

CONVERGENCE, DIVERGENCE, AND NETWORKS IN THE AGE OF GLOBALIZATION A SOCIAL NETWORK ANALYSIS APPROACH TO IPE

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ABSTRACT. National economies are not randomly distributed in the global economy, but embedded in complex networks of trade, financial flows, and international organizations. This research uses this insight to address the Convergence-Divergence debate by focusing on how network structures at the international level affect domestic policy outcomes. My thesis posits that economic forces of globalization impose differential impacts on national economies depending on a country's relative positions in networks and the network channelling effects. Convergence and divergence in domestic economic policies can be considered as different ends of a continuum. Depending on countries' network positions, their national economies are subject to differential levels of pressure to adapt to the forces of globalization. This results in national variations in a wide range of domestic policy outcomes. I present two hypotheses: first, the similarity of network positions induces convergence in domestic economic policies as a result of competitive pressure from other similar countries. Second, proximity in network positions facilitates communication and policy learning which in turn brings about domestic policy convergence among close "neighbors". The empirical analysis applies a latent space model of network analysis and indicates that network position similarity in international portfolio investments and network position proximity in IGO networks have been important and consistent driving forces of policy convergence. In trade networks, on the other hand, I find weaker network effects on domestic policy outcomes.

1. INTRODUCTION

The convergence-divergence debate has been a heated topic in the field of political economy in the past few decades. Convergence denotes a process wherein distinctive domestic institutions and economic policies fade away over time, giving away to common economic structures whose efficiency and universality produce super strength in the market (Berger & Dore 1996). Divergence, on the other hand, refers to persistent and maybe increasing diversity of national policies and institutions among which the efficiency-mandated minimalism is only one of the many varieties. The debate has largely been set in the broader context of the ongoing globalization process. The issue at stake is whether and how forces of economic globalization take over domestic forces in the processes of national policy- and institution- making. Living in a world of more and more globalized economies, this debate has profound implications as few policy and institutional choices are as fundamental as those that influence or even determine how a national economy should engage, or rather resist, the forces of economic globalization. This debate also reflects a conceptual challenge to traditional models of political economy that largely assume that the most important political processes to model are internal to each polity.

One key logic of the convergence thesis is that of a "race to the bottom". That is, the global mobility of factors of production, and above all, of finance, puts competitive pressure on national economies and results in their efforts to create more and more "business-friendly" economic policies and institutions in order to make their domestic economic arena more "attractive" to international investors (Berger & Dore 1996, Rodrik 1997, Rudra 2002). In the field of political economy, the implication for empirical analysis is that models of domestic political and economic processes have to be updated by incorporating variables from the international level to measure the extent to which a country is subject to the pressure of convergence (Gourevitch 1978). Efforts have been made by closely studying macro-economic policy and institutional changes such as in social welfare policies

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(Cameron 1978, Garrett & Mitchell 2001, Burgoon 2001), industrial subsidies (Zahariadis 1997), monetary and fiscal policies (Mosley 2000, Basinger & Hallerberg 2004), to name but a few.

However, dominant models in the current literature such as those applied in the aforementioned works incorporate globalization forces in a problematic way. They usually summarize economic forces of globalization by a simple estimate of a national economy's overall trade exposure to the global market, therefore overlook the richness and complexity of network structures in the system of the international political economy. Empirical studies following this fashion unsurprisingly leave us with confusion by revealing a mixed picture of convergence-divergence caused by economic forces of globalization (Garrett 1998, Burgoon 2001, Rudra 2002). We still have to ask why and how convergence has happened in some countries, in some policy areas (but to different extents), but not in the others?¹ Disappointing performances of globalization variables in the model lead some scholars to return to traditional domestic variables such as partisan gravity, number of veto players, strength of the union to explain domestic political processes (Garrett 1998, Garrett & Lange 1989). Indeed, domestic variables are undoubtedly important in shaping domestic political outcomes. But forces of globalization at the international level need further exploration. The absence of uniform convergence uncovered by models with misspecified therefore misleading globalization variables can not be considered as counterargument against the convergence theory and globalization thesis in general. What we need is a better model of the "third image" to account for variations of convergence and uncover the underlying mechanisms. In this research, we focus on international networks to explain convergence-divergence phenomena.

2. NETWORK EXPLANATIONS OF CONVERGENCE-DIVERGENCE PHENOMENA

2.1. Networks and Network Positions. National economies are not randomly distributed in the global economy. One way to conceptualize the system of international political economy is to picture a complex system of networks wherein national economies are embedded in and connected by multiple networks such as those of trade, of finance, of inter-governmental organizations (IGO), of information flows, and of migration. Moreover, states are not connected and influenced by those network structures in the same way as networks often, if not always, imply hierarchy and clustering. Therefore, it is reasonable to suspect that economic forces of globalization impose differential impacts on national economies depending on their relative positions in networks and the channelling effects of networks. Convergence and divergence in domestic economic policies can be considered as different ends of a continuum. Depending on their positions in international networks, national economies are subject to differential levels of pressure to adapt to the forces of globalization. This results in national variations in a wide range of domestic and international policy outcomes. In other words, globalization does not have to be equal to a uniform convergence of national policies and insinuations. It also follows that, to account for domestic policy and institutional (to a lesser extent because of institutional inertia) variations from the systemic level, we need to fully rediscover the real face of the "third image" by systematically modeling network structures and mechanisms that provide constraints and opportunities for national economies therefore shape domestic political processes.

Indeed, the idea of studying structure and networks in international economy has a long tradition in the field of political science. Dependency theory (Cardoso & Faletto 1979), world system theory (Wallerstein 1974), and other studies of networks and hierarchies in international system (Ward 1978, Snyder & Kick 1979, Nemeth & Smith 1985, Smith & White 1992) all point to one key aspect of the international economy: the "absolute positions" of each country in the system. By its absolute position, each country is assigned a grouping label. Borrowing terms from the Dependency thesis, countries are categorized as the core, the periphery, or even the semi-periphery in the system. State behavior and performances, including domestic economic policy and institution outcomes, are then structurally determined by its absolute position in the system. However, this

¹ Berger defines convergence as a process wherein distinctive domestic institutions and economic policies fade away over time, giving away to common economic structures whose efficiency and universality produce super strength in the market (Berger & Dore 1996, in the edited volume introduction). The definition itself reveals that convergence doesn't have to involve international forces at all. Indeed, Marxist interpretation proposes a technology-dictated single optimal way of organizing production and common economic institutions: here, the engine of convergence is technology; every country has to progress along a common trajectory of technological possibilities. Moreover, Iversen and Cusack (2000) trace sources of welfare policies of post-war OECD countries to the process of De-industrialization rather than Globalization. While we acknowledge the importance of domestic variables, we only focus on variables at the international level in this paper.

is a *static* version of networks and network positions in the sense that once a national economy is locked in a specific position in the system (defined in the context of dependency and hierarchy), its behavior is also locked in a certain pattern. For instance, a core country behaves as the center of the world economy exploring those in the periphery. If we apply the *dependency* logic into the study of the convergence phenomena caused by globalization, the recently observed “convergence” in some areas of national economic policies and institution should be explained by the flattening of hierarchies in the system.

More recent studies in international relations have discovered the logic of externalities of national economic policy-making. One country’s policy decision depends on “what are the neighbors doing” (Ward & Gleditsch 2002, Ward 2005). According to Simmons and Elkins (2004), one country’s policy decision alters the costs and benefits of the policy for the others, either materially through direct economic competition or ideationally through subjective pressures of prevailing global norms. Also emphasized is the importance of information and learning (learning from success, learning through communication, and learning from cultural reference groups) in the process of policy diffusion. Beck, Gleditsch, and Beardsley (2006) broaden our concept of space by going beyond geography and showing how trade connection facilitates the diffusion of democracy. These works have uncovered another key structural character of network positions in the global economy which could be considered as the “relative position” in networks of international economy. Positions relative to its closest neighbors.

From this perspective, the behavior of each country is defined or influenced by a subset of countries that it is most closely related to or embedded in. In a simple example, a high school student’s attitude towards a new pop star often is influenced by the circle of her close friends. A newcomer might even survey the opinion of group members and choose to express similar attitude in order to be accepted by the group. On the other hand, an old member might choose a opinion dramatically different from the common view to show her uniqueness. Unlike the notion of absolute positions which specify patterns of behavior according to a country’s “label” — the core, the periphery, and the semi-periphery, the relative position emphasizes the fact that how country A behaves depends on what its close neighbors do. We suspect that it is this more dynamic version of network positions and pattern of interactions accordingly induced that underpin the process of convergence-divergence in domestic economic policies and institutions.

2.2. Main Hypotheses. International economy and politics are more than the sum of individual national economies and politics. If we consider states as nodes, then the whole international system can be conceptualized as being composed of various sorts of networks embedded with national economies and politics.² Therefore, from the perspective of social network analysis (Wasserman & Faust 1994), the behavior of each node, i.e., national economies and politics, is not only function of nodal characteristics such as partisan gravity of the government, strength of the labor, and domestic coalition building and preferences formation, but also is determined/influenced by its positions in networks and specific network natures and structures.³ Previous IPE and CPE research has been mainly focused on those nodal characteristics and to some extent the overall contacts that a node has with the whole network. For instance, annual trade volume as percentage of annual GDP is often taken granted as an overall estimate of a country’s exposure to international economy. No further exploration in terms of the distribution and components of these contacts has been seriously pursued.⁴ Using trade networks as an example, the current literature often ignores the obvious fact that different distributions of same amount of trade flows often induce different levels of adaptation pressure from the “closest neighbors”. Country A and B, having the same overall level of trade exposure, might have different feelings towards the global market and have different answers to the following questions are different: what kinds of goods a country exports? With how many and which kind of economies it trades? Does it have lots of competitors in exports targeting the same overseas markets?

It is our general argument that *systemic level convergence forces do not hit individual country through open air, but more likely through the media of complex network structures*. Simmons and Elkins (2004), when discussing policy diffusion, argue that governments’ liberalization policies will be influenced by the policies of their most important foreign economic competitors (pp.173). Berry and Baybeck (2005) also attribute the diffusion of policy across American states to interstate competition (along with policy learning). When

² But not limited to national entities as neo-liberals and constructivists will argue.

³ Node and vertex are often used interchangeably in network analysis and graph theory, both refer to a member in a network.

⁴ With world system theory and dependency theory as exceptions (Cardoso & Faletto 1979, Wallerstein 1974).

competing in the international market, countries targeting same sources of foreign investments and same overseas markets are facing a collective action problem as they all want to be competitive; actually more competitive than their major competitors. A country thus adopts efficiency-mandated economic policies and institutions to gain advantages over their competitors. Other countries respond by going even further in that direction. Such competition at group level results in convergence to liberal style minimalism, or a “race to the bottom”, among a group of competitors.

From a network perspective, these competitors are connected in similar ways to the same external markets and sources of finance (which are also actors in the same networks), therefore occupy similar or even equivalent positions in the networks, be it trade or money flows. If we recognize a duality between actor and position and a expectation that position is the primary determinant of opportunity and constraint (a fundamental disciplinary premise of Sociology (Podolny, Stuart & Hannan 1996)), we can speculate that it is the similarity or even equivalence in the network positions that causes competition which in turn results in convergence. More specifically, we expect:

Hypothesis One: similarity in network positions, especially that of exports and financial inflows networks, induce nodal similarity in terms of domestic economic policies and institutions by peer competitive pressure.

In other words, national economies with similar profiles of exports and inflows of investments tend to adopt similar economic policies therefore result in more convergence in their economic configurations. We therefore observe clusters of similar national economies. The implication of this hypothesis is that the extent of convergence among group of national economies does not have to be a positive function of overall volume of network flows among them. What matters is the distribution of these interactions or ties that defines the position of each node in the network. Therefore, it is not that surprising to see divergent domestic policy outcomes between countries with similar overall level of exposure to global economy even after controlling for various domestic variables. It is also not counter-intuitive to see convergence among national economies with low level of direct economic contacts. China and Mexico might not have high level of direct economic interactions with each other, but their similar economic ties to the US market put them in similar positions in the trade networks, therefore competition with each other which might result in similar move to the direction of efficiency-mandated economic policies.

In addition to competition induced by similarity of network positions, learning is another mechanism that induces diffusion of ideas and practices that result in convergence (Simmons & Elkins 2004). The previous hypothesis of competition-induced convergence explains why actors that do not have direct contact with each other, therefore situate far apart in a network, might end up being alike. But on the other hand, actors that locate close to each other might just enjoy a higher chance of interactions. Interactions in turn facilitate learning and/or imitation, therefore could result in convergence in nodal characteristics.

Hypothesis Two: the closer/more proximate the national economies in networks, the more “similar” they are as closeness/proximity facilitates communication, policy learning, imitation, therefore diffusion.

The closeness/proximity here can be defined in different ways. The most straightforward case is the physical distance that is used to measure closeness in transportation networks. (Time and cost are also often used.) Another more abstract way to measure how “connected” two airports are in a transportation network is by looking at the overall flows between them. For instance, the number of airline passengers as well as the volume of air freight are used as an indicator of the “connectedness” in the literature of airline transportation (Zook & Brunn 2006). Analogically, the closeness in a typical network in the global economy, such as that of trade, can be conceptualized as a positive function of the magnitude of interactions/ties between two nodes in the network. The more two countries trade with each other, the closer they are in the network of international commerce.

Eventually, similarity/equivalence and closeness/proximity have to be defined with regard to specific networks in the system. Countries that are close in trade networks might end up being far away from each other in the “map” of transnational money flows. Therefore, we need to further specify various possible networks that bring national economies in contact with each other. In the empirical analysis, we are going to closely study trade, financial flows (Portfolio investment), and IGO networks. Geography is also included given its obvious importance. Indeed, if there exists a social space of economic policies where we can use some negative function of the distance between two countries as a proxy of their similarity/convergence, then we can think of the dynamic convergence in economic policies (and to a lesser extent of institutions because of the institutional inertia) as

a function of their similarity and closeness in other networks that they are embedded in. We ask whether countries' positions in other (real) networks, and in which networks, induce their closeness in the dimension of economic policies and institutions.

3. EMPIRICAL VIEW OF CONTEMPORARY CONVERGENCE-DIVERGENCE PHENOMENA

3.1. Convergence-Divergence in a Multidimensional Policy Space. Convergence denotes the phenomenon wherein distinctive domestic institutions and economic policies fade away over time, giving away to common economic structures (Berger & Dore 1996). In the following, we choose to only focus on convergence-divergence in domestic economic policies rather than institutions. This section displays the empirical view of contemporary convergence-divergence phenomena in domestic economic policies. To capture patterns of convergence-divergence, we conceptualize and construct a multi-dimensional space of economic policies, with each dimension specifying one particular domestic economic policy. In this way, we are able to locate every national economy of the global economy in this policy space. The global level convergence-divergence in domestic economic policies can be estimated by the average distance between national economies in the multi-dimensional policy space. The smaller the distance, the higher the average level of convergence. At the same time, some measurement of the variation of the policy distances such as the standard deviation, in addition to an average estimate of the "grand" trend of convergence-divergence, gives us more information about possible clustering effects. Low average distance with relatively high variation of the distance reveals possible clustering of national economies in the multi-dimensional policy space.

More specifically, we can denote a country i 's policy portfolio as $P^i = [p_1^i p_2^i \dots p_n^i]'$, with n here as the number of possible policy dimensions. The distance between two countries, $d(P^i, P^j)$, then can be calculated accordingly in this n -dimensional policy space. We choose to use Euclidean distance:

$$(1) \quad d(P^i, P^j) = \sqrt{\sum_{n=1}^N (p_n^i - p_n^j)^2}$$

where p_n^i describes country i 's score in the n th policy dimension.⁵

3.2. Dimensions of Domestic Economic Policies. In this research, we provide a comprehensive picture of the convergence-divergence phenomena by including eleven domestic economic policies that can be broadly categorized into three important policy areas: the size of government, the access to sound money, and the regulation of credit, labor, and business. The Fraser Economic Freedom of the World Index (Gartzke, Gwartney & Lawson 2005) provides sufficient data for most of the economic entities in the world. We assume equal importance of each policy dimension. Each of these eleven dimensions of domestic economic policies is standardized to a 0 to 10 scale to measure the extent to which domestic economic policies support personal choice, voluntary exchange, freedom to compete, and security of privately owned property (Gartzke, Gwartney & Lawson 2005: 3). High values indicate low levels of government involvements in economic activities such as retrenched government spending and transfers, low and stable inflation rate, and minimum regulations on labor, credit and business — a policy configuration often related to a neo-liberal model of economic management. In the following, we uncover the patterns of convergence-divergence phenomena across three policy areas.

TABLE 1. *Average and standard deviation of policy distance regarding the size of the government.*

	1990	1995	2000	2003
Mean distance	6.75	6.56	6.18	6.26
Standard deviation of distance	2.76	2.72	2.57	2.63

⁵ We can easily transform the policy distance to a measurement of policy similarity between any two individual national economies, $S(P^i, P^j)$, in similar way to that of foreign policy similarity from Signorino and Ritter (1999):

$$(2) \quad S(P^i, P^j) = 1 - 2d(P^i, P^j)/d^{max}$$

where $d(P^i, P^j)$ is the actual distance between country i and j , and d^{max} is the maximum distance among all countries. S is bounded by -1 and 1 which the former representing a distance of d^{max} and the latter overlapping/identical position in the space.

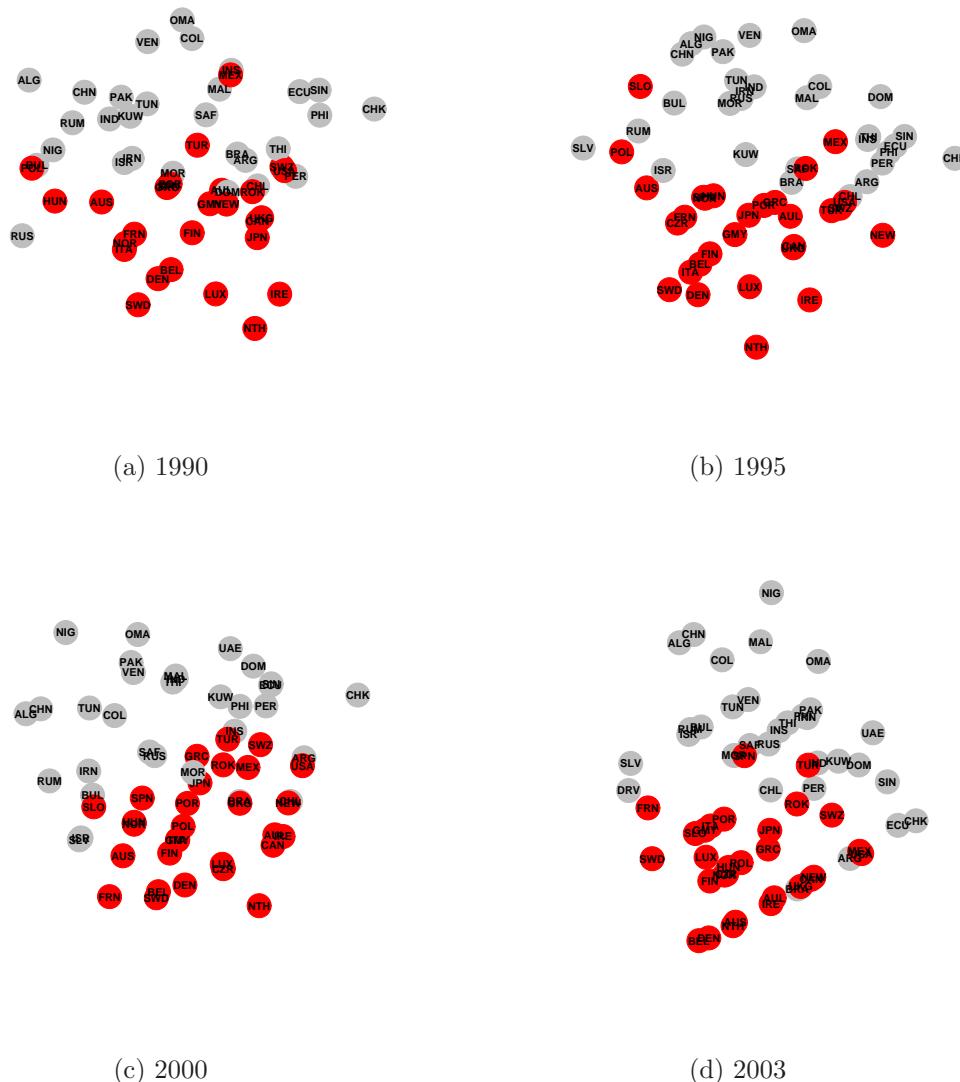


FIGURE 1. Countries' relative positions in a two-dimensional policy space characterizing the size the government: policies regarding government consumption, transfers, investments, and taxation. Hongkong ranks at the top in all of these four years by having the most economically "free" policies related to the size of the government. We use red color for 30 OECD countries.

3.2.1. *Size of Government: Expenditures, Taxes, and Enterprises.* High levels of government spending, transfers as well as taxation, and large public sector are often considered as key characteristics of the social democratic variety of capitalism (Hall & Soskice 2001) whose survival in the age of globalization often becomes a focal point in the convergence-divergence debate. Scholars from welfare state and compensation politics literature (Cameron 1978, Katzenstein 1985, Garrett & Lange 1989, Garrett 1998, Iversen & Cusack 2000) and taxation literature (Hallerberg & Basinger 1998, Wibbels & Arce 2003) have been studying these policies closely. The ways that governments collect and spend money have significant effects on the redistribution of wealth in the society. Globalization, the convergence thesis argues, weakens the role played by the government and shifts the power to the market to allocate resources, goods, and services. High taxation and generous social policies becomes more and more incompatible with globalized economies. Countries (should) have raced to the "bottom"

of a more neo-liberal style of social and taxation policies. We choose four components in this policy area to measure the extent to which a national economy relies on individual choice and markets rather than the political process to allocate resources, goods, and services:

- General government consumption spending as a percentage of total consumption;
- Transfers and subsidies as a percentage of GDP;
- Government enterprises and investment as a percentage of total investment;
- Top marginal tax rate and income threshold at which it applies.

We treat each of the four dimensions as equally important as to characterize a country's policy profile in terms of the size of the government. We standardize a country i 's score on each policy dimension to a 0 – 10 scale with 10 indicating the most neo-liberal type of government policies in this area. We are able to locate countries in the four-dimensional policy space of the size of the government according to their standardized scores.⁶ Using techniques of classical multidimensional scaling, we can collapse four dimensions to two and easily display countries's relative positions in the policy space. If forces of economic forces of globalization such as trade, capital flows, and new communication technologies force all countries toward the same liberal type of governments, we should be able to observe the average distance of countries in the policy space shrinking and a clustering effects of countries toward the most liberal/economically free types of governments.

Table 1 summarizes the changes in the average and variation of distances among countries in a four-dimensional policy space regarding the size of the government. From 1990 to 2003, the average distance decreases, but slowly. The same is the variation of policy profile distances. Figure 1 visualizes countries' relative positions in the policy space. As we know from the ranking in the Fraser Index (Gartzke, Gwartney & Lawson 2005), Hongkong ranks at the top by having the smallest size of the government. We can use Hongkong as a reference point in the policy space: the farther away a country is from Hongkong, the more likely its policy profile is characterized by high levels of government spending, transfers, taxation, and large public sector. Through out the whole period, some countries did move closer to the neo-liberal role model (Hongkong), but the overall extent of convergence is small. OECD countries, especially those at West Europe, form their own group, and their cluster has been distinguished from others over the years. While some newly industrialized countries (some of them are OECD countries as well) such as Singapore, Mexico, Argentina are approaching Hongkong, wealthy small European countries such as Denmark, Belgium, Austria, and the Netherlands occupy the other end of policy space, therefore present themselves as counter-examples of the convergence/“race to the bottom” thesis. Small states in the world markets still redistribute a lot (Katzenstein 1985).

3.2.2. Access to Sound Money. Too much money chasing too few goods invariably leads to inflation. At the same time, when the rate of inflation increases, it often becomes volatile. High and volatile inflation are detrimental for healthy economic activities as it distorts relative prices, alters the fundamental terms of long-term contracts, therefore makes it impossible for individuals and businesses to plan the future. Indeed, low and stable inflation has become the policy objective of most (conservative) central banks in the world (Broz 2002). We therefore consider three policy dimensions related to money growth and inflation as key components of monetary policies: the average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years, the standard inflation variability in the last five years, and the recent inflation rate. Moreover, the freedom to own foreign currency bank accounts domestically and abroad is considered as an additional dimension of monetary policies. It measures the ease with which alternative currencies, often more credible than the national one, are accessible to individuals and businesses via domestic and foreign bank accounts.⁷

⁶ We use a simple formula $(V_{max} - V_i)/(V_{max} - V_{min})$ to standardize the first two dimensions: government consumption and transfers. V_{max} is the highest absolute score in the policy outcome under consideration; V_{min} is the lowest. V_i the score of country i . For instance, if a government consumes the highest percentage of GDP, its standardized score on the policy dimension of government consumption is the lowest, i.e., 0, the least economically “free”. The scale for the other two dimensions — state owned enterprises and taxation are estimated by according to reference schemes in Gartzke et al (2005), page 174-181.

⁷ We use formula $(V_{max} - V_i)/(V_{max} - V_{min})$ to standardize the first three dimensions of the monetary policies. For the last dimension — the freedom to own foreign currency bank accounts domestically and abroad is coded as follows: when foreign currency bank accounts were permissible without restrictions both domestically and abroad, the rating was 10. When these accounts were restricted, the rating was zero. If foreign currency bank accounts were permissible domestically but not abroad (or vice versa), the rating was 5. Original data are from International Monetary Fund, Annual Report

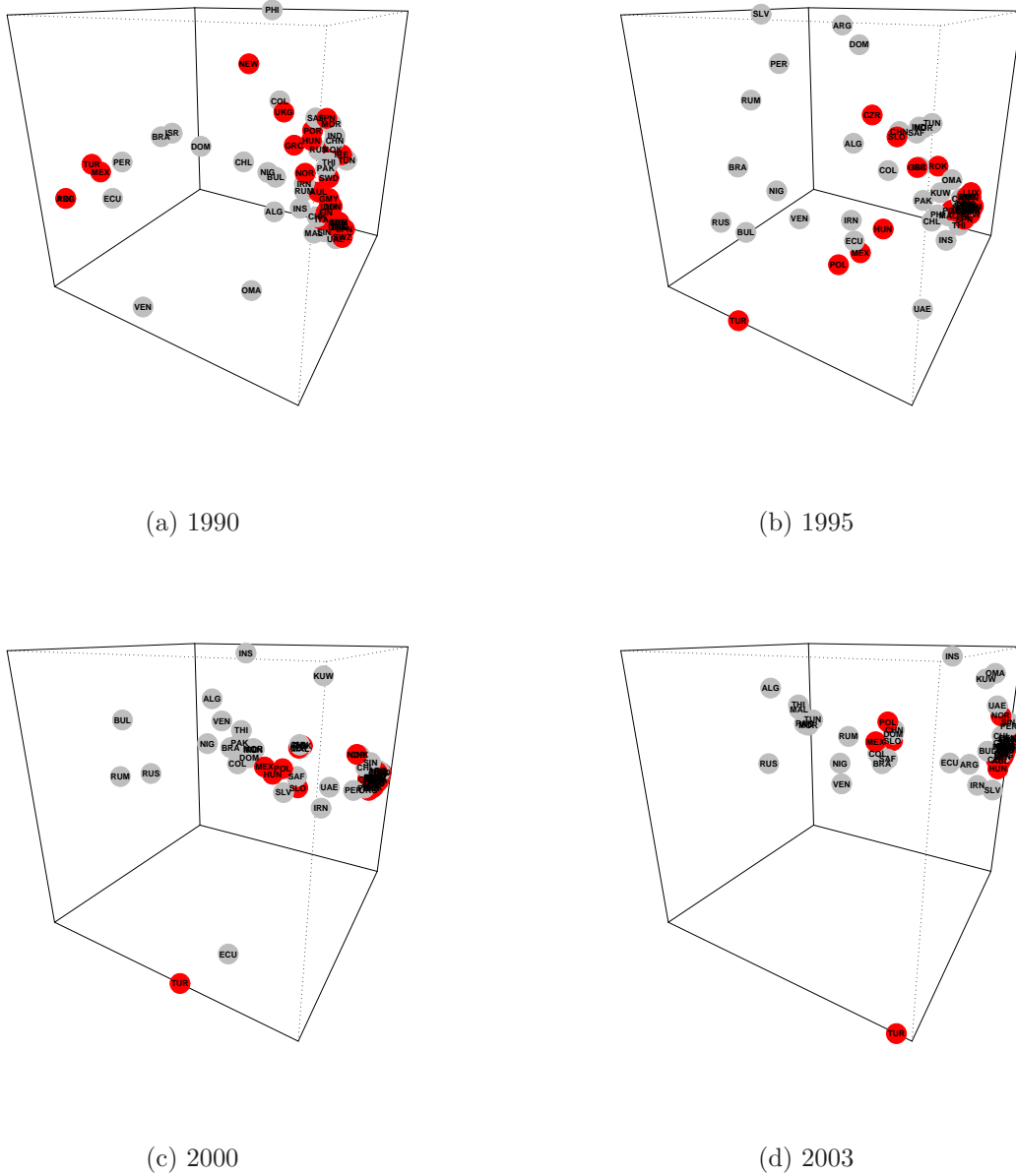


FIGURE 2. Countries' relative positions in a three-dimensional policy space characterizing four important aspects of monetary policies: money growth, level and fluctuation of inflation rate, access to foreign currency. We use red color for 30 OECD countries.

TABLE 2. Average and standard deviation of policy distance regarding four dimensions of monetary policies, 1990-2003.

	1990	1995	2000	2003
Mean distance	8.97	7.99	6.59	5.56
Standard deviation of distance	4.92	5.37	4.42	3.75

on Exchange Arrangements and Exchange Restrictions (various issues) and Currency Data and Intelligence, Inc., World Currency Yearbook (various issues) (Gartzke, Gwartney & Lawson 2005).

Monetary institutions such as central bank independence and fixed exchange rate are often created and sustained to achieve the policy objectives of stable and low inflation rate (Bernhard, Broz & Clark 2002). According to the convergence thesis, as the economy becomes more and more globalized, a country should converge to a monetary policy configuration characterized by reasonable money growth, low and stable inflation rate, and free access to alternative sources of currencies. A pattern of most countries moving toward the role-model country of this policy configuration should be observed has the convergence in monetary policies has happened. However, do we actually observe convergence in the space of monetary policies? Table 2 presents the mean distance and standard deviation of distances for year 1990, 1995, 2000, and 2003. Both the mean and the standard deviation of distances in the policy space have been decreasing over the 14 years period by more than 20%, revealing a overall trend that the monetary policy profiles of countries are becoming similar to each other, but only on average. We need to take a look at the “moves” that countries have taken over the 14 years period.

Figure 2 displays countries’s relative positions in a three-dimensional space collapsed from the actual four-dimensional space of monetary policies. Countries do move in the space, and the overall trend is to move to the cluster where we find countries/economic entities that have the most economically free type of monetary policies such as Hongkong, Singapore, and the United States. Moreover, over the years, this group of countries, including some newly industrialized countries, oil-export countries, and all current OECD members except Mexico, Slovenia, Poland, and Turkey, become more and more clustered. Some of them almost have exact overlapping positions in the policy space, exemplifying a perfect case of convergence. However, another group of countries seem to form their own cluster that is quite distinguished from the previous one. This cluster includes some major economies in the developing world such as China, Brazil, and Mexico. There are some other very small clusters that have been formed during this period. Finally, Turkey remains an outlier from other countries.

3.2.3. Regulation of Credit, Labor, and Business. The last broad policy area that we focus on is regulation policies. Fraser Index (Gartzke, Gwartney & Lawson 2005) provides the estimates on regulation policies on credit, labor, and business. Regulation policies on credit reflect conditions in the domestic credit market. There are five components of credit market regulations. The first two components measure the extent to which banking industry is dominated by private firms and whether foreign banks are permitted to compete in the market. The last three indicate the extent to which credit is supplied to the private sector and whether controls on interest rates interfere with the credit market.

Labor market regulations include various aspects of the labor market including minimum wages, dismissal regulations, centralized wage setting, extensions of union contracts to nonparticipation parties, and unemployment benefits. A country that allows market forces to determine wages and establish the conditions of dismissal, avoids excessive unemployment benefits earns high ranks in this policy dimension. Finally, the last dimension of regulation policies concern business activities. It identifies the extent to which regulatory restraints and bureaucratic procedures limit competition and the operation of the market.⁸

TABLE 3. *Average and standard deviation of policy distance regarding three dimensions of regulations of the market: credit, labor, and business.*

	1990	1995	2000	2003
Mean distance	5.75	4.01	3.18	2.77
Standard deviation of distance	3.95	2.84	2.25	1.42

The policy area of regulation witnessed the most obvious trend of convergence for some seventy most important national economies covered by our research. At the very beginning of 1990s (Figure 3(a)), OECD countries formed their own cluster with few newly industrialized economies such as Thailand and Singapore. At the same time, we can observe that China, Russia, and Poland shared very similar regulation policy profile, indicating their common communist legacies. A group of developing countries in Africa and Latin American countries (Algeria, Peru, Argentina) found themselves close to neither the OECD nor the communist/socialist cluster. Within five years, all countries were moving to the OECD cluster with the exception of Algeria and Romania (Figure 3(b)). The latter moved quickly to the main cluster by year 2000 and three years later the

⁸ 10 out 15 subcomponents of regulation policies are based on survey data because of the difficulties in developing objective measures of regulatory restraints. See Appendix A for more details about components of regulation policies.

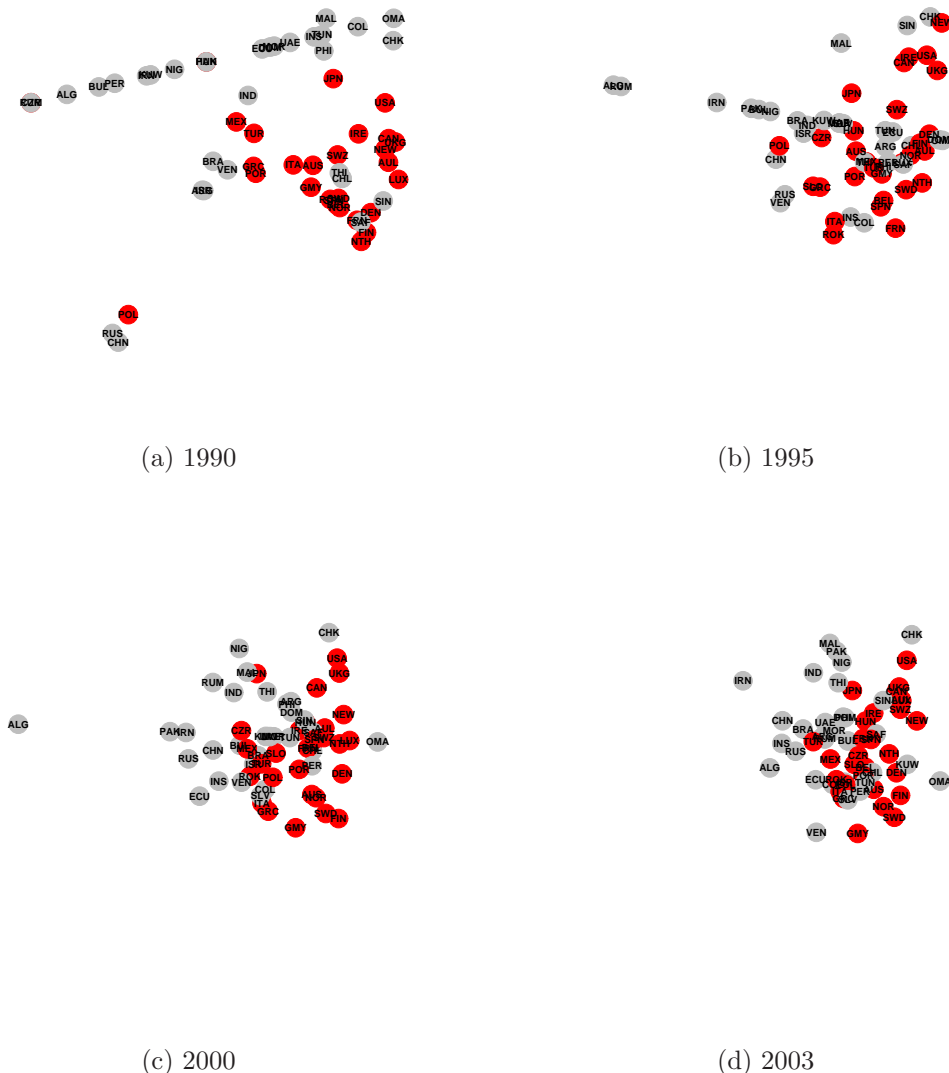


FIGURE 3. Countries’ relative positions in a two-dimensional policy space characterizing three important aspects of regulation policies: credit, labor, and business. We use red color for 30 OECD countries.

only outlier, Algeria, moved to the cluster as well (Figure 3(d)). This overall pattern of convergence is further reflected in Table 3 as it shows a persistent and significant decrease in the mean and the standard deviation of policy distances in the space of regulation policies.

Another interesting phenomenon is the convergence among developed countries. The moves made by wealthy OECD countries are quite small compared to non-OECD countries. If only considering the clustering among OECD countries, we can observe some persistent cluster such as that of USA, Britain, Canada and that of Finland, Norway, Sweden. This corresponds approximately to the categorization of capitalism in the varieties of capitalism literature (Hall & Soskice 2001).

3.3. Overall Policy Space. Figure 4 summarizes countries’ positions in a policy space consisting of the three broad policies areas discussed above—size of the government, monetary policies, and regulations. More specifically, eleven policies are considered and used to construct an 11-dimensional policy space. We collapsed it into

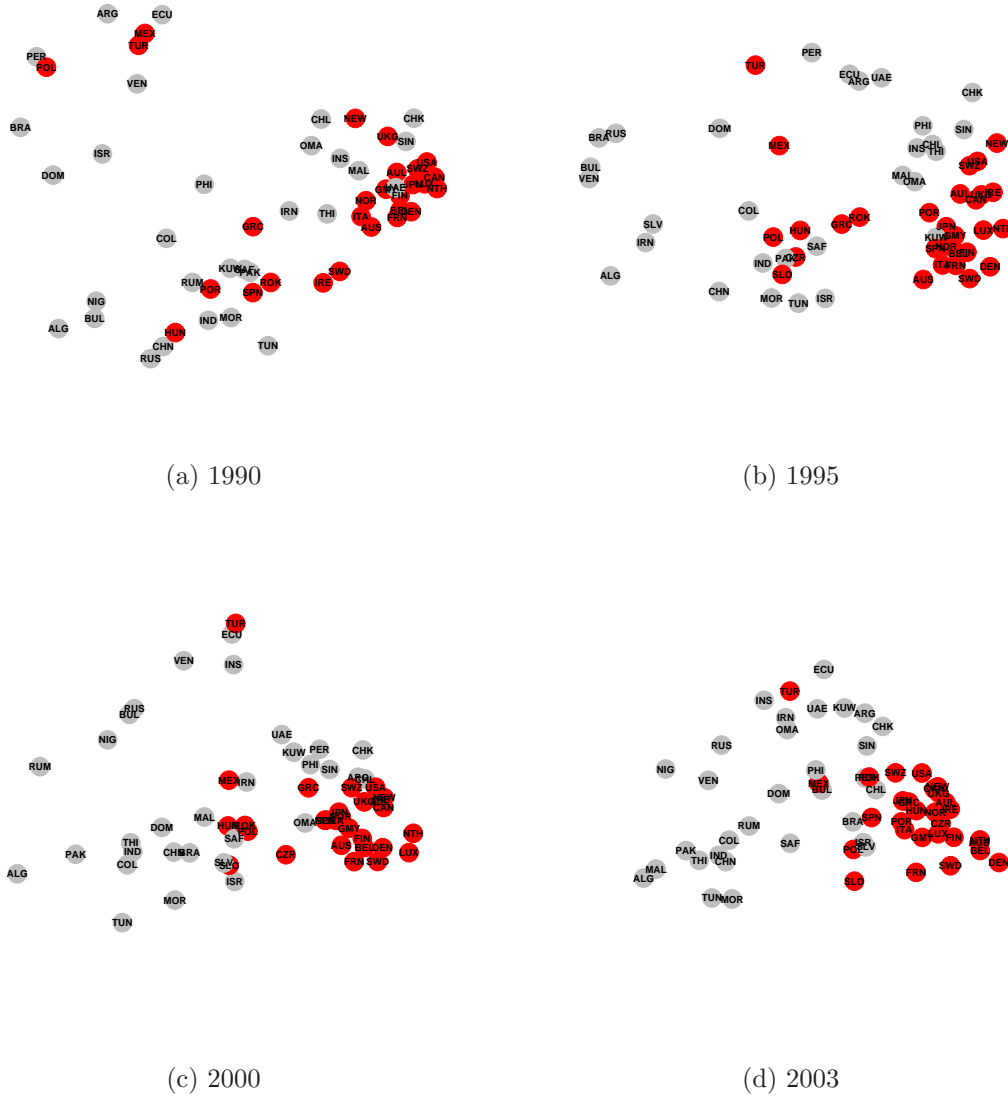


FIGURE 4. Countries' relative positions in a two-dimensional policy space characterizing three broad policy areas of domestic economic policies: the size of the government, monetary policies, and regulations. We use red color for 30 OECD countries.

a two-dimensional representation of the space to trace the overall trend of convergence-divergence in the overall domestic economic policy profiles in the world. The cluster of wealthy OECD countries is clear through out the 14 years. Other countries have been moving to the OECD cluster and the fast movers include some Eastern European countries and newly industrialized countries. Some clusters disappeared overtime, such as the one of China, Russia, and Hungary and that of Mexico, Ecuador, and Turkey in 1990, and some new clusters formed by year 2003 such as that of India, Pakistan, China, and Thailand. Table 4 also shows the overall pattern of convergence.

Convergence-divergence phenomena are multi-faceted. The overall trend of changes in domestic economic policies in the past decade and half has been a convergence to an efficiency-mandated configuration characterized by small government, stable monetary policies, and business-friendly regulations. However, the extent of convergence to the neo-liberal configuration is different across different countries and different policy

TABLE 4. *Average and standard deviation of overall policy distance.*

	1990	1995	2000	2003
Mean distance	13.94	12.58	10.69	9.779
Standard deviation of distance	4.679	4.98	4.058	3.47

areas. The convergence-divergence literature has been focusing for a long time on policy and institution changes in OECD countries (Berger & Dore 1996, Garrett 1998, Garrett & Lange 1989, Garrett & Mitchell 2001), but we notice here that it is some Eastern European Countries and newly industrialized countries that have made the largest move by adopting more business friendly economic policies. And their changes of positions in policy spaces are most apparent in monetary and regulation policies (Figure 2 and 3). Wealthy developed countries, on the other hand, form their own cluster and have moved relatively little during the period, especially in the policy area regarding government spending, transfers, and taxation. Moreover, the distinction between different varieties of capitalism (Hall & Soskice 2001) among the group of developed countries is reflected in policy space, especially in that concerning the size of the government (Figure 1) and that of regulations (Figure 3). Finally, while the clustering of countries into different groups has become more and more evident in the policy space of monetary policies (Figure 2), in the space of regulation policies, other clusters have been disappearing with countries converging to the OECD cluster (Figure 3). Can characteristics of a country's network positions explain the complex convergence-divergence phenomena that we have observed in the past decade and a half? In the following, we test our network explanation.

4. EXPLAINING CONVERGENCE-DIVERGENCE PHENOMENA

4.1. Notions of Network Position. One of the most central concepts in social network analysis and structural theory in general is the notion of position. However, the term position itself refers to more than one concept and a variety of definitions exit along with even a larger number of empirical operationalizations of these definitions. According to Borgatti and Everett (1992),

The fundamental idea underlying the notion of position is that of structural correspondence or similarity. Actors who are connected in the same way to the rest of the network are said to be equivalent and to occupy the same position. In general, the objective of positional analysis is to partition actors into mutually exclusive classes of equivalent actors who have similar relational patterns. This positional approach to network analysis is intended to contrast with the relational or cohesive approach (Burt 1976, Friedkin 1984), which attempts to find subsets of actors who are strongly or closely related to each other. In the first case the underlying clustering principle is similarity; in the second, it is cohesion or proximity.

The relational or cohesive approach of network analysis (Burt 1976, Friedkin 1984) corresponds to the second hypothesis of this research: proximity/closeness in a network induces similarity in nodal characteristics of network members. The strength of relationship between actors is often used to distinguish a subset. In a typical network in the international political economy such as that of trade, the volume of goods exchanged between countries is often taken as the indicator of how close they are in the network. Similarly, in the network of inter-governmental organizations (IGOs), the higher the number of shared memberships, the closer the two countries are in the "web" of inter-governmental connections (Ingram, Robinson & Busch 2005).

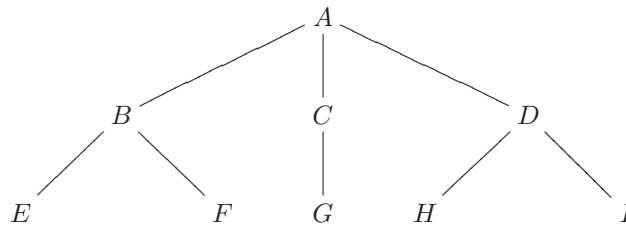
Position similarity, on the other hand, provides another conceptualization of network member relationship. To define network position of a node is to characterize the way it is connected to the rest of the network. Two countries might be far away from each other geographically and have little direct contact with each other in the global economy. But the fact that they are connected to the rest of the world market in a similar fashion — export same goods to the same foreign markets, receive similar foreign aid programmes from same sources, put them in similar network positions which might induce competition therefore convergence (Hypothesis One). As closeness/proximity is relatively a more straightforward concept, we focus our discussion on network position similarity.

There are different ways to characterize network position similarity, or equivalence. Structural equivalence, structural isomorphism, regular equivalence are three definitions of "equivalence" that have been particularly useful in applying graph theory to the understanding of "social roles" and "structural positions"

(Hanneman & Riddle 2005).⁹ According to Pattison (1988), among all definitions of equivalence, there is a fundamental distinction between structural equivalence and all others. And among others, the one most similar to structural equivalence is structural isomorphism. In the following, we are going to present the concepts of the three types of equivalence, and our theoretical reasons to choose structural equivalence to operationalize peer competitive pressure induced by structural similarity in network positions.

4.1.1. *Three Equivalences.* In the context of binary relationship networks, i.e. non-valued networks, Burt (1976) defines a set of structurally equivalent nodes as a set of nodes connected by the same relations to exactly the same people. Again, the actor's position in the networks is only determined by who she is connected to. Two actors may be said to be structurally equivalent to each other if they have the same pattern of ties with other actors. In other words, they are substitutable. The following graph is developed by Wasserman and Faust to illustrate the three types of equivalence/similarity of network positions. According to the definition of

FIGURE 5. *Wasserman-Faust Network: Three Types of Equivalences.*



structural equivalence in a binary-relationship network, node (vertex) E and F are structurally equivalent to each other: each of them has a single tie and that tie is connected to the same actor B. Similarly, actors H and I fall in the same structural equivalence class. That is, they have exactly the same pattern of ties to all other actors. As Hanneman and Riddle put it (2005),

Actors that are structurally equivalent are in identical “positions” in the structure of the diagram. Whatever opportunities and constraints operate on one member of a class are also present for the others. The nodes in a structural equivalence class are, in a sense, in the same position with regard to all other actors.

Exact structural equivalence is rare in large non-valued networks, and even harder to find in valued networks where the tie is not simply an indicator of presence or absence of a certain relationship or interaction, but a measurement of the strength/volume of that relationship/interaction, for instance, flows of commodities in trade networks, number of emails received and sent in Internet. We are more often interested in examining the degree of structural equivalence.

A “less strict” version of equivalence is structural isomorphism. It is a concept that depends crucially on the notion of isomorphism. An isomorphism is a concept of a one-to-one mapping of one set of objects to another such that the relationships among objects are also preserved. In other words, a graph isomorphism is a mapping of the nodes in one graph to corresponding nodes in another graph such that if two nodes are connected in one graph, then their correspondents in the second graph must also be connected. One way to think about structurally isomorphic nodes in one graph is to find equivalent/similar ones after we delete the labels in Figure 5: in this case, instead of two equivalent classes {E, F} and {H, I}, these four nodes form one single equivalent class, because they all only have one tie to a node at a higher level of the hierarchy (B and D are indistinguishable without label) which are in turn connected to A at the highest level of the hierarchy. B and D are also structurally isomorphic for the same logic. The idea of automorphic equivalence is that sets of actors can be equivalent by being embedded in local structures that have the same patterns of ties. Large scale populations of social actors often display a great deal of this sort of “structural replication.”

Let's take a look at Figure 5 again to grasp the concept of regular equivalence in an intuitive way. In the graph, there are three regular equivalence classes. The easiest class to see is the five nodes at the lowest level

⁹They are listed here in order of generalization: any pair of nodes that is structurally equivalent is also automorphically and regularly equivalent, and any pair of automorphically equivalent nodes is also regularly equivalent.

of the network hierarchy, i.e., E, F, G, H, and I. These actors are regularly equivalent to one another because a) they have no tie with any actor in the highest level A, b) each has a tie with an actor in the second level, i.e., either with B, C, or D. Each of the nodes has identical pattern of connections with other levels of nodes, even though the actual number of ties with nodes in other regular equivalent classes might vary. For the same reason, nodes B, C, and D form a regular equivalent class and A is in a class by itself.

In social context, we can think of the family structure as an example of regular equivalence. Assuming each of the two families have three generations: grandparents, parents, and children, the grandparents of two families are regularly equivalent even though they might have different numbers of children (parents in the family tree), and their children might also have different number of their children. As we can see here, regular equivalence captures the basic concept of “social roles” that are the basic building blocks of all social institutions. Regularly equivalent actors in social networks do not necessarily fall in the same network positions or locations with respect to other individual actors in terms of exact number of ties. Rather, they have the same kinds of relationships with some members of other sets of actors.

4.1.2. The Choice of Structural Equivalence. According to the first causal mechanism, peer competitive pressure induces convergence in domestic economic policies. In turn, the extent of peer pressure between any country is a positive function of the extent of similarity in terms of their network positions. We have presented three basic definitions of equivalence to capture the concept of similarity in order of generalization. The empirical question is then which definition should we apply in our analysis to best capture the level of peer competitive pressure.

The concept of structural equivalence is commonly used in the study of world system to capture similarity in terms of trade network positions (Snyder & Kick 1979, Nemeth & Smith 1985), and recently in the study of the effects of IGO networks on bilateral trade (Ingram, Robinson & Busch 2005). We also choose to use structural equivalence in estimating position similarity in trade and financial flow networks, because it provides the most rigorous test of the hypothesis of peer competitive pressure. Structure equivalence, by its definition, is the most strict form of similarity in network positions. Moreover, with networks in international relations composed of well-specified countries, and countries’ nodal characteristics such as level of economic development, population, and natural endowments vary greatly across the globe. The label of each node in networks is therefore not ignorable. In other words, we are dealing with a labelled graph and structural equivalence is the best to appreciate the “labels”. If we use Figure 5 to represent a (over-) simplification of the world trade system, and take B as the United States and D as Haiti, then it is most likely that a structural isomorphism and/or a regular equivalence measurement of network position similarity would wrongly classify E, F, H, I, plus G (if using regular equivalence) as equivalent therefore misrepresent the obvious fact that United States and Haiti face different levels of competitive pressure in the export markets. Finally, we follow the routine and choose Pearson correlations as specific measurement of structural equivalence.¹⁰

4.2. Network Covariates.

4.2.1. Export networks. In the context of international trade, structural equivalence can be captured by a similarity matrix of first correlation calculated based on each country’s export profile. The more similar country i and country j are in terms of their export profiles — the more similar their positions in the trade network, the higher level of peer pressure, and according to the competition logic, the more likely that they converge to similar domestic economic policy profiles. In terms of trade networks, we want to capture the extent to which two countries compete for the same export markets in the world economy. A correlation matrix of country’s export profile across different trade sectors has become a conventional way to capture this similarity in the literature since the world system and dependency literature (Snyder & Kick 1979, Nemeth & Smith 1985, Smith & White 1992), and lately in the study of globe-wide liberalization (Simmons & Elkins 2004). However, the exact procedure among these works to capture export profile similarity are different. The first difference is whether we need dyadic measurement of export, and the second is how to choose or aggregate sectors of trade.

¹⁰ The correlation measure of similarity is particularly useful when the data on ties are “valued,” — they tell us about the strength and direction of association, rather than simple presence or absence. Pearson correlations range from -1.00 (meaning that the two actors have exactly the opposite ties to each other actor), through zero (meaning that knowing one actor’s tie to a third party doesn’t help us at all in guessing what the other actor’s tie to the third party might be), to +1.00 (meaning that the two actors always have exactly the same tie to other actors - perfect structural equivalence). Pearson correlations are often used to summarize pair-wise structural equivalence because the statistic (called “little r ”) is widely used in social statistics.

As for the purpose of this research, dyadic measurement of trade is necessary, since it is the actual “ties” — bilateral trade that connect countries and constitute the trade network. Moreover, total volume of bilateral trade without a distinction of the types of goods being exchanged is not a reasonable way to capture similarity in trade network positions, since different countries might compete in different commodity markets. We choose the categorization of United Nations’ Standard International Trade Classification (SITC), Revision 2 to differentiate sectors of trade (UN 1975). This standard classifies 1832 types of commodities traded in international markets into 10 sections, 63 divisions, 233 groups, and finally 786 subgroups. We follow the classification at section level to categorize the 10 broad trade sectors in international commerce:

- Food and live animals directly for food
- Beverages and tobacco
- Crude materials, inedible, except fuels
- Mineral fuels, lubricants and related materials
- Animal and vegetable oils, fats and waxes
- Chemical and related products
- Manufactured goods, classified chiefly by material
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Commodities and transactions not classified elsewhere¹¹

Data for dyadic sector-level trade are from the Center of International Data at the University of California, Davis (Feenstra, Lipsey, Deng, Ma & Mo 2005).¹² This data set covers international commerce at the dyadic level from 1962 to 2000. Bilateral trade across different commodities are detailed at the level of four-digits Standard International Trade Classification (SITC). Aggregating bilateral trade to one-digits level gives rise to the ten sectors we just specified. In the following, we work on the ten socio-matrices of bilateral trade, $EXPORT_{k=0,1,\dots,9}$, with each matrix carrying information for one sector of trade.

Instead of a single network of international trade representing the sheer volume of bilateral trade, we break down international trade into 10 sub-networks, with each of them capturing the interactions in one specific, though still broad, sector of international commerce. Absolute volume of bilateral trade between country i and j , $Export_{i,j}$, is disaggregated into a vector of $Export_{k=0,i,j}$, $Export_{k=1,i,j}$, ..., $Export_{k=9,i,j}$; here k refers to trade sectors 0 to 9. Therefore, in each network of sectoral trade, machinery and transport equipment for instance for instance, the export profile of any country i can be captured by the i th row vector in the matrix $EXPORT_{k=7}$, i.e., $Exp_{k=7,i} = [Exp_{k=7,i,1}, Exp_{k=7,i,2}, \dots, Exp_{k=7,i,n}]$. Calculating the first correlation between any country i ’s and j ’s export profiles in one specific trade sector, we have a correlation matrix capturing the structural equivalence of this sub-network of trade: SE_k .

Each element, $se_{k,i,j}$, in the correlation matrix represents how similar country i and country j are in the network of one specific sector of trade k . It is obvious that the correlation matrix is symmetric with the diagonal elements all being 1: a country i ’s profile is perfectly correlated with that of itself — perfectly structurally equivalent. In year 1995, in the trade network of machinery and transport equipment, Germany’s export profile is most similar to that of Switzerland with a correlation of 0.9456, followed by Italy (0.8972), Belgium-Luxembourg (0.8953), UK (0.8910), and Austria (0.8311). In other words, in the sector of machinery and transport equipment, Germany is mostly competing with her fellow West European countries. At the same time, we notice that in the network of trade in mineral fuels, lubricants and related materials, the two countries that are most similar to Germany in terms of structural equivalence are Peru (0.9951) and Ecuador (0.8758).

We notice that levels of structural equivalence between any countries i and j vary across different trade sectors: Switzerland might be the most important competitor of Germany in the trade sector of machinery and transport equipment, but only ranks as the 31th competitor in crude materials (inedible, except fuels) among the 64 countries that compete with Germany in year 1995.¹³ Then the question for us is how to come up with

¹¹ There are other ways to classify commodities therefore define trade sectors, e.g., Simmons and Elkins (2004) uses nine sectors from IMF data. See Table 1: Summary Statistics and Sources for Variables Included in the Analysis. It shows trade data are from 1) IMF’s Annual Exchange Arrangements and Restrictions, analytical appendix, and 2) IMF’s Direction of Trade Statistics.

¹² See <http://cid.econ.ucdavis.edu/>.

¹³ The trade data from CID stick to the 72 countries that reported their exports from 1984-2000. For these years (1984-2000), the 72 countries for which import and export data were obtained from the UN are listed in Table 1 in Feenstra

a weighting scheme to have a summary of structural equivalence over 10 sectors of trade. One simple strategy is to take the average of the 10 first correlation matrices, i.e., the final structural equivalence score in export profiles between country i and j is the mean structural equivalence score across 10 trade sectors. This strategy treats 10 sectors of international trade as equally important. However, the volumes (measured by money value) of trade are different across trade sectors. Therefore, we come up with a weighting scheme when calculating the final structural equivalence matrix. The 10 matrices of sectoral structural equivalences are weighted by the proportion of the trade sector among total trade values.¹⁴

4.2.2. Portfolio Investments. Many believe that international financial market is the most significant driving force of convergence in domestic economic policies (Andrews 1994, Cerny 1995, Rodrik 1997, Mosley 2000). We hypothesize in general that similarity in network positions induces peer competition therefore convergence. We expect that the structural equivalence in network positions of portfolio investments predicts convergence.

The data for bilateral portfolio investment flows are from the recent IMF's Coordinated Portfolio Investment Survey (CPIS).¹⁵ The data only cover 2001, 2002, and 2003, and 2004. Geographic breakdown tables of the CPIS Data provide inflows of four types of portfolio investments *from* 71 countries: equity securities, total debt securities, long-term debt securities, short-term debt securities, and also the sum of these four categories—total portfolio investment.¹⁶

We need to calculate the structural equivalence of countries in the network of financial flows, more specifically in terms of the distribution of “inflows” from these 71 “sender countries”. First-order Pearson correlation between country i and j 's profiles of financial inflows can capture the concept of structural equivalence. Large amounts of missing values exist, and this causes problem estimating the Pearson correlation. The missing data problem is more severe in the data detailing each category of portfolio investments. Therefore, we use the total bilateral portfolio investment data. But even in this case, we have to reduce the number of “receiver” countries to 92 countries.¹⁷

The use of the CPIS data also provides an important correction for a common practice in the study of international financial market. Because of the lack of data on real money flows, most research to date use a similarity measurement between countries' infra-structural and educational profiles as a proxy for similarity in network positions in financial market. The underlying assumption of this strategy is that countries with similar educational and infra-structural profiles will compete for the same pool of capital therefore subject to similar level of peer competitive pressure (Simmons & Elkins 2004). However sound this assumption is, the similarity measurement based on educational and infra-structural profiles doesn't correlate to that based on the actual bilateral portfolio investment flows. For instance, the correlation for year 2001 is -0.0664 — basically uncorrelated. Also, the top 10 competitors in 2001 for Japan in terms of attracting foreign portfolio investments are Sweden, Luxembourg, Britain, Switzerland, Norway, Austria, Iceland, Australia, Israel, and Denmark predicted by similarity in educational and infra-structural profiles. However, the actual top 10 as revealed by the bilateral portfolio investment data are Singapore, India, South Africa, Korea, Bulgaria, Russia, Switzerland, Mexico, Peru, and Egypt — the only overlapping country is Switzerland.

et al. (2005). These countries accounted for 98% of world exports in the last five years. Because of the missing data problem, we only have 65 countries for year 1995. They are Algeria, Angola, Argentina, Australia, Austria, Belgium-Lux (this is actually two countries), Brazil, Bulgaria, Canada, Chile, China, China HK SAR (not a country but economic entity), Colombia, Czech Rep, Denmark, Dominican Rp, Ecuador, Finland, France-Monac (this is actually two countries), Germany, Greece, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Kazakhstan, Korea Rep., Kuwait, Libya, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Fed, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switz.Liecht, Thailand, Tunisia, Turkey, UK, Untd Arab Em, USA, Venezuela, and Viet-Nam.

¹⁴ The weights of 10 sectors (in order of 0 to 9), for example in year 1995, are 0.068, 0.009, 0.045, 0.073, 0.005, 0.098, 0.162, 0.388, 0.129, 0.022 respectively.

¹⁵ See <http://www.imf.org/external/np/sta/pi/datars1.htm>.

¹⁶ See Appendix-C for names of sender countries.

¹⁷ If we are not using the same set of countries for these four years but maximize the number of countries included in each year, we have 106 for 2001, 101 for year 2002, 108 for 2003, and 106 for 2004. We provide a list of country in Appendix C.

4.2.3. *IGO networks and Geography.* The last network we consider is that of inter-governmental organizations (IGO). We used the IGO data on international governmental organizations with at least three independent states as members (Version 2.1) maintained by Jon Pevehouse and Timothy Nordstrom (Pevehouse, Nordstrom & Warnke 2003).¹⁸ Even though scholars have demonstrated the competition mechanism induced by structural equivalence in IGO networks on bilateral trade (Ingram, Robinson & Busch 2005), we so far focus on the aspect of network proximity in this research. Finally, we control for the effects of proximity in geography on convergence.¹⁹

4.3. **Modeling Relational and Network Data.** Relational data, also often referred as social network data, consist of measurements that are made on pairs of objects or under pairs of conditions. The relational data framework has been broadly applied across different disciplines such as epidemiology, the study of protein interactions, and social interactions among individuals. In the analysis of international relations, the unit of analysis is often a pair of countries, typically referred to as a dyad. International political economy often uses flows of goods and services within dyads as the primary object of the study. This research applies a relational/network analysis framework in the study of convergence-divergence phenomena. It models pairwise distance of countries in a multidimensional policy space as a function of network position similarity in trade and portfolio investments, network position proximity in trade and IGO networks, and geographical distance. However, statistical modelling for relational and social network data often provides great challenge to standard statistical models because network data are often of a highly inter-dependent nature. Ignoring these dependencies and employing a somewhat naïve treatment of dyads as independent observations often mischaracterize valuable scientific information. In the following, we explain the nature of higher order dependency in relational and network data, and introduce a latent space model designed specifically to accommodate such dependencies (Hoff, Raftery & Handcock 2002, Hoff 2003, Hoff & Ward 2004, Hoff 2005).

4.3.1. *Second- and Third-order Dependencies in Relational and Network Data.* It is well-known in the social network literature that second- and third-order dependencies are prevalent in most social network environments. Second order dependence refers to what is often described as reciprocity in the context of directed relationship. If one person i perceives person j and his/her friend, it is often the case that j will reciprocate with a similar perception of i . This means that we expect $y_{i,j}$ and $y_{j,i}$ to be positively co-related.²⁰ Fortunately, since our response variable represents an undirected relationship, second-order dependence does not pose a threat to our empirical analysis. Third-order dependence, on the other hand, needs to be taken care of.

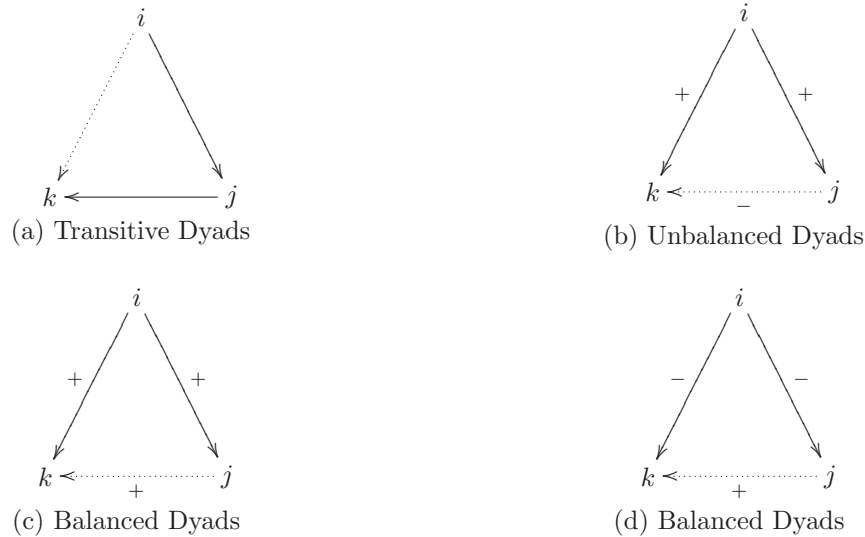
Similar to second-order dependence, third-order dependence is commonly recognized in the literature of social network analysis. Aspects of this higher order dependence include, but is not limited to, (a) transitivity, (b) balance, and (c) clusterability (Wasserman & Faust 1994). *Transitivity* follows the logic of “a friend of a friend is a friend.” In particular, for directed binary data, triad i, j, k is transitive if whenever $y_{i,j} = 1$ and $y_{j,k} = 1$, we also observe that $y_{i,k} = 1$. A triad i, j, k is said to be *balanced* if all pairs of actors relate to one another in an identical fashion, specifically: $y_{i,j} \times y_{j,k} \times y_{k,i} > 0$. The idea is that if the relationship between i and j is “positive” then both will relate to another unit k identically. If $y_{i,j}$ is positive, then to observe balance, $y_{j,k}$ and $y_{k,i}$ are either both positive or both negative. *Clusterability* is a relaxation of the concept of balance. A triad is clusterable if it is balanced or the relations are all negative. The idea is that a clusterable triad can be divided into groups where the measurements are positive within groups and negative between groups.

Consider a triad of countries $\{i, j, k\}$. This triad is composed of three dyads $\{i, j\}$, $\{j, k\}$, and $\{k, i\}$. In a network context, there are six possible links if the data are directional and three if data are non-directional. If we know that country i considers j as an ally and country j is allied with k , then the probability that k will also be allied with i is likely to be higher than for another country outside of this network, since these countries are at least indirectly connected in the alliance network by virtue of their separate linkages to country j . In other

¹⁸ These data are at <http://cow2.la.psu.edu/>.

¹⁹ We calculate distance using the Haversine formula with data on latitude and longitude of capital cities taken from the world.cities database maintained as part of the maps package in the R statistical programming package. These are available from cran.r-project.org. Distance was calculated in 1000s of Kilometers.

²⁰In the study of international trade, strong reciprocity exist among a large number of dyads (Ward & Hoff 2005): we generally expect to see imports from country i to j go up as the flow of commodities in the opposite direction within the same dyad increases. International conflicts also often evince reciprocity at the dyadic level. For instance, India’s aggressive behavior towards Pakistan is likely to induce similar behavior from Pakistan.

FIGURE 6. *Transitivity and Balance in Triads*

words, knowing something about the relationship between countries in the first two dyads in a triad often tells us something about the relations in the third dyad. Treating dyads $\{i, j\}$, $\{j, k\}$, and $\{k, i\}$ as independent from each other, as the way we routinely do in empirical analyses of international relations, can ignore important patterns in these data.²¹

4.3.2. *A Latent Space Model for Relational and Network Data.* As we think about the nature/cause of the third-order dependence in some network data sets, i.e., knowing the relation between i and j as well as the one between j and k tells us something about the relationship between i and k , a conceptualization of a somehow “unobserved” or latent “social space” where every network actor is embedded in is very helpful. As Hoff, Raftery, and Handcock (2002) have described:

In some social network data, the probability of a relational tie between two individuals may increase as the characteristics of the individuals become more similar. A subset of individuals in the population with a large number of social ties between them may be indicative of group of

²¹ The notion that “a friend of a friend is a friend” captures the concept of transitivity in directed binary network data setting and is illustrated in Figure 6. The concept of balance implicates the putative stability in a triad; unbalance therefore creates tension among actors of the same triad. The graph/network composed of a large set of balanced triads is therefore called balanced graph or balanced network. In signed directional relationships such as a friendship network, if i likes j and k at the same time, then the very fact that j dislikes k will create a tension in this triangle: person i might realize that her friendliness with k is inconsistent with her friend j ’s unfriendliness with k —therefore tension is likely to be created in this very simplistic version of network. In an international relations context, we can think of friendship as being amity or cooperation between two countries, composed of friendly actions from one country to another that could include, diplomatic support, military or economic assistance or aid, alliance commitments, among others. On the other hand, negative relations might include hostile behaviors such as criticism, nonsupport in international organizations such as the UN, or even militarized interstate conflicts. Unbalanced networks are not stable and have a strong tendency to become balanced via a dynamic that changes the valences of individual countries for others. For example, i has incentive to change j ’s attitude towards k ; then the triad becomes balanced: in this sense, balance can be thought of as a type of equilibrium in the network context. Clusterability is a relaxed version of balance: a triad is clusterable if it is balanced or the relations are all negative. In short, clusterability means that the network can be decomposed into sets of relatively balanced groupings of dyads. An example is that during the cold war, members of the NATO pact all had mostly cooperative relations with one another, as did members of the Warsaw Treaty Organization, but members in each “cluster” had relatively hostile relations across these two blocs. Thus, while the entire network was not necessarily clustered into one grouping, individual countries could be clustered in terms of their probability of having positive relations with those clustered nearby and negative relations with those located in different clusters, further away.

individuals who have nearby positions in this space of characteristics, or “social space.” Note if some of the characteristics are unobserved, then a probability measure over these unobserved characteristics induces a model in which the presence of two individuals is dependent on the presence of other ties.

Thus, for example, the observation of two links, $i \rightarrow j$ and $j \rightarrow k$, suggests that i and k are not too far away from each other in this social space, therefore are also likely to have a link between them. The third-order dependence is an expression of the underlying probability of a link between two actors. But we don’t observe the complete set of all of these characteristics therefore their relative positions to each other, we have to infer them from what we do observe: the pattern of dyadic linkages. In other words, the “social space” summarizing these unobserved characteristics is another “image” of the third-order dependence in network data. If we can somehow map out the latent positions of each actor in the “social space”, we can then assume that the ties in the network are conditionally independent given these positions. Series of latent models have been recently developed by Hoff, Raftery, and Handcock (2002) and Hoff (2005) where latent vectors, say z_i and z_j , for any two actors i and j are used to locate them in the social space and calculate their distance.

Our response variable is no exception to third-order dependency in relational/network data. In the multi-dimensional policy space, if country i is close to j , and j is close to k , then it is likely that i is not that far way from k . If i and j are close enough to each other, then their distances from k won’t be that different. Also, we are likely to see clusters of countries. The latent space model, by assuming that each node has a vector of latent characteristics and that nodes relate preferentially to others with similar characteristics, addresses third-order dependencies in dyadic data. Moreover, it provides a general approach to incorporate dyadic as well as nodal covariates as predictors in the model:

$$(3) \quad y_{i,j} = \beta'_d x_{i,j} + \beta'_s x_i + \beta'_r x_j + a_i + b_j + \gamma_{i,j} + z'_i z_j,$$

where

$$\begin{aligned} \beta_d x_{i,j} &= d \in \text{dyadic effects} \\ \beta_s x_i &= s \in \text{sender effects} \\ \beta_r x_j &= r \in \text{receiver effects} \\ a_i &= \text{random effect of sender} \\ b_j &= \text{random effect of receiver} \\ \gamma_{i,j} &= \text{reciprocity} \\ z'_i z_j &= \text{cross-product of latent positions for sender and receiver} \end{aligned}$$

Sender here refers to the actor who sends a relationship/tie, be it product sold in the international market or an email sent through the Internet. The actor that receives it, on the other hand, is the receiver in this relationship. Since our dyadic response variable denotes symmetric relationship, i.e., $y_{i,j} = y_{j,i}$, and so far we only consider dyadic/network covariates, we have a reduced, symmetric version of the Model 3:

$$(4) \quad y_{i,j} = \beta'_d x_{i,j} + a_i + z'_i z_j + \epsilon_{i,j}$$

where $\beta'_d x_{i,j}$ represents network covariates: network position similarity and network closeness, i.e., covariates to test our main hypotheses. a_i is the country random effects. The cross product of latent vectors of i and j — $z'_i z_j$ are used to capture the third-order dependencies. $\epsilon_{i,j}$ represents a normally distributed random error because of the perfect reciprocity in symmetric relations.

5. FINDINGS

Applying a latent space model of network data specified as in Equation 4, we want to model the distance between countries in multidimensional policy as a function of similarity in export and portfolio investment networks, proximity in export, IGO network, and geography. We estimate the latent space model in five years respectively: 1995, 2000, 2001, 2002, and 2003. However, because the data are not always available for all these five years, only for year 2001, we manage to have a full set of the five dyadic covariates. Feenstra et al (2005) provides bilateral sector-level trade data from 1962 to 2000 that we use to calculate how similar (by structural equivalence) and close (by shared total volume of bilateral trade) countries are in export networks in year 1995

and 2000. For year 2001, we use the trade data from 2000, assuming a one year lag. We also use one year lag IGO membership data for year 2001 since the IGO data set also ends in 2000. Meanwhile, IMF’s Coordinated Portfolio Investment Survey (CPIS) is only available for year 2001, 2002, 2003, and 2004. Given available data, we try to accommodate as many dyadic covariates as possible for each of the five years and use them to model policy distance in three broad policy areas — size of the government, sound money, and regulations, as well as that in their overall policy profile.

Figure 8 provides a summary of the posterior distributions for the coefficients estimated by the Bayesian bilinear random effects model (as in Equation 4, also see Hoff (2005) for the detailed procedure of MCMC estimation). The first column of panels models policy distance in the space of the size of the government, the second in the space of the sound money—monetary policies, the third regulation policies, and the last column overall policy distance. In every column, from the top to the bottom, rope ladders are plotted to display the effects of dyadic covariates on policy distance over time: the effects of export and portfolio investment network position similarities (measured by structural equivalence), export and IGO network position proximity (by bilateral trade and shared IGO memberships respectively), and closeness in geography. The dot in each panel represents the location of the posterior mean and the gray lines present the 95% confidence intervals.

The first two rows of panels in Figure 8 present the “test results” on the similarity-peer competitive pressure hypothesis of policy convergence (Hypothesis One). The first row tests whether position similarity in export network induces convergence across different policy areas. The results are mixed. In terms of policies that relate to government spending, transfers, and taxation, peer-competitive pressure makes countries converge towards each other as it reduces their distance from each other in this policy space. However, this converging effect disappears in year 2001, uncovered by a 95% confidence interval that includes zero. Moreover, in the space of monetary policies, similarity in export network positions induces divergence among countries, and this diverging effect is consistent for all the three years. In the area of regulation policies, diverging effects of position similarity is significant for the first two years then disappears in year 2001. These inconsistent converging-diverging “mixed” effects of position similarity of the trade network across three different policy areas unsurprisingly result in an undetermined relationship in the space of countries’ overall domestic economic policy profiles.

The second row of panels in Figure 8, on the other hand, shows that position similarity in the network of portfolio investments results in countries’ convergence in domestic economic policies. Except for in the space of regulation policies in year 2001 (the first “rope” in the third panel in the second row) where the relationship is uncertain as indicated by a posterior mean around zero, the structural equivalence measurement of countries’ positions in portfolio investment networks has significant and negative effects on countries’ policy distance in policy spaces. This finding is consistent with that in Simmons and Elkins (2004). The competitive pressure from international financial markets seems to be much more influential for governments than that from the international market of commodities.

Another aspect of the trade network, proximity, has no significant effects on the convergence-divergence phenomena as indicated by the third row of panels in Figure 8. Trade networks, however multi-faceted they are, seem to have little influence on countries’ decisions regarding policy convergence or divergence. If there is any clear relationship between trade and convergence-divergence phenomena, countries tend to diverge their domestic economic policies, counter-intuitive to the convergence logic, when they are competing on similar commodity markets in international economy. Though this relationship is only consistent for monetary policies.

Proximity in IGO networks, however, has the most consistent converging effect on domestic economic policies as shown by the fourth row in Figure 8. The more ties two countries have in the network of inter-governmental organizations, the more similar their profiles of domestic economic policies. The mechanism of policy learning and/or imitation facilitated by the IGO networks is actually driving countries’ domestic economic policy making in a consistent way. Finally, the effects of geography on the convergence-divergence phenomena are mixed. Close neighbors in geography were unlikely to adopt similar economic policies until 2001.

To recap, our first hypothesis — network position similarity induces peer competitive pressure therefore convergence in domestic economic policy convergence, holds for the network of transnational portfolio investment, but not for the trade network. The second hypothesis — closeness/proximity in network positions induces policy convergence is rejected by the trade network (again) but approved by the consistent and positive relationship between proximity in IGO networks and domestic economic policy convergence. A reading of posterior coefficient distributions of dyadic covariates at Table 5 provides more detailed information of the findings for year 2001, on overall policy distance.

6. CONCLUSION AND DISCUSSION

This research has been trying to answer two key questions of the convergence-divergence debate. The first question concerns whether and to what extent countries have been converging to a neo-liberal stereotype characterized by efficiency-mandated domestic economic policies. The second question asks what explains the convergence-divergence phenomena. The first part of this paper visualizes patterns of convergence-divergence phenomena for a group of some seventy important national economies in the past decade and a half. We are able to reveal the overall pattern of policy convergence to a neo-liberal policy profile characterized by small government, stable monetary policies, and business-friendly regulations. However, the extent of convergence varies across different policy areas and different countries. Some Eastern European countries and newly industrialized countries have experienced the highest level of convergence, while wealthy OECD countries' policy profiles changed relatively little during the same period. In addition to the overall trend of convergence, the clustering of countries into different distinct groups has happened, and it is most evident in the area of monetary policies.

To explain the convergence-divergence phenomena, people have been focusing on the economic forces of globalization. However, the network nature of international political economy has often been overlooked by most of the convergence-divergence research to date. New research on policy diffusion has started to approach the question by studying spatial dependence among units of analysis, be it country (Simmons & Elkins 2004, Beck, Gleditsch & Beardsley 2006, Prakash & Potoski 2006) or state in a federal system (Berry & Baybeck 2005). Spatial model often used in these works defines close neighborhood and assumes that the behavior of an "actor" depends on "what her neighbors are doing". This is an indirect way to represent networks, because neighborhood is often, if not always, defined by proximity of members in various networks. This research conceptualizes the global economy as composed of various types of networks and focuses on how the networks of trade, portfolio investment, and inter-governmental organization affect convergence-divergence in countries' domestic economic policies.

We present and test two hypotheses: first, the similarity of network positions induces convergence in domestic economic policies as a result of competitive pressure from other similar countries. Second, proximity in network positions facilitates communication and policy learning which in turn brings about domestic policy convergence among close "neighbors". The empirical findings indicate that proximity in IGO networks has the most consistent converging effect on domestic economic policies. We also find that network position similarity induces convergence through the network of transnational portfolio investment. Trade, the most intensively studied network in international political economy, has no consistent effects on convergence in domestic economic policies. Given the fact that most of the works on convergence-divergence to date use some measure of trade exposure to capture the extent a country is subject to the pressure of globalization, the finding of this research on trade reminds us that the research in this area might have to target some new sources of globalization pressure.

The model of network analysis applied in this paper, on the other hand, has its own conceptual limitations. First, it only models pair-wise policy distance or similarity, but not the absolute measurement of economic policy outcomes. Second, the time dimension of network analysis is problematic in the context of group level convergence. In an extreme case, it is possible that two countries are racing to the neo-liberal "bottom" at the same speed and to the same direction. This results in the fact that their distance in the policy space remains the same but converge does happen. We are not using time series network model to capture convergence over time (but rather analyzing yearly slices of the data), therefore somehow get away with this time dimension problem (by not modeling it in a parametric way). However, we have to account for this possible pattern of group level convergence when we will eventually apply time-series/dynamic network model in the analysis.²² Third, we have not incorporated domestic variables in our analysis, given their obvious importance. The latent space model actually allows for nodal characteristics ($\beta'_s x_i$ and $\beta'_r x_j$ in Equation 3). We will include important domestic variables in future analysis. Finally, the latent space shows clear patterns of clustering of countries, implying possible networks that need to be explored in future analysis.

²²The author is currently involved in a project directed by Peter Hoff and Michael Ward on inferential methods for dynamic social networks (NSF, MSBS-0433927: Longitudinal Network Modelling of International Relations Data). Also see Anton Westveld's work on dynamic network models.

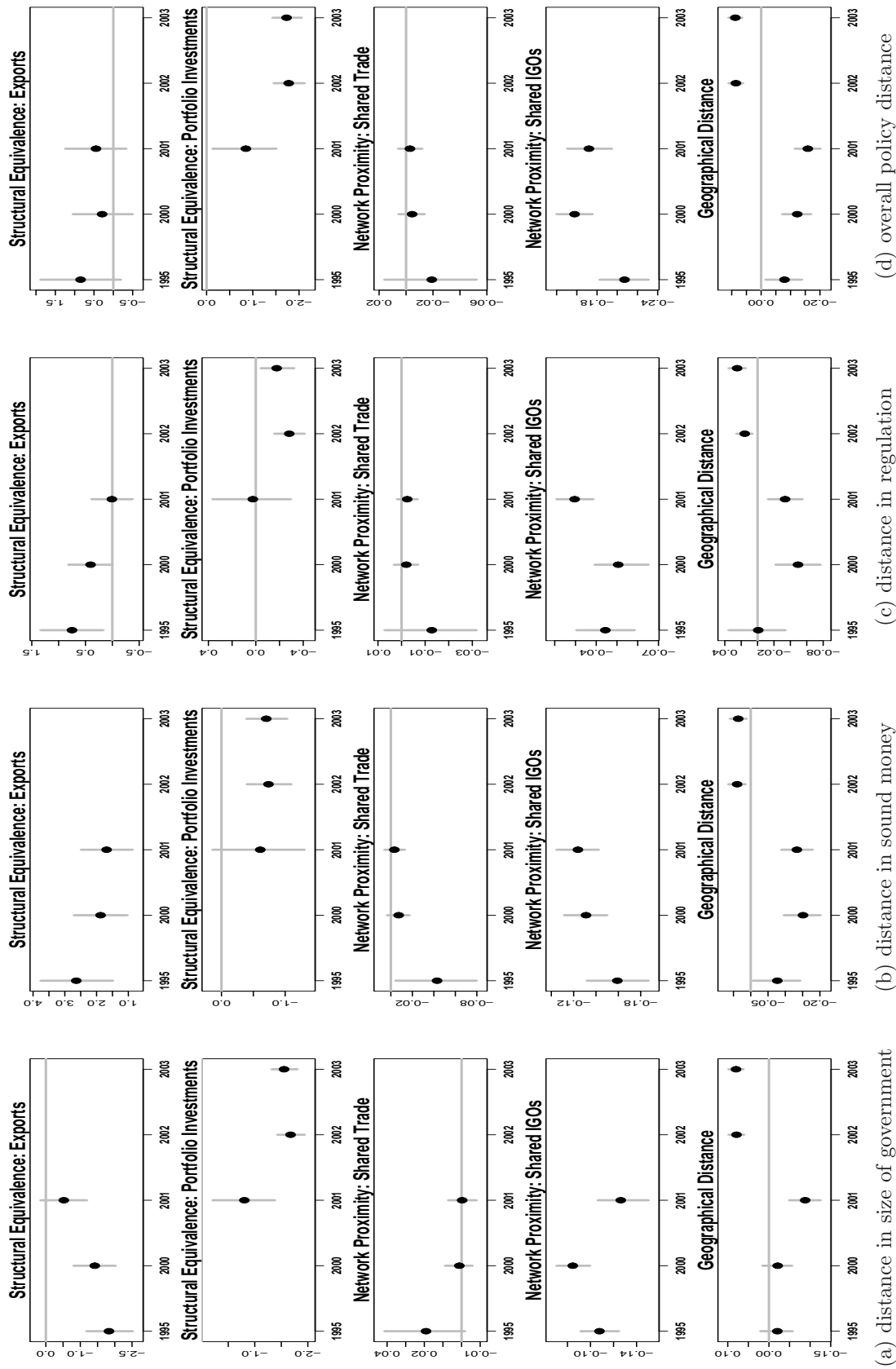


FIGURE 8. Changing effects of dyadic covariates on policy distance, 1995, 2000, 2001, 2002, and 2003. The dot in each panel represents the location of the posterior mean and the gray lines present the 95% credible intervals.

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APPENDIX A. DETAILED DIMENSIONS OF DOMESTIC ECONOMIC POLICIES

A.1. Size of Government: Expenditures, Taxes, and Enterprises. There are four components in this policy area indicating the extent to which countries rely on individual choice and markets rather than the political process to allocate resources, goods, and services. Specifically,

- A. General government consumption spending as a percentage of total consumption;
- B. Transfers and subsidies as a percentage of GDP;
- C. Government enterprises and investment as a percentage of total investment;
- D. Top marginal tax rate (and income threshold at which it applies):
 - i Top marginal income tax rate (and income threshold at which it applies);
 - ii Top marginal income and payroll tax rates (and income threshold at which they apply).

These policies/policy outcomes cover the ways governments collect and spend money: often time the indicators, though not exactly the same, for welfare state/compensation politics (Cameron 1978, Katzenstein 1985, Garrett & Lange 1989, Garrett 1998, Iversen & Cusack 2000) literature and taxation literature (Hallerberg & Basinger 1998, Wibbels & Arce 2003).

A.2. Access to Sound Money. Too much money chasing too few goods invariably leads to inflation. At the same time, when the rate of inflation increases, it often becomes volatile. High and volatile inflation are detrimental for healthy economic activities as it distorts relative prices, alters the fundamental terms of long-term contracts, therefore makes it impossible for individuals and businesses to plan the future. Indeed, low and stable inflation has become the policy objective of most (conservative) central banks in the world (Broz 2002).

- A. Average annual growth of the money supply in the last five years minus average annual growth of real GDP in the last ten years;
- B. Standard inflation variability in the last five years;
- C. Recent inflation rate;
- D. Freedom to own foreign currency bank accounts domestically and abroad.

There are various aspects of monetary policies, and the four indicators listed above characterize some important aspects among them: the supply of money, level and stability of inflation rate, and some form of capital control for citizens. Though there are other measurements of capital market liberalization in the literature (Quinn & Inclan 1997, Simmons & Elkins 2004)

A.3. Regulation of Credit, Labor, and Business. This is the most multifaceted policy area we considered in this research. The details are listed in the following:

- A. Credit market regulations:
 - i Ownership of banks—percentage of deposits held in privately owned banks;
 - ii Competition—domestic banks face competition from foreign banks;
 - iii Extension of credit—percentage of credit extended to private sector;
 - iv Avoidance of interest rate controls and regulations that lead to negative real interest rates;
 - v Interest rate controls—interest rate controls on bank deposits and/or loans are freely determined by the market.
- B. Labor market regulations:
 - i Impact of minimum wage—the minimum wage, set by law, has little impact on wages because it is too low or not obeyed;
 - ii Hiring and firing practices—hiring and firing practices of companies are determined by private contract;
 - iii Share of labor force whose wages are set by centralized collective bargaining;
 - iv Unemployment benefits—the unemployment benefits system preserves the incentive to work;
 - v Use of conscripts to obtain military personnel.
- C. Business regulations:
 - i Price controls—extent to which businesses are free to set their own prices;
 - ii Administrative conditions and new businesses—administrative procedures are an important obstacle to starting a new business;

- iii Time with government bureaucracy—senior management spends a substantial amount of time dealing with government bureaucracy;
- iv Starting a new business—starting a new business is generally easy;
- v Irregular payments—irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications are very rare.

APPENDIX B. COUNTRY NAMES AND ACRONYMS

There are 72 countries in the trade data from Feenstra et al (2005). Their names are corresponding acronyms are listed in Table B-1. All the figures in the paper use these acronyms.

TABLE B-1. *Country names and corresponding acronyms for dyadic sectoral exports data from the Center of International Data at UC Davis. There are 72 countries (regions) that reports sector-level dyad exports/imports data, we choose to use the acronyms from Ward and Gleditsch (1999).*

Country Names	Country Acronyms	Country Names	Country Acronyms
1 Algeria	ALG	37 Kuwait	KUW
2 Angola	ANG	38 Libya	LIB
3 Argentina	ARG	39 Luxemburg	LUX
4 Australia	AUL	40 Malaysia	MAL
5 Austria	AUS	41 Mexico	MEX
6 Belgium: 99-00	BEL	42 Morocco	MOR
7 Belgium–Lux	BEL	43 Netherlands	NTH
8 Brazil	BRA	44 New Zealand	NEW
9 Bulgaria	BUL	45 Nigeria	NIG
10 Canada	CAN	46 Norway	NOR
11 Chile	CHL	47 Oman	OMA
12 China	CHN	48 Pakistan	PAK
13 China HK SAR	CHK	49 Peru	PER
14 Colombia	COL	50 Philippines	PHI
15 Czech Rep	CZR	51 Poland	POL
16 Denmark	DEN	52 Portugal	POR
17 Dominican Rp	DOM	53 Qatar	QAT
18 Ecuador	ECU	54 Romania	RUM
19 Finland	FIN	55 Russian Fed	RUS
20 Fm Czechoslovakia	CZE	56 South Afr.Cus.Union: 84-99	SAF
21 Fm Fed Germany	GFR	57 Saudi Arabia	SAU
22 Fm USSR	USR	58 Singapore	SIN
23 Fm Yugoslavia	YUG	59 Slovakia	SLO
24 France, Monac	FRN	60 Slovenia	SLV
25 Germany	GMY	61 South Africa	SAF
26 Greece	GRC	62 Spain	SPN
27 Hungary	HUN	63 Sweden	SWD
28 India	IND	64 Switz.Liecht	SWZ
29 Indonesia	INS	65 Thailand	THI
30 Iran	IRN	66 Tunisia	TUN
31 Ireland	IRE	67 Turkey	TUR
32 Israel	ISR	68 UK	UKG
33 Italy	ITA	69 Untd Arab Em	UAE
34 Japan	JPN	70 USA	USA
35 Kazakhstan	KAK	71 Venezuela	VEN
36 Korea Rep.	ROK	72 Viet Nam	DRV

APPENDIX C. SENDER COUNTRIES OF PORTFOLIO INVESTMENTS

The countries we choose from IMF's Coordinated Portfolio Investment Survey (CPIS) after deleting cases having missing values are: Argentina, Aruba, Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Bermuda, Brazil, Bulgaria, Canada, Cayman.Islands, Chile, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Gibraltar, Greece, Guernsey, Hongkong (SAR of China), Hungary, Iceland, Indonesia, Ireland, Isle of Man, Israel, Italy, Japan, Jersey, Kazakhstan, Korea (Republic of), Lebanon, Luxembourg, Macao (SAR of China), Malaysia, Malta, Mauritius, Mexico, Netherlands, Netherlands Antilles, New Zealand, Norway, Pakistan, Panama, Philippines, Poland, Portugal, Romania, Russian Federation, Singapore, Slovak Republic, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Vanuatu, and Venezuela.

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