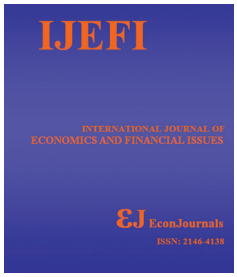

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On the Relationship between Economic Freedom and Output per Worker: The Case of Asia-pacific Countries

Noha Emara[1,2]*, Loreto Reyes Rebolledo[3]

[1]Department of Economics, Helwan University, Helwan, Egypt, [2]Rutgers University, USA, 311 North 5th Street, Camden, NJ 08102, USA, [3]School of International and Public Affairs, Columbia University, USA. *Email: nemara@camden.rutgers.edu

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ABSTRACT

In this paper we study the effect of economic freedom on output per worker using a panel least square estimation methodology for a sample of 14 Asia-pacific (APAC) and 18 OECD countries over the 1980-2014 period. This methodology allows us not only to study the relationship between the economic freedom and output per worker in APAC countries but also compare it with the empirical association between economic freedom and output per worker observed in OECD countries. The study also investigates the role of governance in affecting the impact of economic freedom on output per worker and its components. Our results indicate that (1) economic freedom has a positive and statistically significant impact on output per worker when we consider all countries in the sample and control for country-and time- fixed-effects. (2) A country's economic freedom has a on its positive and statistically significant impact on its output per worker, but this effect higher for OECD countries than for APAC countries. (3) For APAC countries, a country's size of government, legal system, and regulation has a positive and statistically significant impact on its output per worker.

Keywords: APAC, Economic Freedom, Political Freedoms, Productivity, Corruption
JEL Classifications: O16, O43, N20

1. INTRODUCTION

It has been empirically observed that countries with higher levels of economic freedom exhibit a better economic performance. In this context, there are several papers that have studied the relationship between economic freedom and economic development. In particular, Haan and Sturm (1999) compare the economic freedom measures developed by the Fraser Institute and the Heritage Foundation in order to asses the extent at which these indexes rank countries in a similar position and study whether there is an empirical relationship between a country's economic freedom and its economic development. Their findings indicate that both economic freedom indexes yield consistent results and that there is a positive relationship between economic freedom and output per worker. Interestingly, authors document that what affect a country's economic growth are the variations in economic freedom, not its level. Similarly, Hall and Jones (1999) find a positive relationship between economic freedom and output per worker. Specifically, the authors analyze a sample of 127 countries finding that there is a robust and positive relationship between a country's economic performance (measured as capital accumulation, human capital, and total factor productivity) and its institutional characteristics, which they refer as "social infrastructure." Another paper that also examines this relationship corresponds to Alexandrakis and Livanis (2013). In this paper the authors assess the relationship between economic freedom and output per worker for a sample of Latin American countries and compare it with the relationship observed in OECD countries. Their findings indicate that there is a heterogeneous relationship between a country's level of economic freedom and its economic development that can be positive or negative depending on the particular policy area in which economic freedom is being

measured. In particular, they find that OECD countries are positively affected (in terms of their output per worker) by increasing the size of their government while Latin American countries are negatively affected. A similar phenomenon is observed with the increase in the access to international markets. Analogously, Emara (2014; 2016) analyzes the relationship between economic freedom and output per worker, capital stock, human capital, and TFP for a sample of Middle East and North Africa Countries (MENA) using panel least estimations. Her results are similar to the ones presented in Alexandrakis and Livanis (2013).

In addition, there are other studies that analyze the impact of the different components of economic freedom on economic performance. For instance, Heckelman and Michael (2000a) indicates that although the literature documents a positive relationship between an aggregate measure of economic freedom and economic growth, it is necessary asses this relationship at the level of the individual components of economic freedom since the association between economic freedom and economic performance is particular to each country and component of economic freedom. Similarly, Cebula (2011) studies the extent at which the 10 components of the economic freedom index developed by the Heritage Foundation affect the economic growth of OECD countries. Also, he investigates the impact of political stability on economic growth based on the political stability index developed by the World Bank. His findings indicate that there is a positive impact of several components of economic freedom (such as business, monetary, labor, investment, fiscal, property rights freedom, and freedom from corruption) on the logarithm of per capita real GDP of OECD countries. He also documents a positive impact of political stability on the economic growth of OECD countries. A further analysis of this relationship is found in Cebula et al. (2012), in which the authors assess the association between economic freedom and income (measured by per capita real GDP) in OECD countries between 2002 and 2006. Their results are in line of those found by Cebula (2011). In a similar way, Corbi (2007) studies which sub-components of economic freedom index are associated with economic growth. Using the economic freedom index developed by the Fraser Institute, and a sample of 114 countries over the 1970-2000 period, the author documents a positive relationship between some sub-components of economic freedom related to size of the government (government consumption, transfers and subsidies, government investments), legal structure and property rights (judicial independence, protection of intellectual property, absence of military intervention), sound of money (relationship between the growth of money supply and growth of real GDP, stability of inflation), and freedom to trade internationally (low trade barriers, relationship between the official exchange rate and the black-market rate, and low regulation in the business markets), and economic growth. Other papers have studied the causal association between economic freedom and economic growth by performing a Granger causality test. For instance, Heckelman (2000b) indicates that economic freedom Granger causes economic growth, with exception of government intervention for which the causal relationship is in the opposite direction.

Regarding the relationship between governance and economic growth, many studies have confirmed the positive link of improved quality of governance on economic growth. For instance, the study by Emara (2016)[1] shows that the per capita GDP would rise by about 2 percent if a composite index of governance increases by one unit. Within the same lines, the study of Knack and Keefer (1997), Campos and Nugent (1999), Kaufmann et al. (1999a; 1999b), Knack and Keefer (1995), and Mauro (1995) reach the similar conclusions about the importance of governance to economic growth and development. Similar findings are reached in the work of.

In this paper we study the relationship between economic freedom and output per worker for a sample of 14 APAC and 18 OECD countries between 1980 and 2014 by using a panel least square estimation methodology. In particular, we study the relationship between economic freedom and output per worker, capital accumulation, human capital, and total factor productivity in APAC countries and compared it with the relationship between economic freedom and output per worker observed in OECD countries, following the methodological approaches developed by Hall and Jones (1999), Alexandrakis and Livanis (2013), and Emara (2014; 2016). We use economic freedom index developed by the Fraser Institute in the following policy areas: size of government, legal system, sound of money, freedom to trade internationally, and regulation, given it has the longest data availability. The paper also explores whether good governance has an impact on the relationship between economic freedom and output per worker in the APAC countries as compared to the OECD countries.

This paper is organized as follow. Section 1 presents an introduction and provides a review of the literature. Sections 2 and 3 present the methodological approach and the data used in this paper, respectively. Section 4 presents our main findings. Finally, Section 5 concludes.

2. METHODOLOGY

In order to estimate the relationship between output per worker and economic freedom, we follow the methodological approaches developed by Hall and Jones (1999), Alexandrakis and Livanis (2013), and Emara (2014; 2016). In these papers, the authors use a traditional Cobb-Douglas production function representing a country's aggregate output, and decompose it to express the output per worker as a function of three main components: the stock of physical capital, human capital, and total factor productivity (TFP).[2] Following this approach and using a panel least square estimation methodology, we estimate the impact of a country's level of economic freedom on the output per worker through the following equations:

1 The study by Emara (2016) provides a good review of the literature on governance.

2 This methodology assumes that the capital intensity, human capital, and TFP are proxies for a country's total output and therefore, can be used as alternative measures to assess the impact of a country's economic freedom on its output per worker (Alexandrakis and Livanis, 2013; Emara, 2014; 2016).

$$lny_{i,t} = \beta_0 + \sum_{j=1}^{5}\beta_j EF_{i,j,t-s} + \sum_{j=1}^{5}\alpha_j .APAC_i .EF_{i,j,t-s} + \delta_i + \gamma_t + \mu_{i,t} \quad (1)$$

$$\left(\frac{\alpha}{1-\alpha}\right)lnk_{i,t} = \beta_0 + \sum_{j=1}^{5}\beta_j EF_{i,j,t-s} + \sum_{j=1}^{5}\alpha_j .APAC_i .EF_{i,j,t-s} + \delta_i + \gamma_t + \mu_{i,t} \quad (2)$$

$$lnhc_{i,t} = \beta_0 + \sum_{j=1}^{5}\beta_j EF_{i,j,t-s} + \sum_{j=1}^{5}\alpha_j .APAC_i .EF_{i,j,t-s} + \delta_i + \gamma_t + \mu_{i,t} \quad (3)$$

$$lnA_{i,t} = \beta_0 + \sum_{j=1}^{5}\beta_j EF_{i,j,t-s} + \sum_{j=1}^{5}\alpha_j .APAC_i .EF_{i,j,t-s} + \delta_i + \gamma_t + \mu_{i,t} \quad (4)$$

Where $y_{i,t}$, $k_{i,t}$, $hc_{i,t}$, and $A_{i,t}$ correspond to the output per worker,[3] capital intensity,[4] human capital, and TFP of the country i at the time t, respectively. In addition, $EF_{i,j,t-s}$ corresponds to a lagged measure of country i's economic freedom in the policy area j at time t-s (where s corresponds to the lag).[5] Also, $APAC_i$ represents a dummy variable that takes the value 1 for APAC countries, and zero for OECD countries. By including the interaction between this variable and our measure for each country's economic freedom, we will be able to capture the difference of the impact of economic freedom between OECD and APAC countries.[6] Specifically, given the regression specifications presented in equations (1) to (4), the impact of economic freedom in the policy area j for OECD countries will be given by β_j, while for APAC countries will correspond to $\beta_j+\alpha_j$.

Next to explore the role of governance on the relationship between economic freedom and output per worker, following Emara (2016), we use the principal component analysis to create an index for governance that consists of the six indicators including government effectiveness, political stability, control of corruption and regulatory quality, voice and accountability, and rule of law[7].

In a similar way to Hall and Jones (1999), Alexandrakis and Livanis (2013), and Emara (2014; 2016), we include country and time fixed-effects to control for all factors that vary among countries but are constant over time (δ_i), and time-specific events affecting all countries (γ_t), respectively. Finally, $\mu_{i,t}$ represents the error term associated with the country i at time t.

3. DATA

Our dataset covers 14 APAC and 18 OECD countries compose our sample. APAC countries are grouped according to the definition of the IMF[8] and the Daniel K. Inouye Asia-pacific Center for Security Studies[9], which also includes Canada, Chile, Cook Islands, French Polynesia, Nauru, New Caledonia, Niue, Pakistan, Peru, and Russia as part of the APAC region in addition to the IMF's list. In our sample, OECD countries correspond to Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom. Analogously, APAC countries correspond to Australia, Canada, Chile, India, Indonesia, Malaysia, Japan, New Zealand, Peru, Philippines, Singapore, Sri Lanka, Thailand, and United States.[10] It is important to mention that although there are 46 countries in the APAC region, for most of them we do not have information on their economic freedom index, which reduces of our sample size to the 14 countries previously mentioned.

We have information from 1980 to 2014 that we have split into eight sub periods of different length in order to take advantage of the data availability. Specifically, taking a similar approach as the one developed in Alexandrakis and Livanis (2013) and Emara (2014; 2016), between 1980 and 1999 we split out sample into four sub periods of 5 years; three sub periods of 4 years between 2000 and 2011, and one sub period of 3 years between 2012 and 2014. 1 in the Appendix section presents a detailed description of the sub-periods, and the time at which variables are included in this study.

For our measures of output per worker, capital intensity, human capital, and productivity, we use information from the Penn World Table developed by The Center for International Data at the University of California Davis, which is available for the 1950-2014 period at an annual basis.[11] We compute the output per worker and capital intensity as the ratio between a country's GDP and the total people engaged in the labor force and a country's stock of physical capital and its GDP, respectively. These variables are measured at chained PPPs (in mil. 2011US$). Human capital corresponds to an index already calculated in the information available at the Penn World Table's website as well as the TFP. As in Alexandrakis and Livanis (2013) and Emara (2014; 2016), we use the averaged value for each one of these variables by sub-period as dependent variables presented in equations (1) to (4).[12]

The measure of economic freedom used in this paper is based on the index elaborated by the Fraser Institute since it has the longest data availability.[13] In particular, it is available every 5 years from 1970 to 1999, and from 2000 to 2014 it is available at an annual

3 Defined as the ratio between a country's total output and its employment.
4 Defined as the ratio between a country's stock of physical capital and its total output.
5 Following Alexandrakis and Livanis (2013).
6 Ibid.
7 The detailed definition of each indicator is provided in the appendix.
8 Available at https://www.imf.org/external/oap/about.htm.
9 Available at http://apcss.org/about-2/ap-countries/.
10 Although countries such as Australia, Canada, Chile, and United States are part of the OECD we have included only as part of the APAC region.
11 Available at http://cid.econ.ucdavis.edu/pwt.html.
12 Table A1 in the Appendix section presents a detailed description of the sub-periods, and the time at which variables are included in this study.
13 Available at https://www.fraserinstitute.org/economic-freedom/.

basis. For each country in the sample we use the chain-linked overall index of economic freedom as well as the economic freedom index computed for each one of the following policy areas: size of the government, legal system and property rights, sound of money, economic freedom to trade internationally, and regulation. Table 1 presents a description of the economic freedom index by policy area and its components.

For governance indicators, we use the Worldwide Governance Indicators which is published annually since 1998 and compiled by Kaufmann et al. (1999a; 1999b). These indicators are based on some 30 opinion and perception-based surveys of various governance measures from investment consulting firms, non-government organizations, think tanks, governments, and multilateral agencies; and classified into six areas including government effectiveness, political stability, control of corruption and regulatory quality, voice and accountability, and rule of law. Table A of the appendix presents a description of the components of the governance index.

According to the literature, since most of the reforms conducted in these areas have effects in the long run, we use the economic freedom index at the beginning of each sub period following Alexandrakis and Livanis (2013). Table 2 presents the descriptive statistics of all the variables in the model.

Table 1: Economic freedom index and its components

Index by policy area	Individual components
EF_1: Size of government	A. Government consumption
	B. Transfers and subsidies
	C. Government enterprises and investment
	D. Top marginal tax rate:
	Top marginal income tax rate
	Top marginal income and payroll tax rate
EF_2: Legal system and property rights	A. Judicial independence
	B. Impartial courts
	C. Protection of property rights
	D. Military interference in rule of law and politics
	E. Integrity of the legal system
	F. Legal enforcement of contracts
	G. Regulatory costs of the sale of real property
	H. Reliability of police
	I. Business costs of crime
EF_3: Sound of money	A. Money growth
	B. Standard deviation of inflation
	C. Inflation: most recent year
	D. Freedom to own foreign currency bank accounts
EF_4: Freedom to trade internationally	A. Tariffs:
	Revenue from trade taxes (% of trade sector)
	Mean tariff rate
	Standard deviation of tariff rates
	B. Regulatory trade barriers:
	Non-tariff trade barriers
	Compliance costs of importing and exporting
	C. Black-market exchange rates
	D. Controls of the movement of capital and people:
	Foreign ownership/investment restrictions
	Capital controls
	Freedom of foreigners to visit
EF_5: Regulation	A. Credit market regulations:
	Ownership of banks
	Private sector credit
	Interest rate controls/negative real interest rates
	B. Labor market regulations:
	Hiring regulations and minimum wage
	Hiring and firing regulations
	Centralized collective bargaining
	Hours regulations
	Mandated cost of worker dismissal
	Conscription
	C. Business regulations:
	Administrative requirements
	Bureaucracy costs
	Starting a business
	Extra payments/bribes/favoritism
	Licensing restrictions
	Cost of a tax compliance

Source: Fraser Institute (https://www.fraserinstitute.org/economic-freedom/approach)

4. RESULTS

A first approximation to study the relationship between economic freedom and output per worker consists in analyzing the correlation between these variables and determine whether this correlation is statistically significant or not.[14] Table 3 presents these results.

14 This analysis is based on the correlation analysis developed in Alexandrakis and Livanis (2013).

As we can observe, there is a positive and statistically significant relationship between the aggregate index of economic freedom and output per worker, capital intensity, and human capital, for both APAC and OECD countries. Surprisingly, the correlation between economic freedom and total factor productivity is only statistically significant for APAC countries. When we analyze the correlation between economic freedom by policy area and output per worker in APAC countries, we find that it is positive and statistically significant for almost all policy areas with exception of the size of government for which the correlation is negative

Table 2: Descriptive statistics

APAC countries					
Variable	**Observations**	**Mean**	**Std. dev.**	**Min.**	**Max.**
ln *y*	112	10.227	0.913	8.105	11.615
[*α*/(1−*α*)]ln *k*	112	0.483	0.139	0.106	0.819
ln *h*	112	0.979	0.242	0.279	1.313
ln *A*	112	−0.513	0.378	−1.416	0.012
Economic freedom (EF)	112	7.015	1.213	2.470	8.880
EF_1: Size of government	112	6.552	1.137	3.540	8.753
EF_2: Legal system	112	6.377	1.822	2.230	9.170
EF_3: Sound of money	112	8.002	1.904	0.000	9.828
EF_4: Freedom to trade internationally	112	7.097	1.737	1.300	9.960
EF_5: Regulation	112	7.047	1.210	3.390	8.860
OECD countries					
Variable	**Observations**	**Mean**	**Std. dev.**	**Min.**	**Max.**
ln *y*	144	11.042	0.325	10.129	11.940
[*α*/(1−*α*)]ln *k*	144	0.620	0.125	0.257	0.980
ln *h*	144	1.068	0.172	0.444	1.315
ln *A*	144	−0.114	0.175	−0.626	0.438
Economic freedom	144	7.133	0.836	3.720	8.525
EF_1: Size of government	144	4.736	1.248	1.630	7.835
EF_2: Legal system	144	7.628	1.078	4.480	9.280
EF_3: Sound of money	144	8.575	1.804	0.780	9.830
EF_4: Freedom to trade internationally	144	8.089	1.059	3.430	9.760
EF_5: Regulation	144	6.638	1.040	3.870	8.590

Table 3: Correlation matrix

APAC countries										
	ln *y*	**[*α*/(1−*α*)]ln *k***	**ln *h***	**ln *A***	**EF**	**EF_1: SG**	**EF_2: LS**	**EF_3: SM**	**EF_4: FT**	**EF_5: RE**
ln *y*	1									
[α(1−α)]ln *k*	0.5882*	1								
ln *h*	0.8772*	0.5619*	1							
ln *A*	0.8775*	0.2357*	0.6887*	1						
EF	0.7937*	0.6476*	0.6697*	0.6332*	1					
EF_1: SG	−0.0805	0.1541	−0.06	−0.1925*	0.2360*	1				
EF_2: LS	0.8244*	0.5119*	0.6264*	0.7462*	0.8150*	−0.2315*	1			
EF_3: SM	0.5883*	0.5489*	0.5174*	0.4536*	0.8669*	0.1091	0.6347*	1		
EF_4: FT	0.7646*	0.5781*	0.6355*	0.6573*	0.9179*	0.2304*	0.7301*	0.6967*	1	
EF_5: RE	0.7888*	0.6372*	0.7432*	0.5731*	0.8818*	0.0913	0.7492*	0.7139*	0.7537*	1
OECD countries										
	ln *y*	**[*α*(1−*α*)]ln *k***	**ln *h***	**ln *A***	**EF**	**EF_1: SG**	**EF_2: LS**	**EF_3: SM**	**EF_4: FT**	**EF_5: RE**
ln *y*	1									
[*α*/(1−*α*)]ln *k*	0.2169*	1								
ln *h*	0.7113*	0.2389*	1							
ln *A*	0.4157*	−0.6651*	0.1410	1						
EF	0.6893*	0.1663*	0.7417*	0.1515	1					
EF_1: SG	0.1323*	−0.0567	−0.0532	−0.0646	0.2834*	1				
EF_2: LS	0.4353*	0.0327	0.6640*	0.2115*	0.6592*	−0.1707*	1			
EF_3: SM	0.6481*	0.3728*	0.6840*	0.0361	0.8597*	−0.0031	0.4893*	1		
EF_4: FT	0.3492*	0.0127	0.5202*	0.1742*	0.7345*	−0.0815	0.4687*	0.6795*	1	
EF_5: RE	0.6801*	0.0422	0.6397*	0.2274*	0.7555*	0.2045*	0.4915*	0.5238*	0.3654*	1

*P<0.05

but not statistically significant. We obtain similar results when we study the correlation between economic freedom by policy areas and capital intensity, human capital, and total factor productivity. In particular, we observe that for size of government the correlation is negative and statistically significant for total factor productivity.

Similarly, for OECD countries the correlation between economic freedom by policy area and output per worker is positive and statistically significant. When we look at the correlation between the economic freedom by policy area and the components of output per worker, we find that for almost all policy areas is positive and statistically significant for human capital and total factor productivity, with exception of size of government for which this correlation is negative although not statistically significant. Interestingly, only the correlation between economic freedom in the sound of money policy area and capital intensity results positive and statistically significant.

Once we have assessed the correlation between economic freedom and output per worker for both APAC and OECD countries, we can study the effect of economic freedom on the output per worker.

Table 4 presents the effect of economic freedom on output per worker, capital intensity, human capital and total factor productivity.

As we can observe in column (1) of the previous table, economic freedom has a positive and a statistically significant impact on output per worker when we consider all countries in the sample and control for all those characteristics that are particular to each country but that are constant over time (i.e., country fixed-effects), and variables that change over time but are the same across countries in a given sub-period (i.e., sub-period fixed effects). Similarly, in columns (2) to (4) we explore the channel through which we find this positive relationship between economic freedom and output per worker. Our results suggest that economic freedom has a positive impact on output per worker by improving capital intensity and human capital. Surprisingly, our results indicate that the effect of economic freedom on a country's total factor productivity is not statistically significant.

In Table 5 we study whether the positive relationship between economic freedom and output per worker changes when we split our sample in APAC and OECD countries. We capture this difference through the interaction between economic freedom and the dummy variable that takes the value 1 for APAC countries, and 0 for OECD countries. Results in column (1) indicate that the relationship between output per worker and the aggregated index for economic freedom is positive and equivalent to 0.0366 and 0.0352 for OECD and APAC countries, respectively. Results in columns (2) to (4) suggest the main channel that explains this relationship is through total factor productivity. In particular, our results indicate that for OECD countries the improvement in output per worker induced by economic freedom is mainly explained by total factor productivity since the coefficients associated to capital intensity and human capital are statistically insignificant. Specifically, the effect of economic freedom on the logarithm of total factor productivity is equal to 0.0366 and statistically significant at the 10% significance level for OECD countries when we control for country and time fixed effects. In contrast, for APAC countries our results indicate that the total effect of economic freedom on total factor productivity is negative (compared to

Table 4: The effect of (Aggregate) economic freedom on output per worker, capital intensity, human capital, and total factor productivity

Regressors	ln y	$[\alpha/(1-\alpha)]\ln k$	ln h	ln A
	(1)	(2)	(3)	(4)
Economic freedom	0.0357**	0.0279**	0.0202***	−0.0008
	(0.0168)	(0.011)	(0.0067)	(0.0158)
Sub-period 1985-1989	0.0545*	−0.0023	0.0498***	−0.0526*
	(0.0302)	(0.0197)	(0.012)	(0.0285)
Sub-period 1990-1994	0.1795***	0.0039	0.0830***	−0.0512*
	(0.0325)	(0.0213)	(0.013)	(0.0307)
Sub-period 1995-1999	0.3144***	0.0136	0.1146***	−0.0367
	(0.0365)	(0.0239)	(0.0146)	(0.0345)
Sub-period 2000-2003	0.3855***	−0.0077	0.1449***	−0.0173
	(0.0374)	(0.0245)	(0.0149)	(0.0353)
Sub-period 2004-2007	0.4965***	0.0443*	0.1648***	−0.0106
	(0.0384)	(0.0251)	(0.0153)	(0.0362)
Sub-period 2008-2011	0.6103***	0.1241***	0.1912***	−0.0335
	(0.0369)	(0.0241)	(0.0147)	(0.0348)
Sub-period 2012-2014	0.7030***	0.1568***	0.2110***	−0.0493
	(0.037)	(0.0242)	(0.0148)	(0.0349)
Constant	10.0895***	0.3209***	0.7662***	−0.2512**
	(0.1054)	(0.069)	(0.0421)	(0.0995)
Within-R^2	0.8426	0.4775	0.7581	0.0314
# Observations	256	256	256	256
# Countries	32	32	32	32
F(8,206)	144.514	24.6714	84.6355	0.8741
Prob>F	0.0000	0.0000	0.0000	0.5391

*** 1%, ** 5%, * 10%. standard errors in parentheses

Table 5: The effect of (Aggregate) economic freedom on output per worker, capital intensity, human capital, and total factor productivity for APAC countries relative to OECD countries

Regressors	ln y	$[\alpha/(1-\alpha)]\ln k$	ln h	ln A
	(1)	(2)	(3)	(4)
Economic freedom	0.0366*	−0.0208	−0.005	0.0366*
	(0.0223)	(0.0137)	(0.0085)	(0.0206)
Economic freedom×APAC	−0.0014	0.0749***	0.0389***	−0.0575***
	(0.0224)	(0.0138)	(0.0086)	(0.0208)
Sub-period 1985-1989	0.0544*	0.0029	0.0525***	−0.0566**
	(0.0303)	(0.0186)	(0.0116)	(0.0281)
Sub-period 1990-1994	0.1792***	0.0215	0.0922***	−0.0648**
	(0.033)	(0.0203)	(0.0126)	(0.0306)
Sub-period 1995-1999	0.3140***	0.0366	0.1265***	−0.0544
	(0.0373)	(0.0229)	(0.0142)	(0.0346)
Sub-period 2000-2003	0.3850***	0.0209	0.1597***	−0.0393
	(0.0384)	(0.0236)	(0.0147)	(0.0356)
Sub-period 2004-2007	0.4960***	0.0733***	0.1799***	−0.0329
	(0.0395)	(0.0242)	(0.0151)	(0.0366)
Sub-period 2008-2011	0.6099***	0.1468***	0.2030***	−0.051
	(0.0376)	(0.0231)	(0.0143)	(0.0349)
Sub-period 2012-2014	0.7026***	0.1799***	0.2230***	−0.0670*
	(0.0377)	(0.0231)	(0.0144)	(0.0350)
Constant	10.0871***	0.4530***	0.8348***	−0.3528***
	(0.1128)	(0.0692)	(0.043)	(0.1046)
Within-R^2	0.8426	0.5406	0.7793	0.0646
# Observations	256	256	256	256
# Countries	32	32	32	32
F(9,215)	127.86	28.11	84.36	1.65
Prob>F	0.0000	0.0000	0.0000	0.1029

*** 1%, ** 5%, * 10%. Standard errors in parentheses

Table 6: Total effect of economic freedom on the output per worker, capital intensity, human capital, and total factor productivity in APAC countries

Regressor	ln y (1)	$[\alpha/(1-\alpha)]\ln k$(2)	ln h (3)	ln A (4)
EF: Economic freedom in APAC	0.035*	0.054***	0.034***	−0.021
	(0.019)	(0.011)	(0.007)	(.0172)

*** 1%, ** 5%, * 10%. In parentheses we present the standard error to the total effect of adding up the coefficient of EF to the interaction between this coefficient and a regional dummy variable that takes the value 1 for APAC countries (i.e., EF ×APAC) (The coefficients are taken from the results of the previous table)

OECD countries) and equivalent to -0.0209. In addition, the effect of economic freedom on capital intensity and human capital correspond to 0.0541 and 0.0339, respectively. In order to assess the statistical significance of these results, we perform an F test on the coefficients associated to the aggregate economic freedom and its interaction with the regional dummy. We reject the null hypothesis that these coefficients are statistically insignificant at the 5% significance levels for columns (2) to (4) and at the 10% significance levels for column (1).

It is interesting to observe that total factor productivity is not an important channel through which economic freedom affects output per worker when we consider all the countries in the sample. However, when we allow for the existence of a differentiated effect of economic freedom on output per worker for APAC and OECD countries, we find that total factor productivity becomes statistically significant and shows opposite signs depending on the region we are studying. Intuitively, these results are non-contradictory since the opposite signs cancel each other when we consider all the countries in the sample giving us a non-significant effect in column (4) of Table 4.

Using the results of Table 5, the total effect of economic freedom on output per worker, capital intensity, human capital and total factor productivity in the APAC countries is computed by adding the coefficients of economic freedom to the interaction coefficient. Table 6 presents the results.

In order to provide a deeper analysis of the total effect of economic freedom by policy area, Table 7 provides the detailed regressions of regressing each of the five components of economic freedom on the output per worker, capital intensity, human capital and total factor productivity. The regressions add interaction terms to provide the analysis for the APAC countries

For OECD countries, there is a positive and statistically significant association between size of the government and output per worker that is mainly explained through an improvement of total factor productivity. Similarly, a country's legal system has a positive effect on its output per worker by improving total factor productivity and lowering capital intensity and human capital accumulation. In a similar way, regulation is negatively associated to output per worker by lowering capital intensity and human capital.

Table 7: The effect of economic freedom by policy area on output per worker, capital intensity, human capital, and total factor Productivity APAC countries relative to OECD countries

Regressors	ln *y*	$[\alpha/(1-\alpha)]$ln *k*	ln *h*	ln *A*
	(1)	(2)	(3)	(4)
EF_1: Size of government (SG)	0.0353**	−0.0121	0.0014	0.0276*
	(0.0165)	(0.0102)	(0.0058)	(0.0154)
EF_2: Legal system (LS)	0.0557***	−0.0451***	−0.0209***	0.0852***
	(0.0209)	(0.0129)	(0.0074)	(0.0195)
EF_3: Sound of money (SM)	0.0112	0.0132*	0.0085**	−0.0067
	(0.0115)	(0.0071)	(0.004)	(0.0107)
E_4: Freedom to trade internationally (FT)	0.0192	−0.0013	0.0076	0.0085
	(0.0158)	(0.0097)	(0.0056)	(0.0147)
EF_5: Regulation (RE)	−0.0393*	−0.0359***	−0.0153**	−0.0011
	(0.0215)	(0.0132)	(0.0076)	(0.0200)
EF_1: SG×APAC	0.0157	−0.0167	0.0063	0.0219
	(0.0271)	(0.0167)	(0.0096)	(0.0253)
EF_2: LS×APAC	−0.0344	0.0266	0.0162	−0.0385
	(0.0313)	(0.0193)	(0.0111)	(0.0292)
EF_3: SM×APAC	−0.0460***	−0.0104	−0.0220***	−0.0053
	(0.0159)	(0.0098)	(0.0056)	(0.0148)
EF_4: FT×APAC	−0.0045	0.0313**	−0.0018	−0.0233
	(0.0226)	(0.0139)	(0.008)	(0.021)
EF_5: RE×APAC	0.0794**	0.0783***	0.0768***	−0.0467
	(0.0311)	(0.0192)	(0.0110)	(0.029)
Sub-period 1985-1989	0.0649**	0.0042	0.0525***	−0.0484*
	(0.0292)	(0.018)	(0.0103)	(0.0272)
Sub-period 1990-1994	0.1423***	0.0400*	0.0785***	−0.0886***
	(0.0355)	(0.0219)	(0.0126)	(0.0331)
Sub-period 1995-1999	0.2657***	0.0712***	0.1213***	−0.1058***
	(0.0406)	(0.0250)	(0.0143)	(0.0378)
Sub-period 2000-2003	0.3511***	0.0485*	0.1523***	−0.0701*
	(0.0401)	(0.0247)	(0.0142)	(0.0374)
Sub-period 2004-2007	0.4588***	0.1134***	0.1684***	−0.0675
	(0.0446)	(0.0275)	(0.0157)	(0.0415)
Sub-period 2008-2011	0.5860***	0.1733***	0.1889***	−0.0668*
	(0.0423)	(0.0261)	(0.0149)	(0.0394)
Sub-period 2012-2014	0.6812***	0.2076***	0.2072***	−0.0793*
	(0.0438)	(0.0270)	(0.0155)	(0.0409)
Constant	9.7850***	0.7365***	0.8412***	−0.7499***
	(0.1589)	(0.0980)	(0.0561)	(0.1481)
Within-R^2	0.8659	0.6048	0.8387	0.1953
# Observations	256	256	256	256
# Countries	32	32	32	32
F(17,207)	78.63	18.63	63.32	2.95
Prob>F	0.0000	0.0000	0.0000	0.0001

*** 1%, ** 5%, * 10%. Standard errors in parentheses

Table 8: Total effect of the components of economic freedom on the output per worker, capital intensity, human capital, and total factor productivity in APAC countries

Regressors	ln *y* (1)	$[\alpha/(1-\alpha)]$ln *k* (2)	ln *h* (3)	ln *A* (4)
EF_1: Size of government (SG)	0.051**	−0.029**	0.008	0.050**
	(0.022)	(0.014)	(0.008)	(0.021)
EF_2: Legal system (LS)	0.021	−0.019	−0.005	0.047**
	(0.024)	(0.015)	(0.008)	(0.022)
EF_3: Sound of money (SM)	−0.035***	0.003	−0.014***	−0.012
	(0.011)	(0.007)	(0.004)	(0.010)
EF_4: Freedom to trade internationally (FT)	0.0147	0.030**	0.006	−0.015
	(0.017)	(0.010)	(0.005)	(0.016)
EF_5: Regulation (RE)	0.040*	0.0424***	0.062***	−0.048
	(0.025)	(0.016)	(0.009)	(0.024)

*** 1%, ** 5%, * 10%. In parentheses we present the standard error to the total effect of adding up the coefficient of EF to the interaction between this coefficient and a regional dummy variable that takes the value 1 for APAC countries (i.e., EF_j×APAC) (The coefficients are taken from the results of the previous table)

The following table shows the impact and the statistical significance of the different components of economic freedom on the output per worker, capital intensity, and total factor productivity for APAC countries. Specifically, it shows the total effect of each one of the components of the economic freedom in the policy area j (i.e. EF_j) and its interaction with the regional dummy for

APAC countries (i.e., $EF_j \times APAC=1$). In order to assess the statistical significance of the total effect we perform an F test of join significance on these coefficients.

For APAC countries, the results in the first column of Table 8 indicate that a country's size of government, legal system, and regulation have a positive and statistically significant impact on its output per worker. On the contrary, a country's sound of money has a negative (and statistically significant) association with its output per worker. Surprisingly a country's freedom to trade internationally does not have any significant effect on its output per worker. Intuitively, these results indicate that in the group of APAC countries, a smaller government (represented through a lower public consumption and expenditure), stronger property rights and rule of law (represented through an impartial judiciary system that guarantees the enforcement of legal contracts), and a greater deregulation of credit, labor and business market operations, have a positive (and statistically significant) effect on a country's output per worker. However, a country's increasing sound of money (represented through a lower inflation and money growth) lowers its output per worker.

Regarding the channel through which these components affect output per worker, the results of columns (2) to (4) indicate that the size of the government increases output per worker by increasing a country's total factor productivity and lowering its capital intensity. Since the coefficient associated to total factor productivity outweighs the coefficient on capital intensity (0.0495 and −0.0288, respectively), the net effect on output per worker is positive (i.e., 0.0207). Similarly, the channel through which a country's property rights and rule of law increases output per worker is by lowering capital intensity and human capital accumulation and increasing total factor productivity. In this case, the effect of capital intensity, human capital accumulation, and total factor productivity is statistically significant but in opposite directions. However, since the magnitude of the impact of total factor productivity outweighs the combined (negative) effect of capital intensity and human capital, the net effect on output per worker is positive (i.e., 0.0235). In addition, the main channel through which a country's sound of money lowers its output per workers is by lowering its human capital accumulation. Although the effect of freedom to trade internationally does not have a significant effect on output per worker, it affects positive and statistically significant a country's capital intensity. Finally, the positive effect of (de) regulation on output per worker is mainly driven by the increase in capital intensity, and human capital accumulation.

Intuitively, these results indicate that in the group of APAC countries, a smaller government (represented through a lower public consumption and expenditure), stronger property rights and rule of law (represented through an impartial judiciary system that guarantees the enforcement of legal contracts), and a greater deregulation of credit, labor and business market operations, have a positive (and statistically significant) effect on a country's output per worker. However, a country's increasing sound of money (represented through a lower inflation and money growth) lowers its output per worker.

5. CONCLUSIONS

In this paper we study the relationship between a country's economic freedom and its output per worker for sample of 14 countries of the Asia-pacific (APAC) region and 18 OECD countries over the 1980-2014 period. Using a panel least square estimation methodology, we assess the extent at which a country's level of economic freedom affects its output per worker controlling for country and time fixed-effects. Our estimation methodology also allows us to explore the channel through which this relationship is empirically observed. In particular, we study three alternative channels through which economic freedom can affect output per worker: capital intensity, human capital accumulation, and total factor productivity. We measure a country's economic freedom by using the Economic Freedom Index developed by the Fraser Institute. This index measures a country's economic freedom in five policy areas: size of government, legal system, sound of money, freedom to trade internationally, and regulation; which allow us not only study the relationship between economic freedom at an aggregate level but also analyze which one of these components has a greater impact on output per worker and its three alternative measures.

Our results indicate that economic freedom has a positive and statistically significant impact on output per worker when we consider all countries in the sample and control for country and time fixed-effects. We also find that economic freedom has a positive impact on output per worker by improving capital intensity and human capital accumulation. Surprisingly, we find that economic freedom does not have a significant effect on a country's total factor productivity. When we allow for the existence of a differentiated effect of economic freedom on output worker for OECD and APAC countries, we find that the effect of a country's economic on its output per worker is positive and statistically significant, but higher for OECD countries than for APAC countries. Additionally, we find evidence that in OECD countries this effect is mainly driven by an improvement in total factor productivity. For APAC countries, the positive effect of economic freedom on output per worker is explained by an improvement in capital intensity and human capital accumulation.

We also find interesting results when we explore the channels through which the individual components of economic freedom impact output per worker. In particular, our findings indicate that for OECD countries there is a positive and statistically significant effect of a smaller government and stronger property rights and rule of law that is mainly driven by an improvement in total factor productivity and a reduction in capital intensity and human capital accumulation. For APAC countries, we find that a smaller government (represented through a lower public consumption and expenditure), stronger property rights and rule of law (represented through an impartial judiciary system that guarantees the enforcement of legal contracts), and a greater deregulation of credit, labor and business market operations, have a positive (and statistically significant) effect on a country's output per worker. However, a country's increasing sound of money (represented through a lower inflation and money growth) lowers its output per worker. Regarding the channel through which these components

affects a country's output per worker in APAC countries, our findings indicate that the size of the government increases output per worker by increasing a country's total factor productivity and lowering its capital intensity. Similarly, the channel through which a country's property rights and rule of law increases output per worker is by improving total factor productivity and lowering capital intensity and human capital accumulation, although the net effect is positive and attributable to total factor productivity. In addition, the main channel through which a country's sound of money lowers its output per worker is by lowering its human capital accumulation. In a similar way, the channel through which regulation increases output per worker is by improving capital intensity and human capital accumulation.

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APPENDIX

Table A: Governance indicators and definitions

1-Voice and accountability	Measured by the extent to which a country's citizens are able to participate in selecting their government as well as freedom of expression, association, and the press
2-Political stability and absence of violence	Measured by the likelihood that a government will be destabilized by unconstitutional or violent means, including terrorism
3-Government effectiveness	Measured by the quality of public services, the capacity of civil services and their independence from political pressure, and the quality of policy formulation
4-Regulatory quality	Measured by the ability of a government to provide sound policies and regulations that enable and promote private sector development
5-Rule of law	Measured by the extent to which agents have confidence in and abide by the rules of society, including the quality of property rights, the police and the courts, and the risk of crime
6-Control of corruption	Measured by the extent to which public power is exercised for private gain, including both petty and grand forms of corruption as well as elite "capture" of the state

Table A1: Description of sample sub-periods

Year	Sub-period	Length of sub-period (No. years)	Economic freedom index[a]	Dependent variables[b]
1980	1980-1984	5	1980	Average 1980-1984
1981				
1982				
1983				
1984				
1985	1985-1989	5	1985	Average 1985-1989
1986				
1987				
1988				
1989				
1990	1990-1994	5	1990	Average 1990-1994
1991				
1992				
1993				
1994				
1995	1995-1999	5	1995	Average 1995-1999
1996				
1997				
1998				
1999				
2000	2000-2003	4	2000	Average 2000-2003
2001				
2002				
2003				
2004	2004-2007	4	2004	Average 2004-2007
2005				
2006				
2007				
2008	2008-2011	4	2008	Average 2008-2011
2009				
2010				
2011				
2012	2012-2014	3	2012	Average 2012-2014
2013				
2014				

(a) Economic Freedom Index correspond to the aggregate economic freedom index developed by the Fraser Institute as well as disaggregate index for each one of the five policy areas.
(b) Dependent variables correspond to log of: output per worker ($\ln y$), capital intensity ($[\alpha/(1-\alpha)\ln k$), human capital accumulation ($\ln h$), and total factor productivity ($\ln A$)