7.54)	(-1.33)	(-3.12)	(-10.98)
ipr		2.453***	2.545***	1.531***
		(2.88)	(2.85)	(2.76)
lnGNI		5.448***	6.208***	
		(4.22)	(5.12)	
open		0.010	0.009	0.060**
		(0.88)	(0.79)	(2.07)
lnland		1.269**	1.355**	2.263***
		(2.16)	(2.34)	(7.16)
democra		-1.026	-0.085	
		(-1.53)	(-0.24)	
inequality		-11.221	-17.942**	-8.225
		(-1.17)	(-2.38)	(-1.42)
rle		0.187*		
		(1.97)		
Year dummy	Yes	Yes	Yes	Yes
Continent dummy	Yes	Yes	Yes	Yes
Observations	128	128	128	52
R-squared	0.6967	0.8966	0.8939	0.9695

*T-statistics reported in parentheses are based on clustered standard errors at the country level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

To examine whether this instability is driven by multicollinearity, we conduct a VIF test. The results show that the VIF values for rule of law, GNI per capita, the Europe regional dummy, and democracy are exceptionally high, at 24.96, 12.55, 12.55, and 10.89, respectively, whereas the VIF values for the remaining variables are below 6. Therefore, Models 2, 3, and 4 present selected regression results after excluding either the rule of law variable or all four highly collinear variables (The results obtained after excluding each of the other highly collinear variables individually are available upon request). The results are qualitatively similar when other individual variables among these four variables are excluded. In these alternative specifications, the coefficients of *Fties_I* remain negative and statistically significant.

Overall, these findings indicate that the negative relationship between family ties and national innovation capacity is robust to alternative measurements of innovation capacity and to different model specifications addressing multicollinearity concerns.

6. Conclusion

Vietnam aspires to become a highly developed country in the coming decades. Achieving this ambition requires strengthening innovation at the national level. Accordingly, a growing body of research has examined innovation from various perspectives (such as [39], [43]). This study examines the relationship between family ties and national innovation capacity across countries, using a sample of 49 countries for which relevant data are available. In doing so, the study aims not only to contribute to the theoretical understanding of how informal institutions shape national innovation capacity but also to draw relevant policy implications and lessons for Vietnam as it seeks to strengthen its innovation capacity and achieve its long-term development ambitions.

The results consistently show that stronger family ties are associated with lower levels of national innovation capacity. This study contributes to the literature by identifying family ties as a specific informal institution that is associated with national innovation capacity, distinguishing bonding family-based social capital from bridging social capital, and employing the Economic Complexity Index to capture productive capabilities rather than relying on innovation-output measures. From a policy perspective, the findings suggest that promoting innovation requires not only investment in fundamental factors such as technological capabilities, formal institutions, and human capital but also attention to informal institutional environments that facilitate open collaboration, encourage risk-taking behavior, and support meritocratic allocation of resources.

Several limitations should be acknowledged. First, omitted-variable bias and potential endogeneity may affect the estimated relationship between family ties and national innovation capacity. Second, family ties are treated as a time-invariant cultural characteristic, which limits the ability to examine how changes in the strength of family ties may influence innovation over time. Third, the ECI captures productive capabilities embedded in export structures rather than innovation directly. Therefore, it may not fully reflect services, non-tradable innovation, informal innovation, or innovative activities that do not appear in export data.

This study could be extended by employing micro-level analyses at the firm, industry, or regional level to provide deeper insights into the mechanisms linking family ties, collaboration patterns, and innovation behavior. In addition, future studies could examine how family ties interact with other formal and informal institutional factors in shaping national innovation capacity.

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APPENDIX 1

Country	A001	A025	A026	A029	A042	N_A001	N_A025	N_A026	N_A029	N_A042
Albania	1.05	1.14	1.23	0.33	0.37	4948	3383	3420	4967	4967
Algeria	1.08	1.07	1.29	0.28	0.52	2472	1254	1259	2482	2482
Argentina	1.12	1.21	1.28	0.41	0.32	6390	4174	4032	7401	7401
Armenia	1.09	1.07	1.32	0.28	0.20	7305	3456	3416	7315	7297
Australia	1.10	1.26	1.31	0.52	0.30	6734	1998	2034	7987	7987
Austria	1.19	1.42	1.42	0.68	0.15	4662	2781	2904	4648	4621
Bangladesh	1.04	1.10	1.36	0.58	0.18	4223	3008	2990	4225	4225
Belgium	1.15	1.33	1.28	0.38	0.40	3402	3333	3386	3416	3416
Brazil	1.13	1.09	1.20	0.28	0.49	7668	2906	2916	7673	7673
Canada	1.16	1.21	1.23	0.55	0.23	8101	1909	1911	8113	8113
Chile	1.10	1.13	1.24	0.39	0.48	6682	3666	3681	6700	6700
China	1.23	1.17	1.52	0.71	0.12	10748	3429	3395	10813	10813
Colombia	1.16	1.09	1.14	0.30	0.51	9056	2987	2994	12082	12082
Croatia	1.20	1.30	1.17	0.47	0.28	5182	3560	3563	4065	4023
Denmark	1.14	1.65	1.38	0.79	0.12	5882	2439	2451	5843	5843
El Salvador	1.04	1.06	1.13	0.36	0.62	1251	1248	1243	1254	1254
Finland	1.19	1.45	1.51	0.56	0.26	5335	3871	3915	5346	5346
France	1.15	1.25	1.28	0.33	0.32	5982	3036	3104	5978	5978
Georgia	1.07	1.07	1.17	0.53	0.19	8393	3481	3485	8352	8308
Germany	1.23	1.41	1.47	0.70	0.13	13876	5750	6030	13916	13916
Greece	1.14	1.21	1.37	0.47	0.21	3836	2586	2599	3833	3833
Hungary	1.13	1.24	1.36	0.69	0.30	5680	4536	4480	7124	7096
India	1.11	1.14	1.26	0.60	0.64	14265	6355	6347	14313	14313
Indonesia	1.02	1.10	1.25	0.68	0.42	6202	987	973	6215	6215
Ireland	1.10	1.33	1.34	0.54	0.52	2009	1852	1943	1762	1632
Italy	1.10	1.20	1.39	0.44	0.26	6793	3358	3456	6777	6782
Japan	1.11	1.27	1.80	0.66	0.05	8208	3757	4010	9523	9523
Lithuania	1.37	1.21	1.69	0.75	0.18	4934	3320	3357	4870	4861
Mexico	1.10	1.16	1.27	0.36	0.52	9857	6208	6176	11714	11713
Moldova	1.22	1.10	1.27	0.46	0.30	4571	3489	3487	4551	4520
Morocco	1.09	1.02	1.22	0.45	0.43	4846	1246	1246	4851	4851
Netherlands	1.25	1.61	1.41	0.56	0.24	9921	2509	2530	9947	9935
New Zealand	1.08	1.36	1.46	0.53	0.22	3984	1130	1073	4053	4052
Norway	1.11	1.57	1.23	0.88	0.22	4363	2192	2209	4359	4359
Pakistan	1.10	1.06	1.09	0.23	0.46	5923	2724	2707	5928	5928
Peru	1.16	1.08	1.19	0.29	0.52	6816	2675	2659	6822	6822
Philippines	1.02	1.05	1.10	0.59	0.40	4800	2394	2398	4800	4800
Poland	1.10	1.13	1.35	0.35	0.35	7983	3626	3614	6981	6921
Portugal	1.19	1.15	1.20	0.34	0.30	3764	2504	2530	3738	3739
Romania	1.13	1.15	1.28	0.41	0.19	9968	3786	3741	9739	9718
Serbia	1.10	1.20	1.27	0.50	0.38	7731	3891	3932	7700	7702
Slovenia	1.17	1.19	1.27	0.77	0.28	6532	3272	3284	6401	6398
South Africa	1.08	1.12	1.22	0.45	0.44	15135	10010	9897	16786	16786
Spain	1.15	1.19	1.26	0.37	0.40	10207	6406	6518	10212	10206
Sweden	1.11	1.58	1.33	0.69	0.13	7604	3963	4058	7618	7617
Switzerland	1.17	1.34	1.42	0.60	0.17	8242	3565	3807	8204	8204
Uganda	1.12	1.09	1.19	0.32	0.69	1002	988	999	1002	1002
Uruguay	1.11	1.23	1.26	0.49	0.37	3995	972	981	4000	4000
Zimbabwe	1.04	1.04	1.12	0.35	0.64	3715	997	1000	3717	3717
Total	1.13	1.22	1.30	0.49	0.34	6554.7	3203.4	3227.3	6737.1	6728.4