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Strategic Significance: A Model of G-20 Membership

Patrick Eagan-Van Meter
Claremont McKenna College

CLAREMONT MCKENNA COLLEGE

STRATEGIC SIGNIFICANCE: A MODEL OF G-20 MEMBERSHIP

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PROFESSOR BROCK BLOMBERG

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DEAN GREGORY HESS

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PATRICK EAGAN-VAN METER

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Abstract

The membership of the Group of 20 was selected without any official criteria. This paper investigates whether group membership can be explained through the consideration of several different factors that coincide with the mission of the organization. I found strong evidence that membership in the Group of 20 was based on some combination of land mass and economic output. The results demonstrate that these factors are highly predictive of group membership.

Table of Contents

I. Introduction

Visibility of the Group of 20 (G-20) has grown significantly in recent years as a result of the forum's response to the most recent financial crisis. The membership of international organizations is often criticized for not including the right countries. Nations which are not included in the club question whether their exclusion is warranted relative to the other counties which are members. In order to establish whether the correct countries are in the G-20, it is important to understand the reason for the creation of this forum and the criteria utilized to make membership decisions.

Over the past fifty years developed and developing countries around the world created numerous alphanumeric groups in response to a variety of different concerns. The goals of each group varied based on the needs of its member countries and problems afflicting large portions of the world population. Large industrialized nations established the Group of 10 (G-10) specifically so the countries could lend to each other and avoid involving the International Monetary Fund (IMF) to finance balance of payment shortfalls.[1] A few years later the Committee of 20 (C-20) convened every country on the IMF Executive Board which consisted of both developed and developing countries the return the major currencies to fixed exchange rate parities.[2]

The most enduring and one of the more exclusive of these clubs is the Group of 8 (referred to as the G-7 prior to the admission of Russia) which first assembled heads of state of six countries[3] informally in the wake of an oil crisis in 1975 to discuss major issues and, "foster

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[1] Roy Culpeper, "Systematic Reform At A Standstill: A Flock of Gs In Search of Global Financial Stability," in *Critical Issues in International Financial Reform* ed. Albert Berry and Gustavo Indart (New Brunswick: Transaction Publishers, 2003), 208.
[2] Culpeper, 210.
[3] Those invited were France, West Germany, Italy, Japan, the United Kingdom, and the United States. Canada joined one year later in 1976 and Russia was formally admitted to the group in 1997.

cooperation on economic polic[ies]."[4] The informal nature of the group allowed the group to

address a wide variety of topics, and the results of the G-8 summits range from settling debates

over the General Agreement on Tariffs and Trade to placing U.S. missile installations in strategic

locations across Europe.[5] The 1986 summit in Tokyo instituted regular meetings between Finance

Ministers and Central Bank Governors of the member nations.[6] Unlike the IMF or World Bank,

the G-8 does not have any permanent staff or administration. Presidency rotates yearly and the

president hosts the summit and sets the agenda. Since world economic power was so highly

concentrated within the G-7 and G-8, the group dominated the agenda for global financial

governance for nearly three decades.[7]

Globalization in the 1990s connected nations to their trading partners and financial

markets around the world. Financial liberalization measures among emerging market countries to

attract foreign capital and increase exports met with varying degrees of success. Financing from

developed countries poured in to these new markets, creating domestic imbalances and even

crises in some emerging economies. "Unlike crises of previous decades, there were a number of

new ingredients. These included vulnerabilities resulting from rushed or inadequately sequenced

liberalization processes, magnified exposure to imbalances arising from the large stakes

international economic agents had accumulated in emerging markets, contagion effects derived

from greater interdependence, and inflexible exchange rate regimes."[8] Mexico was the first to

experience a crisis in 1994, followed in 1997 by South Korea and many other economies in

Southeast Asia, Russian in 1998, and the Brazilian currency crisis from 1998-1999. Throughout

this period of financial instability traditional crisis indicators such as low growth rate, high fiscal

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[4] Nicholas Bayne, "History of the G7 Summit" *University of Toronto G8 Research Group,* 1997
[5] Bayne, "History of the G7 Summit."
[6] Government of Canada, "History of the Group of Seven," *2010 Iqaluit G7 Web Page*, (Jan 20 2010), http://www.g7.gc.ca/hist-eng.html (accessed March 2011).
[7] Culpeper, 212.
[8] Vanessa Rubio-Marquez, "The G20: A Practitioner's Perspective," In *Networks of Influence?*, ed. Leonardo Martinez-Diaz and Ngaire Woods (New York: Oxford University Press, 2009), 20.

deficits, inflation, and others failed to accurately identify markets about to crash.[9] Due to globalization the balance of economic power shifted more rapidly away from the G-7 countries. The G-7 countries share of world Gross Domestic Product (GDP) was 56.313% in 1980 and declined only 0.491% by 1990, but purchasing power parity dropped by 6.754% between 1990 and 2000.[10]

The contagion effects posed by these new types of crises concerned the developed countries significantly. Beginning in 1998, "there were calls by the leaders of the Group of Seven industrial powers to reform the global financial architecture."[11] Financial crises posed a legitimate threat to globalization and the future of economic openness that the developed nations sought. In addition to reforming the rules of the global economy, the increasing importance of emerging market economies led these countries to pressure the industrialized nations for a larger role in key decision-making bodies. Furthermore, "the G7 understood that the crises originated in a group of middle-income countries, which had recently pursued liberalization processes and were thus more open and vulnerable to external imbalances. Therefore, the problem had to be tackled in cooperation with the representatives of these emerging economies."[12]

During the Asian Financial Crisis in 1998, President Clinton invited "systemically significant" economies to meeting Washington as the Group of 22. This collection of countries included industrial, transitional, and developing economies, though their discussions were, "focused on the minutiae of financial instability rather than on reforming the architecture of the global financial system."[13] Out of this summit came a report on the observance of standards and codes, but more significant was the cooperation displayed by a diverse group of nations in

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[9] Rubio-Marquez, 20.
[10] Calculated using data provided by Economy Watch at www.EconomyWatch.com
[11] Culpeper, 204.
[12] Rubio-Marquez, 21.
[13] Culpeper, 215.

response to a crisis. Consequently, when the G-8 met in September 1999 they unveiled the "Group of 20" countries designated to meet for discussions on financial reform.[14]

In December 1999 in Berlin, the Group of 20 (G-20) finance ministers and central bank governors convened to discuss key economic and financial policy issues to foster greater cooperation towards the goal of stable world economic growth. This group resulted from the need of the Group of 8 Finance Ministers to obtain input and gain support from a broader range of countries in order to build consensus on international issues.[15] The announcement names nineteen countries as well as the European Union as a whole, and representatives of the IMF and the World Bank. The individual countries named to the G-20 included all of the G-8 nations, as well as Argentina, Australia, Brazil, China, India, Indonesia, Mexico, Saudi Arabia, South Africa, South Korea, and Turkey.

This paper will establish a methodology to explore the criteria to select G-20 members. First, existing literature on G-20 membership will be reviewed to establish the criteria that will be considered in the experiment. Then explanatory variables will be introduced and used to represent each criteria, their sources and creation. Next, the relationship between G-20 membership and the explanatory variables will be analyzed. Finally, experimental conclusions will be presented and discussed.

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[14] John Burgess, "Trying to Keep Recovery Going; World Financial Elite Gather to Assess Reform Efforts," *The Washington Post*, 23 September, 1999.
[15] John Kirton, "What is the G-20?," *G-20 Information Centre*, (1999), http://www.g20.utoronto.ca/g20watisit.html (accessed March 2011).

II. Literature Review

To determine the criteria for membership in the G-20, a literary search was conducted to locate sources sanctioned by the organization to see if official metrics were measured or specific conditions prescribed that prospective member countries are required to meet. In the "About G-20" section of the G-20 organizational website, the sanctioned response to the question proclaims "there are no formal criteria for G-20 membership."[16] This is perhaps not surprising since publishing any official guidelines would only be criticized by excluded countries, or those which are close may agitate for inclusion. Without formal standards for members, I will use a combination of G-20 documents, primary, and secondary sources to extrapolate those factors which led to admittance in the club.

While the website and other official documents abstain from sharing the precise basis for G-20 membership, they provide a variety of inexact moderations. Immediately after the G-20 website declines to share the specific factors which countries were judged on, it explains, "it was considered important that countries and regions of systemic significance be included. Aspects such as geographical balance and population played a major part."[17] These characteristics are echoed in the summary of the first meeting of G-20 leaders. The communiqué from the Berlin meeting in December 1999 states that, "the G-20 was established to broaden the discussions on key economic and financial policy issues among systemically significant economies and promote cooperation to achieve

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[16] Group of 20, "Frequently Asked Questions" *G-20 France 2011*, (2011), http://www.g20.org/about_faq.aspx (accessed March 2011).
[17] Group of 20, "Frequently Asked Questions."

stable and sustainable world economic growth that benefits all Both documents mention a 'systemic significance' which is a vague term referring to economic and financial policy issues. This indicates that G-20 membership is contingent on how vital a country is to the functioning of the world economy and financial markets relative to other countries.

A history of the G-20 produced by the organization in 2007 supports this membership theory, explaining "it was accepted, however that countries had to be systemically important to the global economy and have the ability to contribute to global economic and financial stability."[18] Ability to contribute to global economic and financial stability is determined by the size and power of a country's economy and financial market compared to all others. In a 2005 magazine article the first G-20 chairman, Canadian Finance Minister Paul Martin, explained the Asian financial crisis prompted the creation of the new permanent international forum. Prior to 1999, the G-7 had considered creating a broader forum for world economic discussion that included emerging economies, but the crisis's effects on advanced economies spurred the development of the G-20.[19] The official history of the G-20 explains the need to expand the G-7 within the context of, "the increasing interdependence of all countries stemming from the ongoing expansion of cross-border trade and capital flows, and the parallel rise in the exposure of countries to financial shocks emanating from far beyond their borders, underscores the importance of broadening of international economic and financial cooperation."[20] This run-on sentence illuminates a few of the factors determining a country's systemic significance, trade and

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[18] Group of 20, "The Group of 20: A History," *Meeting of G-20 Finance Ministers and Central Bank Governors,* 18 November 2007, 21.
[19] Paul Martin, "A Global Answer to Global Problems" A New Leaders' Forum," *Foreign Affairs*, 2005, 84.3ed.
[20] Group of 20, "The Group of 20: A History," 22.

capital flows. Clues to other factors can be found in the statistics touted in official G-20

materials highlighting common characteristics which demonstrate the relative power of

the members. G-20 countries represent approximately 85% of global gross domestic

product, nearly two thirds of the world's population, and close to 15% of the land mass.[21]

Another factor which G-20 countries dominate the rest of the world are international

reserve holdings, by 2006 the non G-7 members of the G-20 share of global reserves was

43%.[22]

Political freedom is another characteristic which was likely considered when

reviewing countries for membership in the G-20. When the group was first announced on

September 26, 1999, "Indonesia, which [was] being roiled by student riots and by

violence following a vote for independence in East Timor, was left out of the G-20 even

though it is one of the leading economies in Asia and the fourth most populous country in

the world."[23] However, the G-20 assembled three months later for its first meeting in

Berlin, Indonesia attended as a member in good standing. Evidently the omission from

the first announcement was a message to Indonesia to respect the East Timor vote for

independence out of respect for the political freedom of self-determination. One month

after the initial G-20 snub, United Nations forces were permitted to take over the

administration of East Timor.[24] Respect for political freedom as a variable in country

selection is confirmed by the official history of the G-20 which describes Indonesia's

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[21] Group of 20, "The Group of 20: A History," 22.
[22] Group of 20, "The Group of 20: A History," 24.
[23] "Canada to Head New G-20 Group Global Forum Will Tackle Financial Crises," *The Toronto Star*, 26 September 1999: 14.

[24] "UN Official: Indonesia to End Government In East Timor 1999" *BBC Monitoring Asia Pacific*, 27 October 1999.

selection thusly, "the ability of Indonesia to participate effectively in the Group in light of the political instability in the country at that time was also initially an issue. However, such concerns had evaporated by the time of the first ministerial meeting in Berlin in December 1999."[25] By ending the occupation of East Timor, Indonesia achieved the political freedom standard and won membership in the G-20. John Kirton, the founder of the G-20 Research Group sums up the importance of domestic political freedom with this observation, "Indonesia had a place reserved for it once it proved that its embryonic democratic revolution, and the respect for human rights and anticorruption commitment that came with it, were real. Malaysia was excluded, not because of its flirtation with capital controls but because its leader's autocratic treatment of its well respected finance minister defied the basic standards of democracy and the rule of law."[26]

One final factor can be determined from the writings of Vanessa Rubio-Marquez who the Secretary of the G-20 during Mexico's presidency of the organization in 2003. She circumscribes the G-20's initial mandate to three goals, "(1) facilitate agreement on domestic and international action, institutional arrangements, and priorities to prevent and resolve crises; (2) provide legitimacy to the process of globalization, notably by promoting its benefits worldwide to prevent a backlash against it; and (3) build consensus around key international financial issues that would facilitate decision-making within other institutions, primarily the IMF and World Bank."[27] The first and third mandates are largely covered by variables that describe the "strategic significance" of a country

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[25] Group of 20, "The Group of 20: A History," 24.
[26] John Kirton, "From G7 to G20: Capacity, Leadership and Normative Diffusion in Global Financial Governance" *G-20 Research Group Information Centre,* (2005), 5.
[27] Rubio-Marquez, 21.

previously described in this section. In order to adequately represent the second mandate a nation must embody the process of globalization, by demonstrating the aforementioned political freedom as well as levels of economic freedom. According to the IMF, globalization refers to, "an extension beyond nation border of the same market forces that have operated for centuries at all levels of human economic activity."[28] To achieve these aims, "countries must be prepared to embrace the policies needed," that often involve the liberalization of economic restrictions.[29] Rubio-Marquez explains that aside from creating instability, financial crises, "could jeopardize the future of economic openness."[30] If the preservation of economic openness was concern for the organization, then the economic freedom of G-20 countries should be a prize attribute. To legitimize the process of globalization, the G-20 countries model the implementation of economic freedom and reap the benefits to growth and output.

After reviewing the relevant literature I determined that the variables that describe G-20 membership are: trade, foreign investment, foreign exchange reserves, economic output, population, land mass, political freedom, and economic freedom.

III. Data and Methodology

The data portion of this section will take each variable selected to describe G-20 membership, establish a metric used to measure that variable, describe the source used to obtain that data, and the manner in which the data was collected. In the methodology

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[28] IMF Staff, "Issues Brief – Globalization," *The International Monitary Fund*, (2008), http://www.imf.org/external/np/exr/ib/2008/053008.htm (accessed April 2011).
[29] IMF Staff, "Issues Brief."
[30] Rubio-Marquez, 21.

portion I will explain the techniques used to establish the relative ability of each variable to accurately describe the membership of the G-20.

Data

Since the purpose of this investigation is to evaluate the shared attributes of G-20 members using a variety of different factors. For each factor, a metric was selected that described the variation between nations with respect to that factor. Whenever possible, metrics were manipulated to present the relative portion of the world total each country accounted for. This modification normalized the units of independent variables, making comparisons between variables easier. The process of and rational for creating all derived variables will be explained below. To be part of the sample base for the study, a country needed observations recorded for at least six of the eight metrics explained below. One hundred and eighty two countries met this standard for inclusion in the sample.

Factors

Land Mass- A metric for relative land mass was created using the most recent estimates for every country observed in the Central Intelligence Agency (CIA) World Fact Book. Each country's land mass was measured in square miles and divided by the sum of the land mass of every country in the world, to yield the measure of relative land mass.

Population- The metric for population was developed from data furnished by the Penn World Table Version 7. Country populations from 2000-2009 were averaged to control for year-to-year fluctuations and divided by the sum of each country's average to yield the relative average population from 2000-2009.

Economic Output- To capture the total economic output of each country while controlling for brief economic fluctuations such as oil prices, the total real gross domestic product data was averaged from 2000 to 2009, according to the Penn World Table Version 7. The data was normalized by dividing each country's individual average GDP by the sum of every country's average GDP to yield relative share of world GDP from 2000-2009.

Trade- While exports are already factored measured into national GDP, imports must be a independent variable to fully capture each nation's full trade volume. Data on volume of imports for each country was taken from the CIA World Fact Book. This figure was divided by the sum of every country's combined imports to yield the relative share of imports.

Foreign Investment- Foreign direct investment (FDI) measures the inflow of investment to domestic enterprises from investors in other countries. This metric demonstrates how much of the rest of the world's capital is tied to performance in specific domestic economies. To control for year-to-year fluctuations, FDI data from 2000 to 2009 was obtained from the Penn World Tables and averaged. Each country's relative share of FDI was calculated by dividing each nation's average individual FDI during the period by the sum of every country's FDI.

Foreign Reserve Holdings- International reserves encompass all foreign currency deposits, bonds, gold, special drawing rights and IMF reserve positions held by each

individual country.[31] To compute the relative size of each country's international

reserves, I used international reserve estimates compiled by Global Finance Magazine

from the most recent World Bank reports. Each country's estimate was divided by world

aggregate international reserve holdings to yield relative international reserve holdings.

Political Freedom- The metric I choose to assess political freedom was developed by

Freedom House. Freedom House distinguishes between a nation's official government

policies and the freedom of its people. Their annual *Freedom in the World* survey focuses

on the rights and liberties enjoyed by citizens, as Freedom House experts rate each

country based on 10 political rights questions and 15 civil liberties questions. These

answers are translated into an individual country score, from 1 (indicating most free) to 7

(indicating least free) for political rights and civil liberties.[32] Since for all the previous

variables a higher score translated to an increased likelihood of G-20 membership, for

purposes of this study both political freedom and civil liberties scores were totaled,

subtracted from the total amount of points available, and divided by the total number of

points to yield a positive metric for the percentage of points not lost.

Economic Freedom- To represent economic freedom, the metric chosen was the *Index of*

Economic Freedom produced jointly by the Heritage Foundation and the Wall Street

Journal. This index examines ten different characteristics of economic freedom, such as

property rights and freedom from corruption, based on the principles of empowerment of

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[31] Tina Arida, "International Reserves by Country- 2010 Ranking," *Global Finance Magazine,* (2011), Available from http://www.gfmag.com/tools/global-database/economic-data/10212-international-reserves-by-country-2010-ranking.html#axzz1JpUkFeJR, (accessed March 2011).
[32] "Freedom in the World – Methodology," *Freedom House*, (2010), http://www.freedomhouse.org/template.cfm?page=351&ana_page=363&year=2010, (accessed March 2011)

the individual, non-discrimination, and open competition. These categories are rated on a scale from 1 (indicating least free) to 10 (indicating most free). The ten scores are combined to generate an overall country score out of one hundred.[33] For comparison, each country's score was divided by all one hundred points available to derive the measure of economic freedom.

Methodology

This study assumes G-20 countries chosen should rank 1 through 19 based on the membership criteria used to determine admission. To determine what the actual criteria for membership were, variables described above were combined to achieve this perfect ranking. The goal is to model the behavior of the binary dependent variable *G-20 membership* for every country observed, where 1 indicates countries with membership in the G-20 and 0 indicates those excluded, using the explanatory variables described above. This study analyzes G-20 membership through the use of probit regression with multiple regressors and through the creation of derived rankings which combine two or more of the explanatory variables.

Probit Regression

A probit regression is a nonlinear regression model developed specifically to explain the behavior of binary dependent variables like *G-20 membership*. Since binary dependent variables only have values of 0 and 1, probit models can more accurately

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[33] Terry Miller and Anthony B. Kim, "Defining Economic Freedom," In *Index of Economic Freedom* by Terry Miller and others (Washington, DC: The Heritage Foundation, 2011), 21.

model the data because the probabilities they produce only fall between 0 and 1.[34] The

probit regression will demonstrate which explanatory variables are statistically significant

to the probability of G-20 membership thus extraneous variables can be eliminated. For

this reason, the probit model is useful for identifying which variables determine the

majority of the variation between members and non-members.[35] Unlike linear

regressions, Coefficients for the significant variables in a probit model produce a

cumulative normal distribution function which can be applied to a specific country to

determine its z-score, and from that z-score the probability it is a member of the G-20.

Therefore, rankings for the probit model represent the countries in order from

most likely to be admitted to the G-20 to least. Based on the variables included, the probit

model may generate z-scores for certain countries indicating a membership probability of

100%. Rankings using the cumulative normal distribution function produce false

positives and false negatives among countries. False positives identify any countries

which have an argument for admission based on these characteristics. False negatives

highlight those countries which maybe have been included in the G-20 for reasons

outside the hypothesized criteria. Output for the probit model will be applied with actual

country observations to determine predictive ability. This model controls for dissimilar

units of measurement and the use of contiguous and discrete variables together.

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[34] James H. Stock and Mark W. Watson, *Introduction to Econometrics*, 2nd ed. (Boston: Pearson Education Inc., 2007), 389.
[35] Stock, 390.

Derived Rankings

Probit regressions will be helpful to analyze which variables are important to determining the overall movement of the data, but will fail to model G-20 membership accurately when two or more variables are viewed together on a sliding scale. Combining the most significant variables by multiplying their observations together provides a better view of the overall significance of a particular country because relative advantages or deficiencies in particular categories will be magnified. While the inclusion of an additional measure may not change the probability of G-20 membership for most countries, it may have been the criteria to move a country into or out of the top nineteen. Once the factors important to G-20 membership are established, explanatory variables will then be weighted based their perceived importance to the membership process. Evidence of the relative importance of the explanatory variables to the G-20 selection process will be improvement to the predictive rankings when that variable is weighted more heavily.

Weighting for the purposes of this study means applying some percentage to each factor in a derived variable such that the sum of the percentages for all variables will equal one hundred. In order to normalize the effect of the weighting percentage on all the explanatory variables, the weight for each variable will be multiplied by mean of observations for the variable listed in the summary statistics in **Table 1.** The ranking which includes the largest number of G-20 countries in its top nineteen positions will be considered the most descriptive of membership criteria.

IV. Results

The probit model in Column 1 of **Table 2** none of the variables are statistical significant at the 5% level. All of the p-values fall between .35 and .47, so this suggests that many of the explanatory variables could be endogenous thus explain much of the same variation between countries. Coefficients for relative FDI and imports are negative. Since all variables were designed to show positive correlation with G-20 membership, it is unlikely that increases FDI or imports would decrease a country's chances of inclusion in the G-20. None of these relationships can be negatively correlated with G-20 membership, so relative FDI and imports were excluded from the model in Column 2. The result was the GDP became statistically significant at the 5% level and land mass became statically significant at the 10% level.

When FDI and imports were regressed by themselves as a function of G-20 membership on their own in Column 3, FDI maintained the negative coefficient while the coefficient for imports switched to positive and became statistically significant. In Column 4 all the variables not demonstrating significance at either the 5 or 10% levels were eliminated. This left GDP, land mass, and imports to be regressed as a function of G-20 membership. All coefficients in this model were positive, but only GDP and land mass were significant at the 5% level. Imports were excluded from Column 5, and both of the remaining variables showed significance at the 5% level. The resulting probit model was:

Pr(Membership|Land Mass, GDP)=Φ(-3.766754 + 1 144.5543 * Land Mass +228.7388* GDP)

Table 3 shows the rankings by z-value of the cumulative distribution function resulting from the application of this equation to the country observations. The model was highly predictive, ranking seventeen G-20 members in the top nineteen. Eight of the G-20 countries were 100% likely to be included in the G-20. South Africa was the lowest G-20 country on the list with a probability of only 49.18%, but only missed the cut for membership by five places. While GDP had both a larger coefficient and smaller p-value in the model, it is unclear which variable might have received greater weight in the decision-making process.

   To determine which explanatory variables that can be combined to create the most accurate derived variable rankings I assessed the rankings of all the independent variables and observed the following:

 Relative Land Mass – 11/19 G-20 countries concentrated in the top ten, but the distribution of G-20 countries in the ranking is quite wide after that. The United Kingdom and the Republic of Korea lag behind the others in positions 74 and 102 respectively.

Relative Average Population - 10/19 G-20 countries once again concentrated in the top ten, the distribution is small than Relative land mass with all nineteen countries placing in the top fifty. France and the United Kingdom barely miss the cut off at positions 20 and 21, while Saudi Arabia and Australia lag at 44 and 46.

Relative Average Total Gross Domestic Product – 16/19 Most predictive factor for G-20 rankings, with G-20 countries filling sixteen of the top seventeen positions. Distribution of G-20 countries in the rankings is highly concentrated with all countries ranked 26 (South Africa) or better.

Relative Average Foreign Direct Investment – 11/19 More than half of the countries ranked in the top 25 in Foreign Direct Investment were members of the G-20. Though there is a drop of in G-20 countries after position 20, all members placed in the top 50, with Indonesia ranked 50th.

Relative International Reserves- 11/19 Once again more than half of the countries ranked in the top 25 for International Reserves were members of the G-20. Seventeen out of nineteen G-20 countries placed in the top 30 for this variable. All G-20 countries ranked in the top 40, with South Africa ranked 40th.

Political Freedom – 6/19 A discrete variable, six G-20 members received top scores in political freedom. All but three members scored in the top half of countries, while Russia, China, and Saudi Arabia were close to the bottom.

Economic Freedom – 5/19 Another discrete variable, but used a 100 point scale with much more variation in scores from country to country. Wide distribution in member scores, six ranked in the bottom half. The lowest was Russia which ranked 142.

Relative Imports - 13/19 Nine of the top ten places are occupied by G-20 countries. Brazil is ranked 20th, just beyond the cut off. All G-20 members ranked in the top 50, lagging countries were South Africa and Argentina who placed 34 and 46 respectively.

Findings

Total average GDP is the most predictive variable by 16%, properly predicting three more countries than the next closest variable which was relative trade. Land mass, population, FDI, and international reserves were in the next tier of variables. Each placed ranked slightly more than half the G-20 countries in the top nineteen. Variance in G-20 rankings was by far the broadest for land mass. Top population rankings featured the most unique countries, but did not predict G-20 members as accurately. Conversely, international reserves and FDI featured similar countries in the top rankings. G-20 nations were more concentrated near the top for international

reserve rankings. Based the probit regression, derived variables should include GDP and land mass combined as the foundation for the ranking. Political and economic freedom can be employed to drop the ranking of non-G-20 countries which have better relative rankings than members but may have more restrictive societies.

Land mass and GDP when combined with multiplication in **Table 4** rank seventeen G-20 members in the top nineteen countries, and fourteen of the top fifteen. Once again Span and Iran are the non-G-20 countries in the top nineteen, while the members which do not make the rankings change to South Africa at 21 and lagging is South Korea at 36. The majority of non-G-20 countries ahead of South Africa and South Korea were ranked highly based on their relative land mass rather than GDP. The probit coefficients produced a model which balanced land mass and GDP fairly equally. When I tried to use a system of weighting to change the relative importance of land mass and GDP I found that the rankings did not shift at all. Weighting of 60/40, 80/20, or even 99/1 were all attempted on but did not shift the rankings at all. Using multiplication to create derived variables became a limitation when I wanted to change the relative weights of different variables. Regardless of whether .6 or .01 was the initial multiplier, it the same result was created because the function was entirely multiplicative.

Without weighting, the rankings could be further improved by including other types of explanatory variables together. Based on the individual variable rankings, I paired GDP and imports since they had the greatest predicative ability for G-20 membership. This ranking placed fifteen G-20 countries in the top nineteen, and seemed to split the difference between the two categories. Spain remained the top ranked non-G-20 country, but the other three countries included were the small but prosperous countries of the Netherlands, Belgium, and Hong Kong. Consequently, Iran falls significantly and ranks above only two G-20 countries, South Africa and Argentina. South Korea jumps from last in the previous derived ranking to tenth for GDP and

imports. Imports as an explanatory variable provides much unique variation between ranks 11 and 30 but solidifies the general position of G-20 countries at the top of the rankings. Other combinations of two variables do not produce rankings more accurate than GDP and land mass. The discrete variables of political and economic freedom do not have the variance to significantly preference members above non-members when multiplied with only one other variable. In addition, too many G-20 countries lag behind the top twenty countries significantly in both rankings. FDI and international reserves preference developed countries too highly, whereas population improves the ranking of too many low income countries.

For derived variables using three components it is logical to combine the three factors which produced the best results using two variables; GDP, land mass, and imports. This derived variable produces an extremely strong ranking which predicts seventeen of the nineteen countries, and has South Korea and South Africa ranked just outside of the G-20 cut off at positions 20 and 22. None of the other combinations of three variables could balance the characteristics of the G-20 nations as evenly, and they did not produce rankings that model membership as accurately. With three large relative variables modeling G-20 member attributes, I then tried to purge the two remaining non-members from the top nineteen spots. To eliminate Spain without causing collateral damage for other G-20 countries was not possible because Spain ranked higher across all the explanatory variables then the perennial lagging countries of South Africa and Argentina. Trying to remove Spain would be impossible, trying to remove Iran was not.

Variables to remove Iran without shifting the rankings drastically would have to be the descriptive statistics of political or economic freedom where it fared poorly relative to the G-20. Members ranked much higher for political freedom than they did for economic freedom. For political freedom only three G-20 countries ranked in the bottom half, compared to six for economic freedom. In addition, the political freedom scores for Russia and China were not going

to push them out of the top nineteen when balanced with the other variables, though Saudi Arabia would likely lose position. Ultimately, when the new derived variable was created for both political and economic freedom using the factors from the previous derived variable, the one including political freedom was more predictive. **Table 5** shows a near perfect ranking that predicts eighteen out of nineteen possible countries and ranks South Africa just beyond the cut off at position 22. No other ranking generated could dislodge Spain for reasons stated above. Combining all of the explanatory variables multiplicatively into one derived variable produced a strong ranking predicting sixteen of nineteen countries, and all G-20 members placed in the top twenty-five.

V. Conclusion

The variables I choose successfully modeled the G-20 membership using either a probit model or multiplicative combination. Economic output and land mass were the best predictors of G-20 membership, and combining the two factors into one variable enhanced their predictive ability. The most accurate derived ranking utilized GDP, land mass, imports, and political freedom to achieve a near perfect ranking. While the derived ranking model predicted a higher percentage of G-20 countries correctly, 94.7% compared to 89.5%, rankings for both models were very similar and successfully ranked all G-20 countries in the top twenty-five. Adding factors for political freedom and imports improved the rankings, but did not increase the total variation between countries significantly. Since I could develop such an accurate ranking provides empirical evidence that some criteria were used in the selection process for the G-20.

Modeling G-20 membership came very close to predicting all G-20 countries, but even the most accurate ranking produced a false negative and false positive. South Africa was the G-20

country most likely to be left out of the top nineteen in the model used. It lagged behind the other countries (both developed and emerging) in most of the economic indicators, and did not place in the top fifteen in any ranking of the explanatory variables. However, if geographic balance was considered South Africa has a strong case for membership as the top finishing African country in many of these rankings. By offering South Africa membership, the G-20 ensures that the African perspective is represented.

As the false negative, Spain is a more difficult case to understand. Spain was consistently in the top nineteen countries is practically every ranking, while always finishing ahead of a few G-20 members. If geographic balance is considered again, Spain does rank below all the European members in all but one ranking. Moreover, the ranking where Spain places above the European members multiplicatively combines GDP and land mass. As explained above this ranking overstates the importance of land mass to G-20 membership. While Spain is ranked above the United Kingdom, no one would argue that it could match the United Kingdom's "strategic significance" to world affairs. Asia is represented by more countries than Europe, but the breadth interests and geographic regions represented is much greater.

Spain gets indirect representation from both the European Union (EU) and European Central Bank (ECB), but the four European members get extra representation through those same bodies. Whichever country holding the chair of the EU or ECB becomes that organization's representative to G-20 summits. As a political organization, the European Union ranks at or near the top of every ranking. Soon after the creation of the G-20, the EU became a currency union as well, greatly heightening the importance of the ECB to global stability. Since plans for this were known at the time of the creation of the group, including these bodies increase their international legitimacy while expecting that the importance of both bodies in international affairs would grow. In addition, the balance of developed and emerging market countries close to evenly split.

Depending on how developed one considers South Korea, the number of developed countries is either eight or nine, certainly not enough that the inclusion of Spain would have tipped that balance.

It was clear that all the European G-7 countries would all be admitted to the new group, and since including Spain would caused other developed and developing European countries to demand admission, they substituted Spain for broad EU representation. Through this action, the G-20 was able to avoid membership challenges from other European states, and supporting the new organizations in anticipation of their strategic significance. In the process the European members also got extra representation in the group. Since the G-7 countries made the membership decisions, leaving out Spain was the logical decision.

Some level of collinearity between the variables was inevitable in this study of relative global power. Causal relationships between a country's geographic or demographic attributes and the strength of its economic and political systems are complex. However, relative global power or "strategic significance" is not derived in a vacuum. In order for a country to score highly in one attributes, many other conditions must be met. The reason for the creation of the G-20 and focus on economic stability is the collinearity developing between domestic economies around the world. Economic fluctuation in strategically significant countries may have a large affect on many others, but as globalization continues the chain of cause and effect will get longer and longer.

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VII. Appendix

A.1. – List of Countries Used in Sample

Afghanistan	Dominican Republic	Madagascar	South Korea
Albania	Ecuador	Malawi	Spain
Algeria	Egypt	Malaysia	Sri Lanka
Angola	El Salvador	Maldives	St. Kitts & Nevis
Antigua and	Equatorial Guinea	Mali	St. Lucia
Barbuda	Eritrea	Malta	St.Vincent &
Argentina	Estonia	Marshall Islands	Grenadines
Armenia	Ethiopia	Mauritania	Sudan
Australia	Fiji	Mauritius	Suriname
Austria	Finland	Mexico	Swaziland
Azerbaijan	France	Micronesia, Fed. Sts.	Sweden
Bahamas	Gabon	Moldova	Switzerland
Bahrain	Gambia, The	Mongolia	Syria
Bangladesh	Georgia	Montenegro	Tajikistan
Barbados	Germany	Morocco	Tanzania
Belarus	Ghana	Mozambique	Thailand
Belgium	Greece	Namibia	Timor-Leste
Belize	Grenada	Nepal	Togo
Benin	Guatemala	Netherlands	Tonga
Bhutan	Guinea	New Zealand	Trinidad &Tobago
Bolivia	Guinea-Bissau	Nicaragua	Tunisia
Bosnia and	Guyana	Niger	Turkey
Herzegovina	Haiti	Nigeria	Uganda
Botswana	Honduras	Norway	Ukraine
Brazil	Hong Kong	Oman	United Arab
Brunei	Hungary	Pakistan	Emirates
Bulgaria	Iceland	Panama	United Kingdom
Burkina Faso	India	Papua New Guinea	United States
Burundi	Indonesia	Paraguay	Uruguay
Cambodia	Iran	Peru	Vanuatu
Cameroon	Iraq	Philippines	Venezuela
Canada	Ireland	Poland	Vietnam
Cape Verde	Israel	Portugal	Yemen
Central African	Italy	Qatar	Zambia
Republic	Jamaica	Romania	Zimbabwe
Chad	Japan	Russia	
Chile	Jordan	Rwanda	
China	Kazakhstan	Samoa	
Colombia	Kenya	Sao Tome and	
Comoros	Kiribati	Principe	
Congo, Dem. Rep.	Kuwait	Saudi Arabia	
Congo, Republic of	Kyrgyzstan	Senegal	
Costa Rica	Laos	Serbia	
Cote d`Ivoire	Latvia	Seychelles	
Croatia	Lebanon	Sierra Leone	
Cuba	Lesotho	Singapore	
Cyprus	Liberia	Slovak Republic	
Czech Republic	Libya	Slovenia	
Denmark	Lithuania	Solomon Islands	
Djibouti	Luxembourg	Somalia	
Dominica	Macedonia	South Africa	

Table 1

Summary Statistics for movement in country ranking and effect on G-20 membership

      This table shows the spread of the data for all eight independent variables. Observations are for the same 182 countries for each of the eight variables. All variables except for political freedom and economic freedom are relative measures of the particular factor. For variables population, GDP, and FDI, the observation used are relative measures of each country's ten year average from 2009-2000 for the given variable. Countries which received no foreign direct investment for one or more of the years in the sample received the relative average of zero.

	Land Mass	*Pop*	*GDP*	*FDI*	*Int. Reserves*	*Political Freedom*	*Economic Freedom*	*Imports*
Mean	0.0051222	0.00455767	0.0049009	0.005183	0.0054945	0.6686813	0.574357	0.0050359
Standard Error	0.0010369	0.00126015	0.0013117	0.001153	0.0017294	0.0140971	0.012125	0.0010176
Median	0.0009261	0.0009592	0.0004422	0.000411	0.0004435	0.675	0.5955	0.0005375
Mode	#N/A	#N/A	#N/A	0	0	0.9	0	0.0002857
Standard Deviation	0.0139881	0.0170003	0.0176955	0.015552	0.0233305	0.19018	0.163577	0.0137278
Sample Variance	0.0001957	0.00028901	0.0003131	0.000242	0.0005443	0.0361684	0.026757	0.0001885
Kurtosis	33.46165	73.7705867	71.507308	38.26558	106.80442	-1.245351	4.619661	36.580253
Skewness	5.3708052	8.2701303	7.7536728	5.581851	9.7133886	-0.260351	-1.77372	5.4438431
Range	0.1207179	0.17049885	0.1890047	0.140727	0.2775364	0.6	0.897	0.1215205
Minimum	1.28E-06	0.00000517	3.32E-06	-8E-05	0	0.3	0	3.959E-06
Maximum	0.1207192	0.17050402	0.1890081	0.140646	0.2775364	0.9	0.897	0.1215245
Sum	0.9322424	0.8294959	0.8919696	0.943245	1.0000003	121.7	104.533	0.9165336
Observations	182	182	182	182	182	182	182	182

Table 2

Probit regression of G-20 membership as a function of land mass and GDP

Variables	(1) G20	(2) G20	(3) G20	(4) G20	(5) G20
Land Mass	1580.624 (2009.194)	356.0672 (195.3199)*		156.0785 (68.1347)**	144.5543 (56.05755)**
Population	859.3974 (1124.527)	193.1535 (155.8113)			
GDP	2009.248 (2183.301)	175.9412 (79.98527)**		202.2771 (99.59951)**	228.7388 (61.57636)**
FDI	-386.3259 (404.3164)		-30.71665 (28.2074)		
Int. Reserves	480.6235 (546.8212)	80.58928 (61.96879)			
Political Freedom	22.24308 (31.29418)	4.160792 (3.710946)			
Economic Freedom	73.71836 (86.82592)	9.296886 (8.726694)			
Imports	-973.0273 (1143.444)		149.8089 (38.92803)**	26.73069 (81.05456)	
Successes completely determined	14	8	3	8	8
Observations	182	182	182	182	182

Standard Errors in Parenthesis
*= Statistical significance at 10% level   **= Statistical significance at 5% level

Table 3

Rankings based z-scores as determined using the probit model

Countries ranked by z-score produced from the coefficients and constant yielded by the probit model for explanatory variables land mass and GDP. Spain and Iran are non-members of the G-20 who were ranked in the top nineteen. Turkey and South Africa are G-20 members ranked outside of the top nineteen, and the line separates places nineteen and twenty.

Country	β GDP	GDP	β Land Mass	Land Mass	Constant	Z-Value
United States	228.7388	0.189008051	144.5543	0.069379537	-3.766754	53.2625852
China	228.7388	0.10872873	144.5543	0.067757681	-3.766754	34.6651434
Russia	228.7388	0.026814269	144.5543	0.120719176	-3.766754	23.5839397
Canada	228.7388	0.017802486	144.5543	0.070495033	-3.766754	14.2624794
Japan	228.7388	0.060507969	144.5543	0.002668203	-3.766754	14.2262204
Brazil	228.7388	0.021995283	144.5543	0.060117814	-3.766754	13.7214632
India	228.7388	0.042914566	144.5543	0.023209151	-3.766754	13.1712089
Australia	228.7388	0.011776492	144.5543	0.054655543	-3.766754	10.5944344
Germany	228.7388	0.040863177	144.5543	0.002520692	-3.766754	9.71137094
France	228.7388	0.029935271	144.5543	0.004542805	-3.766754	7.50403996
U.K.	228.7388	0.031220949	144.5543	0.001719966	-3.766754	7.39007089
Italy	228.7388	0.026718311	144.5543	0.002127559	-3.766754	6.4190622
Mexico	228.7388	0.018809893	144.5543	0.013869129	-3.766754	6.30739459
Spain	228.7388	0.018626881	144.5543	0.003568077	-3.766754	4.77647128
Indonesia	228.7388	0.012151525	144.5543	0.013446879	-3.766754	4.72332943
Argentina	228.7388	0.006225904	144.5543	0.019630533	-3.766754	4.26178377
Iran	228.7388	0.009964357	144.5543	0.011636795	-3.766754	3.96138382
South Korea	228.7388	0.016747396	144.5543	0.000704056	-3.766754	3.93255359
Saudi Arabia	228.7388	0.0068992	144.5543	0.015177514	-3.766754	3.77208964
Kazakhstan	228.7388	0.002105765	144.5543	0.019238684	-3.766754	3.26270466
Turkey	228.7388	0.010425627	144.5543	0.005532204	-3.766754	3.18444929
Algeria	228.7388	0.002707339	144.5543	0.01681587	-3.766754	3.05007979
Sudan	228.7388	0.001115323	144.5543	0.017691859	-3.766754	2.81255194
D. R. Congo	228.7388	0.00021093	144.5543	0.016555464	-3.766754	2.44141138
South Africa	228.7388	0.005060411	144.5543	0.008607174	-3.766754	2.40171635
Poland	228.7388	0.008180247	144.5543	0.002207658	-3.766754	2.19026634
Colombia	228.7388	0.004305449	144.5543	0.008041077	-3.766754	2.14719549
Netherlands	228.7388	0.009160052	144.5543	0.000293307	-3.766754	2.13765809
Thailand	228.7388	0.007045981	144.5543	0.003622795	-3.766754	2.13537983
Egypt	228.7388	0.004787119	144.5543	0.007070564	-3.766754	2.11708029
Libya	228.7388	0.001364913	144.5543	0.012422927	-3.766754	2.10799608
Pakistan	228.7388	0.005401514	144.5543	0.005620691	-3.766754	2.04803088

Table 4

Derived ranking calculated by multiplying land mass and GDP

Iran and Spain are non-members of the G-20 who were ranked in the top nineteen. South Africa and South Korea are G-20 members ranked outside of the top nineteen, the line separates places nineteen and twenty.

Country	GDP	Land Mass	Total
United States	0.189008051	0.069379537	0.013113291
China	0.10872873	0.067757681	0.007367207
Russia	0.026814269	0.120719176	0.003236996
Brazil	0.021995283	0.060117814	0.001322308
Canada	0.017802486	0.070495033	0.001254987
India	0.042914566	0.023209151	0.000996011
Australia	0.011776492	0.054655543	0.000643651
Mexico	0.018809893	0.013869129	0.000260877
Indonesia	0.012151525	0.013446879	0.0001634
Japan	0.060507969	0.002668203	0.000161448
France	0.029935271	0.004542805	0.00013599
Argentina	0.006225904	0.019630533	0.000122218
Iran	0.009964357	0.011636795	0.000115953
Saudi Arabia	0.0068992	0.015177514	0.000104713
Germany	0.040863177	0.002520692	0.000103003
Spain	0.018626881	0.003568077	6.64622E-05
Turkey	0.010425627	0.005532204	5.76767E-05
Italy	0.026718311	0.002127559	5.68448E-05
U.K.	0.031220949	0.001719966	5.3699E-05
Algeria	0.002707339	0.01681587	4.55263E-05
South Africa	0.005060411	0.008607174	4.35558E-05
Kazakhstan	0.002105765	0.019238684	4.05122E-05
Colombia	0.004305449	0.008041077	3.46204E-05
Egypt	0.004787119	0.007070564	3.38476E-05
Pakistan	0.005401514	0.005620691	3.03602E-05
Thailand	0.007045981	0.003622795	2.55261E-05
Peru	0.00258767	0.009074045	2.34806E-05
Nigeria	0.003513167	0.006522104	2.29132E-05
Venezuela	0.003253182	0.006439371	2.09484E-05
Sudan	0.001115323	0.017691859	1.97321E-05
Ukraine	0.004255771	0.00426126	1.81349E-05
Poland	0.008180247	0.002207658	1.80592E-05
Libya	0.001364913	0.012422927	1.69562E-05
Sweden	0.004800233	0.00317923	1.5261E-05
Chile	0.002709264	0.005338327	1.44629E-05
South Korea	0.016747396	0.000704056	1.17911E-05
Malaysia	0.004224803	0.002328828	9.83884E-06
Norway	0.003398001	0.002286148	7.76833E-06

Table 5

Derived ranking calculated by multiplying GDP, land mass, imports and political freedom

Spain is the only non-member ranked in the top nineteen. South Africa is the only G-20 country ranked outside of the top nineteen. The line represents delineates between ranks nineteen and twenty.

Country	Land Mass	GDP	Imports	Political Freedom	Total
United States	0.06938	0.189008	0.121524	0.9	0.001434227
China	0.067758	0.108729	0.083464	0.35	0.000215214
Canada	0.070495	0.017802	0.025952	0.9	2.9313E-05
Russia	0.120719	0.026814	0.015154	0.45	2.20738E-05
India	0.023209	0.042915	0.020882	0.75	1.5599E-05
Brazil	0.060118	0.021995	0.011986	0.8	1.26798E-05
Australia	0.054656	0.011776	0.012797	0.9	7.41336E-06
Germany	0.002521	0.040863	0.071523	0.9	6.63036E-06
Japan	0.002668	0.060508	0.040666	0.85	5.58057E-06
France	0.004543	0.029935	0.036892	0.9	4.5152E-06
Mexico	0.013869	0.01881	0.019541	0.75	3.82334E-06
U.K.	0.00172	0.031221	0.034899	0.9	1.68664E-06
Italy	0.002128	0.026718	0.029356	0.85	1.41843E-06
Spain	0.003568	0.018627	0.020729	0.9	1.23991E-06
Indonesia	0.013447	0.012152	0.007095	0.75	8.69466E-07
Turkey	0.005532	0.010426	0.01062	0.7	4.28761E-07
Argentina	0.019631	0.006226	0.00336	0.8	3.28487E-07
South Korea	0.000704	0.016747	0.026687	0.85	2.67467E-07
Saudi Arabia	0.015178	0.006899	0.006333	0.35	2.32099E-07
Iran	0.011637	0.009964	0.003766	0.4	1.74662E-07
Poland	0.002208	0.00818	0.01069	0.9	1.73749E-07
South Africa	0.008607	0.00506	0.00492	0.8	1.71426E-07
Thailand	0.003623	0.007046	0.01002	0.55	1.40668E-07
Sweden	0.003179	0.0048	0.010128	0.9	1.39109E-07
Malaysia	0.002329	0.004225	0.011131	0.6	6.57079E-08
Netherlands	0.000293	0.00916	0.02608	0.9	6.30628E-08
Colombia	0.008041	0.004305	0.002316	0.65	5.21073E-08
Algeria	0.016816	0.002707	0.002367	0.45	4.84978E-08
Ukraine	0.004261	0.004256	0.003419	0.75	4.6503E-08