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Trade-growth nexus: A study of G20 countries using simultaneous equations model with dynamic policy simulations

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1. Introduction

The relationship between international trade and economic growth has been long debated among economists. Several studies have been conducted with different sets of countries using various methodologies. Still, this problem is far from being resolved. The growth literature runs into the problem of endogeneity, while empirical policy literature has struggled to establish a clear link between trade openness and economic growth. Even though long-term growth and technological enhancements appear to contribute to changes in the international trade patterns, the evidence for these effects is inconclusive. This can be attributed to the fact that many of these studies in the past have used a partial approach like single equation type estimations and often deal with only one aspect of the issue. The problem needs to be studied with a more wholesome approach addressing the simultaneity issue and analyzing the most quantitative aspects of the relationship between international trade, industrialization, and economic development.

To address these issues and investigate the relationship between trade openness and economic growth, in this paper, we use the simultaneous equations model of trade and development

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proposed by Salvatore (1983). We perform this study for G20 countries (19 countries excluding the European Union) for 2004–2019.

1.1. Background of G20

The Group of Twenty (G20) is an international forum for the governments and central bank governors from 20 major economies. The members include 19 individual countries[1] and the European Union (EU) represented by the European Commission and the European Central Bank. The G20 was founded in 1999 to study, review, and promote high-level discussions about international financial stability policy issues. It addresses the issues that go beyond the responsibilities of any one organization. The G20 heads of the government or states have periodically conferred at summits since their initial meeting in 2008. The group also hosts meetings of finance ministers and central bank governors. With its growing stature after its inaugural leaders' summit in 2008, on September 25, 2009, the leaders of the G20 announced that the group would replace the G8 as the main economic council of wealthy nations.

The group was formally established in September 1999, and its first meeting was conducted in December of that year. It functioned as a collaboration of finance ministers and central bank governors formed in the aftermath of the 1997–98 financial crisis, which revealed the international financial system's vulnerability in the context of economic globalization and demonstrated that key developing countries were insufficiently involved in discussions and decisions about global economic issues. The G20's goals include a) policy coordination among members to achieve global economic stability and sustainable growth, b) financial regulation to minimize risks and prevent future financial crises, and c) modernizing international financial architecture.

Collectively, the G20 nations account for around 85 % of the gross world product (GWP), 80 % of world trade (or, if excluding EU intra trade, 75 %), and two-thirds of the world population. The G20 consists of advanced as well as developing countries. Also, the G20 nations are from different continents and geographical regions, which makes it a good approximation for the whole world. We can generalize the results of a study that we get here for the whole world, of course, with some limitations.

1.2. Related literature

In the past, empirical studies on the relationship between trade liberalization and economic growth have generated mixed results. Balassa (1971) and Little et al. (1970) were the first to address this issue. Many economists since then have attempted to relate the trade policy variables to economic performance and growth. The research can be divided into two groups, firstly, the multi-country studies that detail the experience of some countries subject to trade reforms, and secondly, the cross-country econometric studies that analyze the relationship between trade openness and economic growth. While early empirical studies supported the idea that trade openness is positively related to economic growth, more recent studies have raised doubts about whether these results reject causal influences of trade on growth. The empirical literature on trade and growth can be categorized into a) trade openness and economic growth and b) trade barriers and economic growth.

[1] Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, South Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, and the United States.

The fundamental problem with empirical analyses of the trade-growth link has been how to measure openness. The most obvious approach is to use the simple concept of the total trade volume (exports plus imports) as a share of GDP, as described in Edwards (1993). Many studies have used trade shares in GDP and found a positive and robust relationship with growth, as reviewed in Harrison (1996). However, the size of these effects is often relatively small, and the empirical methods used to estimate the effects have been subject to substantial criticism, e.g., endogeneity issues. The impact of trade on economic performance was investigated by Cadoret et al. (2014). For 1975, 1980, 1985, 1990, 1995, 2000, 2005, and 2010, the study looked at a panel of 130 countries. The Controlling for the endogeneity of international trade with the geographic variables, Frankel and Romer (1999) and Irwin and Terviö (2002) showed that when comparing the IV estimates of cross-country regressions of income on trade and other factors with the OLS estimates indicate that the OLS estimates understate the effects of international trade on income study findings reveal that trade boosts growth in diverse ways worldwide. The authors argue that geographic location can significantly impact the trade-income relationship. However, Irwin and Terviö (2002) and Rodriguez and Rodrik (2000) report that significant and higher IV estimates of trade shares are not robust in including geographical variables such as latitude and tropical climate. More importantly, Rodrik et al. (2004) showed that when entering growth regressions with institutional quality factors measured by the rule of law and property rights, neither the geographical variables nor the trade shares are significant. In addition, export shares and import shares in GDP are also used and enter positively in cross-country growth regressions.

Another approach adopted by many researchers to study this problem has been using the cointegration and causality analysis. Çakmak and Termurlenk (1995) used cointegration tests and Granger causality to investigate the causal link between export expansion and economic growth in Turkey from 1968 to 1993. In terms of causality testing, the study does not support the premise of Turkey's export-led growth. The findings are counterintuitive to popular belief. Many development economists have come to the same conclusion for many developing countries.

On the other hand, Aurangzeb (2003) used cointegration and Granger causality techniques to create a multivariate model to assess the causation between exports, investment, and economic growth in Pakistan and found a solid bi-directional causality between exports and investment growth to GDP growth. The findings also show that export growth promotes import growth, GDP growth causes investment growth, but not the other way around. The study argues that exports and investment are engines of growth in Pakistan. Throughout the investigation, the causal inferences are somewhat consistent. Rahman and Mustafa (1997) investigated the relationship between real exports and real economic development in 13 Asian countries, and Tripathi (2016) studies the trade openness and economic development relationship for G-20 countries using cointegration tests and error correction processes. Individual country-wise analyses show the evidence of cointegration, and short-run and long-run Granger causality, including the directions thereof, varies from one country to another.

Aditya and Acharyya (2013) looked at the export-growth link in 65 countries from 1965 to 2005, using GMM approaches to look at both diversification and the character of the export composition. After adjusting for the effects of other factors such as lagging growth, exports, investments, and infrastructure, the dynamic panel reveals that export diversification and composition are major determinants of economic growth. The link between export concentration and income is nonlinear in this study. The study also shows that their economic growth accelerates as countries get more specialized. These findings on the relationship between exports and economic growth have far-reaching implications for growth.

Gries and Redlin (2012) looked at the short- and long-term dynamics of per capita GDP growth and openness for 158 nations over 1970–2009. The research investigates the causal relationship between openness and economic growth using panel cointegration tests and panel error correction models (ECM) paired with GMM estimates. The findings imply a long-run link between openness and economic growth, with a short-run adjustment to the divergence from equilibrium for both dependent orientations. The long-run coefficients show a significant positive correlation between openness and growth, implying that international integration is a good strategy for long-term growth. On the other hand, the short-run coefficient reveals a negative short-run adjustment, implying that openness can be difficult for an economy going through short-term changes. The data was also separated into income-related subpanels, which the authors investigated. While the long-run effect remains overwhelmingly positive and significant, the short-run adjustment becomes positive when income levels rise. The findings imply that different trade systems have varied effects on economic growth in low- and high-income nations.

Going through the above literature, we see that the relationship between trade openness and economic growth is still far from conclusive. So, in this paper, we investigate the relationship between trade openness and economic growth for G-20 countries from 2004 to 2019 while addressing the simultaneity nature of the problem. We use the simultaneous equations model developed in Salvatore (1983). The model is estimated by Full Information Maximum Likelihood and validated by dynamic simulations. Further, the results are utilized to conduct dynamic policy simulations.

2. Model and methodology

This paper employs the simultaneous equations model of trade development proposed by Salvatore (1983)[2]. In this section, we detail out the equations of the model, the description of the variables under study.

The first equation of the model measures the growth in real per capita GDP (DY),

$$DY_t = a_0 + a_1 I_t + a_2 R_t + a_3 DX_t \tag{1}$$

where

DY_t= growth of real per capita income in year t.

I = gross fixed capital formation as a percentage of GDP.

R = industrial output (manufacturing plus construction) as a percentage of GDP.

DX = growth in the percentage of exports to GDP.

The second equation measures the rate of capital formation. It incorporates the importance of domestic savings and foreign capital inflows, i.e., $I = G(S, F)$. Further, the domestic savings depend on the real per capita income (Y) and growth rate of the real per capita income (DY), and the rate of exports, i.e., $S = H(Y, DY, X)$. Thus, I is a function of and positively related to Y, DY, X, and F as described in Eq. (2).

$$I_t = b_0 + b_1 Y_t + b_2 DY_t + b_3 X_t + b_4 F_t \tag{2}$$

where

I_t= gross fixed capital formation as a percentage of GDP in year t.

[2] We attempted to improve the model by including the level of real per capita income (Y) in the first equation of the model, including the degree of technology absorption in the third equation, and the level of protectionism and the extent of the black market in the fourth equation - and they did not improve the fit of the model.

Y = real per capita income in US dollars.

DY = growth of real per capita income.

X = exports as a percentage of GDP.

F = capital inflows (net imports of goods and services) as a percentage of GDP.

DY in Eq/ (2) establishes the simultaneity links in the model, whereby DY is a function of I in Eq. (1), and I is a function of DY in Eq. (2). Further, DY is directly related to DX in Eq. (1) and indirectly related to X (through the effect of X on I) in Eq. (2).

Next, as industrialization is an important policy for an economy, the third equation of the model includes industrial output as a percentage of GDP in year t (R_t) that depends on the growth rate of the domestic economy and growth rate of the exports as summarized by DY_t, on the rate of exports (X_t) and on the rate of industrial output in the previous year (R_{t-1}),

$$R_t = c_0 + c_1 DY_t + c_2 X_t + c_3 R_{t-1} \tag{3}$$

The fourth equation of the model describes the exports, which depend on the relative competitive position of the nation as well as on the conditions of the world markets. The level of industrialization is also expected to affect the rate of exports.

$$X_t = d_0 + d_1 P_t + d_2 W_t + d_3 R_t \tag{4}$$

Where X and R are as defined previously and.

P = ratio of the consumer price index (CPI) in the nation relative to the consumer price index (CPI) of all market economies.

W = index of real GDP of all market economies.

We estimate the above model using Full Information Maximum Likelihood (FIML). Cowles Commission proposed FIML in the 1950s, which tries to estimate all the equations simultaneously in a grand scheme of joint likelihood functions. Errors are assumed to be distributed normally. FIML estimates are the most efficient in nonlinear systems as per asymptomatic theory. FIML has several advantages over other instrumental variables methods like the three-stage least squares (3SLS) under normality assumption for error terms (Amemiya, 1977) and is consistent for a broad class of error distributions (Phillips, 1982).

Contrary to 3SLS, which forms the instruments from unrestricted estimates of reduced form equations, FIML may be interpreted as an instrumental variable's estimator. All the nonlinear restrictions on the reduced form coefficients are considered in forming the instruments (Hausman, 1975). As a result, FIML uses more information about the model than 3SLS. Further, in contrast to instrumental variable estimators, where the choice of instruments could be more complex in nonlinear models (Hayashi, 2000), the asymptomatic efficiency of FIML does not depend on the choice of instruments as the optimal instruments are generated within the estimation procedure.

3. Empirical results and analysis

3.1. Estimation, validation, and implications of the model

We estimate the model using FIML separately for all the 19 G20 nations (excluding the European Union), eight advanced nations, and 11 developing nations for 2004–2019. Table 1 presents the estimates and standard errors of the model's parameters. From Table 1, we can see that the signs of the 13 slope coefficients are identical for all the three groups (All G20 nations,

Table 1
Full Information Maximum Likelihood estimates, 2004–2019.

	All G20		Advance G20		Developing G20	
Parameter	Estimated coefficient	Standard error	Estimated coefficient	Standard error	Estimated coefficient	Standard error
$DY_t = a_0 + a_1I_t + a_2R_t + a_3DX_t$						
a0	-4.8903***	1.8496	-2.2995	1.8952	-3.1709	2.0816
a1	0.2322**	0.1102	0.1321	0.0824	0.2200*	0.1212
a2	0.0506	0.0352	0.0088	0.0665	0.0165	0.0488
a3	0.0470**	0.0232	0.1303***	0.0179	0.0722**	0.0318
$I_t = b_0 + b_1Y_t + b_2DY_t + b_3X_t + b_4F_t$						
b0	15.9410***	3.1708	10.5581***	3.5628	12.4426***	3.6032
b1	0.0000	0.0000	0.0004***	0.0001	0.0000	0.0001
b2	1.8313***	0.4815	0.0872	0.2465	1.2091*	0.6379
b3	0.1591	0.1421	-0.2040**	0.0966	0.3545**	0.1601
b4	-0.1127	0.0824	0.1712	0.1892	-0.1895	0.1334
$R_t = c_0 + c_1DY_t + c_2X_t + c_3R_{t-1}$						
c0	0.1155	1.5663	-0.1290	1.0675	-0.7256	1.4286
c1	0.7235***	0.1771	0.5648***	0.0716	0.7278**	0.2856
c2	0.0200	0.1568	0.0082	0.0305	0.0557	0.2940
c3	0.9176***	0.0946	0.9685***	0.0301	0.9037***	0.2031
$X_t = d_0 + d_1P_t + d_2W_t + d_3R_t$						
d0	5.5799	5.1835	-28.4272	23.1250	2.8025	6.2458
d1	-0.0209	0.0287	0.1906*	0.1098	-0.0373	0.0355
d2	0.0000	0.0000	0.0000***	0.0000	0.0000	0.0000
d3	0.6180***	0.0799	0.2483	0.4194	0.7401***	0.1103
Number of observations	304		128		176	

Note: ***, ** and * represents significance at 1 %, 5 % and 10 % respectively.

Advance G20 nations, and Developing G20 nations), except for b3, b4, and d1 for the Advance G20 nations. These absolute slope coefficients differ significantly across these three groups.

Firstly, looking at the results for All G20 nations together, we can see that the model fits the data well. All the model's estimated coefficients have the theoretically expected sign, and most are statistically significant at better than the 5 % level. DY depends on I and DX; I primarily depends on DY; R on DY and lagged R; and X on R. Trade is positively related to growth, but as the value of coefficient a3 is small and b3 is statistically insignificant, we must regard trade as a handmaiden of growth rather than the engine of growth. We also see that exports are positively related to industrialization, but the magnitude of c2 is small and statistically insignificant. On the other hand, R is positively related to X and is statistically significant.

Next, we look at advanced and developing G20 nations separately to investigate the relationship between trade and growth. Looking at the estimated coefficients for Advance G20 countries from Table 1, we see that all the estimated coefficients have the predicted signs, and most are statistically significant at the 5 % level. DY primarily depends on DX; I on Y and X; R on DY and lagged R; and X on P and W. Trade is positively related to growth, as a3 is positive and statistically significant and higher in magnitude when compared to All G20 nations. Coefficient b3 is negative and statistically significant, suggesting a negative impact of the increase in exports on capital formation. This suggests that trade is a handmaiden for the Advance G20 nation rather than a growth engine.

Table 2
Historical and simulated average annual values, 2004–2019.

	All G20				Advance G20				Developing G20			
	DY	I	R	X	DY	I	R	X	DY	I	R	X
Historical	2.18	23.81	29.21	27.35	0.96	21.50	23.26	26.16	3.07	25.50	33.54	28.22
Model	2.21	23.99	29.19	27.21	0.97	21.48	23.26	26.17	3.03	25.55	33.53	28.27
RMSE	3.03	5.24	1.35	9.15	1.60	2.13	0.64	9.54	3.66	6.25	1.65	8.33

Further, we also see that exports are positively related to industrialization, but the magnitude of c2 is very small and statistically insignificant. Also, R is positively related to X but is statistically insignificant. The ratio of prices in the nation relative to market prices has a positive and statistically significant (at 10 %) effect on exports. This effect was negative in the case of All G20 nations, suggesting a competitive edge in price levels has a positive impact on exports for advanced nations.

For developing G20 nations, we see that the estimated coefficients have the predicted signs, and most are statistically significant at 5 %. DY depends on I and DX; I on DY and X; R on DY and lagged R, and X on R. Trade is positively related to growth, as a3 is positive and statistically significant and higher in magnitude when compared to All G20 nations but lower when compared with advance G20 nations. Coefficient b3 has a strong positive and statistically significant impact on capital formation. This suggests that growth for developing G20 nations is driven by exports (also via capital formation). We also see that exports are positively related to industrialization, but the magnitude of c2 is small and statistically insignificant. On the other hand, R has a strong positive and statistically significant effect on exports. During the study period, the index of real GDP of market economies has a very low magnitude but positive impact on exports.

It is important to note that trade positively affects growth for advanced G20 nations and developing G20 nations. However, for developing G20 nations, trade also positively impacts capital formation, leading to growth.

It is important to test the validity of the estimated model and the coefficients. To do that, we perform a dynamic simulation of the model over the sample period.[3] Using the exogenous time series but only the starting values of the endogenous variables, the model generates historical simulated values for the endogenous variables. Table 2 presents the historical and simulated average annual values for the study period. We see that the simulated values are close to the historical values, with DY diverging less than 1.6 %, and I, R, and X generally by less than 0.7 %.

Even though the model is highly aggregative and was formulated to analyze average long-run growth, it also captures relatively well most short-run intercountry variations in DY, I, R, and X. Table 3 presents Theil's inequality coefficients (T) and their decomposition into bias (B), variance (V), and covariance (C) proportions. T values suggest 50 % or more of the actual short-run inter-country variations in DY for all three groups of countries (All G20, Advance G20, Developing G20). More than 88 % of the variation in I and R was predicted, and 82 % or more of variation in X for all the three groups of countries. The decomposition of T into its components is also near-optimal, with practically no part of error due to bias for all endogenous

[3] The Newton method was used for dynamic simulations.

Table 3
Theil's inequality coefficients and their decomposition.

	All G20				Advance G20				Developing G20			
	DY	I	R	X	DY	I	R	X	DY	I	R	X
T	0.47	0.11	0.02	0.16	0.46	0.05	0.01	0.18	0.46	0.12	0.02	0.14
B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V	0.42	0.44	0.00	0.24	0.34	0.26	0.01	0.46	0.44	0.46	0.00	0.18
C	0.58	0.56	1.00	0.76	0.66	0.74	0.99	0.54	0.56	0.54	1.00	0.82

Table 4
Dynamic policy and other counterfactual simulation results average annual values, 2004–2019.

	All G20				Advance G20				Developing G20			
	DY	I	R	X	DY	I	R	X	DY	I	R	X
B	2.21	23.99	29.19	27.21	0.97	21.48	23.26	26.17	3.03	25.55	33.53	28.27
PSDX	2.15	23.92	29.18	27.28	0.97	21.47	23.25	26.23	3.02	25.53	33.52	28.22
PSF	2.18	23.95	29.18	27.23	0.97	21.49	23.26	26.09	3.02	25.52	33.53	28.27
PSP	2.17	23.95	29.18	27.24	0.97	21.49	23.26	26.13	3.04	25.60	33.54	28.21
PSDXFP	2.13	23.89	29.17	27.27	0.97	21.47	23.25	26.17	3.02	25.54	33.53	28.21
CSW	2.18	23.97	29.19	27.24	0.95	21.47	23.25	26.22	3.03	25.58	33.54	28.19

DY = growth of real per capita income;
I = gross capital formation as a percentage of GDP;
R = industrial output as a percentage of GDP;
X = exports as a percentage of GDP;
B = refers to the basic solution/ baseline model (from Table 2) to which the other simulation results are compared;
PSDX = the growth in the percentage of exports to GDP is 25 % higher than historically;
PSF = the percentage of foreign capital inflows to GDP is 25 % higher than historically;
PSP = the rate of domestic inflation is 25 % lower than historically;
CSW = the index of real GDP of all market economies is 25 % higher than historically.

variables and all the three groups of countries, and with a large proportion of the error due to imperfect covariance (over which nothing can be done).

3.2. Dynamic policy simulations

The policymakers could attempt to increase its growth rate by operating on the exogenous variables regarded as policy instruments. In the current setup, these policy instruments are the growth in the percentage of exports to GDP (DX), the level of capital inflows as a percentage of GDP (F), and the ratio of the consumer price index in the nation relative to the consumer price index of all market economies (P).

Historically DX was 0.84 % for All G20, 1.72 % for Advance G20, and 0.20 % for Developing G20 countries. Supposing these growth rates could be increased by 25–1.05 % for All G20, 2.14 % for Advance G20, and 0.25 % for Developing G20 countries.[4] This policy

[4] This could possibly be achieved by reduction in trade barriers of or by developed nations for exports of developing nations. Here we assume adequate supply responses from developing nations. 25 % increase has been chosen arbitrarily and can be scaled as needed.

simulation (PSDX) is presented in Table 4. This decreases DY from 2.21 (baseline model) to 2.15 for All G20, remains same at 0.97 for Advance G20, and from 3.03 to 3.02 for Developing G20 nations. PSDX also leads to a decrease in I from 23.99 to 23.92 for All G20, from 21.48 to 21.47 for Advance G20, and from 25.55 to 25.53 for Developing G20 nations.

Further, PSDX leads to a slight decrease in R from 29.19 to 29.18 and from 23.26 to 23.25 for All G20 and Advance G20, and from 33.53 to 33.52 for Developing G20 nations. PSDX also leads to a slight increase in X from 27.21 to 27.28 for All G20 and 26.17 to 26.23 for Advance G20, and a slight decrease from 28.27 to 28.22 for Developing G20. The results suggest that PSDX is not very effective in increasing DY because the historical values of DX and the estimated values of a3 are very small. As a result, I, R, and X are also slightly affected. This implies that, in general, the policy of even substantially increasing DX is not very effective in promoting growth in G20 nations. The result suggests that the rate of economic development depends primarily on internal conditions, and international trade provides only a weak supporting role for most nations.

Most effective would be the policy that attempts to increase the rate of foreign capital inflows by nations. By increasing, I would increase DY. The increase in DY would then increase I, R, and X, which in turn would further increase DY and I. Suppose that the developing nations could increase their average F by 25 % over historical values, i.e., from 1.91 to 2.39 in All G20, from − 0.04 to − 0.05 in Advance G20, and from 3.33 to 4.16 in Developing G20 nations. This policy PSF is presented in Table 4 to decrease DY from 2.21 to 2.18 in All G20, from 3.03 to 3.01 in Developing G20, and remains same at 0.97 for Advance G20 nations. The result suggests that PSF is ineffective in increasing DY for the G20 nations. There is a slight decrease in I from 23.99 to 23.95 for All G20, from 25.55 to 25.52 Developing G20 nations and slight increase from 21.48 to 20.19 for Advance G20. PSF's effect on R is a slight decrease from 29.19 to 29.18 for All G20, while it remains same at 23.26 and 33.53 for Advance G20 and Developing G20 nations, respectively. We see that PSF is also ineffective in increasing DY.

The third policy variable operates on P. Supposing that the governments can curb domestic inflation by 25 %. As P appears explicitly in Eq. (4), the strongest effect of this policy PSP is generally to increase X. With c2 being very small (Table 1), an increase in X has a slight or no effect on R across the three groups. DY stays the same at 0.97 for Advance G20 and increases slightly from 3.03 to 3.04 for Developing G20 nations; I increase from 21.48 to 21.49 for Advance G20 nations and rises for Developing G20 from 25.55 to 25.60.

Finally, suppose that the index of real GDP of all market economies (W) was 25 % higher than historically. W is an exogenous variable and so is not a policy variable from a nation's point. Here we use this as a purely counterfactual simulation. With CSW, DY would have decreased from 2.21 to 2.18 in All G20, from 0.97 to 0.95 in Advance G20, and remained the same at 3.03 in Developing G20 nations. There is a slight decrease in I from 23.99 to 23.97 for All G20, remains same at 21.48 for Advance G20, and increases slightly from 25.55 to 25.58 in Developing G20 nations. PSF's effect on R is a slight decrease from 23.26 to 23.25 in Advance G20, a slight increase from 33.53 to 33.54 in Developing nations, while it remains the same at 29.19 in All G20. We see that PSW is also ineffective in increasing DY.

Further, we combine the three policy simulations operating on DX, F, and P (PSDXFP). We see that PSDXFP decreases DY from 2.21 to 2.13 in All G20, remains the same at 0.97 in Advance G20, and has a slight decrease from 3.03 to 3.02 in developing G20. PSDXFP would have decreased I 0.10 % points from the baseline model for All G20, decreased by 0.01 % points for Advance G20 and Developing G20 nations. R decreases by 0.02 % and 0.01 % points in All G20 and Advance G20 nations, while remains same for developing G20 nations. On the

other hand, X would have increased by 0.06 % points in All G20, remains same for Advance G20, and decreased by 0.06 % points in developing G20 nations.

These results are very important because they indicate that the policies most often advocated for developing nations, such as increasing DX, F, and reducing P (curbing excess domestic inflation), as well as more rapidly expanding international economy, are not very effective in increasing the rate of growth of real per capita income of the G20 nations (advanced or developing). This also indicates the serious difficulty that the countries face in achieving substantially higher growth rates.

4. Conclusions

We explore the relationship between trade openness and economic growth for the G20 countries. Using Salvatore (1983) simultaneous equations model that incorporates the most important quantitative aspects of the relationship between international trade, industrialization, and economic growth, we study the relationship for G20 countries as a whole and subdivided into Advanced and Developing countries from 2004 to 2019.

The model was estimated using FIML and validated by dynamic simulations. We further also conduct dynamic policy simulations. The sign and statistical significance of the estimated coefficients and the dynamic validity simulation strongly support the model empirically. The results suggest a positive relationship between trade and growth. We find that trade is very important to the development process and suggests that trade is a handmaiden rather than an engine for growth. We also find that industrialization helps developing nations increase exports more than advanced nations.

The results of the dynamic policy simulations indicate that some policies that are often advocated, such as increasing growth of exports and foreign capital inflows, and curbing domestic inflation, are not very effective in increasing the growth rate of per capita income – unless the strengths of the proposed policies are unrealistically large.

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