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PRODUCTIVITY AND EMPLOYMENT IN APAC ECONOMIES: A COMPARISON WITH THE EU USING FIRM-LEVEL INFORMATION

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and Peter Morgan

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Abstract

This paper provides an overview of productivity development and other related indicators in Asian–Pacific (APAC) countries, with comparisons with the Europe region. We use the seventh vintage firm-level data from the Productivity Research Network in the APAC region and CompNet in Europe for our study. The overall results show that the productivity growth in developed APAC countries (Australia, New Zealand, and the Republic of Korea) is significantly ahead of the growth in developing APAC countries (India and the People's Republic of China) and on par with the EU's growth. There is an ongoing process of bottom firms catching up with top firms in the Republic of Korea and the richest EU countries. Regarding employment and labor skills, employment growth has generally been quite stagnant in all regions. Labor skills, for which we use the wage premium as a proxy, are quite similar across most regions, with the richest EU countries showing a higher premium than the rest. Our test of the productivity–employment link indicates that the size of employment tends to have a greater impact on productivity in APAC countries, while labor skills have greater emphasis in the EU.

Keywords: productivity, firm-level, employment, labor costs, labor skills, wage premium, TFP dispersion, firm concentration, financial constraint

JEL classification: D24, E24, J21, J24, P52

List of Participating Countries—Asia and Pacific Region

Country	Data Provider	Institution
India	Nanditha Mathew	UNU-MERIT, Sant'Anna School of Advanced Studies and IBIMET-CNR
Thailand	Krislert Samphantharak	PIER and University of California San Diego
	Archawa Paweenawat	Bank of Thailand
People's Republic of China	Robin Kaiji Gong	Hong Kong University of Science and Technology
Japan	Daisuke Miyakawa	Hitotsubashi University Business School
	Miho Takizawa	Gakushuin University
Australia	Sasan Bakhtiari	Australia Department of Industry
Viet Nam	Long Trinh	ADBI
New Zealand	Guanyu Zheng	New Zealand Productivity Commission
Malaysia	Lay Lian Chuah	World Bank Malaysia
Republic of Korea	Pyo Hak-Kil	Seoul National University
	Keun Hee Rhee	Korea Productivity Center
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1. INTRODUCTION

The COVID-19 crisis has had a severe impact on the world's economies. It has wiped out entire sectors, economic activity has fallen dramatically, and unemployment has risen to record levels. Most notably, as government intervention has tried to limit the negative employment impacts, the aggregate productivity has unavoidably slowed down (or even decreased), at least in the short to medium run, deepening the previous negative trends.

In this study, we focus on the interaction between productivity and employment using the latest seventh vintage indicators that the Productivity Research Network (PRN) has produced. The dataset includes a wide range of indicators—derived from firm-level information—related to firm productivity and its potential drivers (e.g., labor markets, trade, finance, and competition) for a wide range of Asian economies.

Due to epidemic-related disruption of our data collection, we will report for now on three major developed APAC economies (Australia, New Zealand, and the Republic of Korea) and two developing APAC economies (PRC and India), leaving the possibility for an extension to the rest of the countries in our sample. As a further contribution to the debate, we will compare the developments in Asia with the sister dataset for Europe using the same methodology, CompNet. We will complement the analysis of productivity and labor markets by also examining financial, trade, and market power issues.

The structure of the study is as follows. Section 2 describes the PRN dataset. Section 3 analyzes productivity development in APAC countries, including comparisons with the EU. Section 4 assesses employment and related factors, including size dynamics, labor costs, and the wage premium. In section 5, we analyze more thoroughly the link between productivity and employment. Section 6 shows the development of other indicators, such as indexes of firm concentration and financial issues. Section 7 concludes.

2. DATA

2.1 Overview

We created our dataset using the "micro-aggregated" approach, which involves country teams running a unified set of codes on their proprietary firm-level data. We aggregated the set of output variables that we obtained (e.g., productivity, labor cost, etc.) at the sector (two-digit code in NACE Rev. 2), macro sector (one-digit code in NACE Rev. 2), and country levels. Subsequently, we collected and combined all these data into a single PRN dataset. In addition to simple averages, the codes generate moments of the distribution (e.g., median, skewness, and 10 deciles) for every variable in the dataset. We also computed a number of joint distributions for relevant pairs of variables (e.g., productivity and firms' employment or labor cost).

We divided the dataset for this study into the following groups: the APAC countries (Australia, the Republic of Korea, New Zealand, the PRC, India), the top EU countries in terms of GDP (Germany, France, Italy, Spain, and the Netherlands), and the remaining EU countries (which we call "remaining EU" in the following sections). Table 1 shows the number of firms in each group.

Table 2 provides an overview of the datasets that we included. All the countries have a rather long time span, which covers before and after the Global Financial Crisis (GFC).

Table 1: Number of Firms by Region and Year

Year	Australia	Republic of Korea	New Zealand	PRC[a]	India	Top EU	Remaining EU
1998				106,191			
1999				112,153			87,386
2000		5,106		111,314			232,309
2001		5,689	43,596	127,459	2,534		235,554
2002	42,305	6,398	44,526	140,623	2,505		281,892
2003	46,114	6,912	47,652	160,332	2,222		420,362
2004	45,612	7,429	49,977	242,678	2,992	697,638	556,677
2005	46,022	7,900	52,251	239,514	3,713	689,695	733,180
2006	45,787	8,497	54,180	267,940	3,153	1,026,126	639,088
2007	43,420	8,914	55,587	303,871	2,938	1,135,321	646,970
2008	43,861	9,320	57,051	371,289	2,356	1,415,974	653,580
2009	42,974	9,599	56,445	250,973	2,091	1,471,344	494,558
2010	45,077	10,273	54,927		1,440	1,474,090	824,783
2011	45,002	10,795	55,131	249,593	1,108	1,479,732	830,197
2012	45,542	11,583	55,311	285,805	961	1,455,883	822,156
2013	46,686	12,203	56,922	297,096	563	1,439,650	816,476
2014	48,816	12,863	58,926			1,442,393	824,385
2015	49,554	13,617	59,871			1,438,950	817,688
2016	50,772	14,350	58,632			1,405,026	817,304
2017	47,698	15,013	64,689			356,834	498,946
2018		15,443	65,145				
2019		15,557					

[a] We unfortunately had to exclude the year 2010 due to data availability.

Source: Authors' calculation with PRN and CompNet seventh vintage data.

Table 2: Brief Description of Input Data Sources across Countries

Country/ Region	Data Source Name	Period of Survey	Firms Included in the Dataset	Source Specific Information
Australia	Business Longitudinal Analysis Data Environment (BLADE)	2002–2017	Firms registered for goods and services tax	Sample data
New Zealand	Longitudinal Business Database (LBD) and Integrated Data Infrastructure (IDI)	2001–2018	All firms that are economically active in the NZ economy	Census data
Republic of Korea	Korea Enterprise Data (KED)	2000–2019	Large firms and SMEs	Sample data
PRC	Annual Survey of Industrial Enterprises (ASIE)	1998–2013	Private industrial firms with revenue from their core business above 5 million RMB, including all state-owned firms before 2007 and state-owned firms with revenue above 5 million RMB after 2007; the revenue threshold for both private and state-owned changed to 20 million RMB in 2011	Sample data, manufacturing only
India	PROWESS (Centre for Monitoring Indian Economy) and Annual Survey of Industries (Ministry of Statistics)	2001–2013	Companies accounting for around 70% of industrial output, 75% of corporate taxes, and more than 95% of excise taxes that the Government of India collects	Sample data
EU region	CompNet dataset (16 countries)	Dependent on the country; the general time span is 2004–2017	All firms excluding those from mining and agriculture, utilities, the financial sector, and public administration	Dependent on the country

2.2 Productivity and Other Indicators

Our dataset includes rich information related to the covariates of productivity developments, which we generated from the "modules" into which we divided the overall code, namely productivity, labor, financial structure, trade, and market power.

Table 3 shows the indicators that we included in each main module that we use in this study.

Table 3: Main Modules of the Datasets

Productivity	Labor	Financial	Market Power
Total factor productivity (VA-based)	Employment dynamics (firm size)	Financially constrained firms	Herfindahl–Hirschman Index
Productivity dispersion	• Employment growth • Labor cost • Wage premium		Top firms' revenue share

2.3 Level of Aggregation and Statistics

The dataset contains three main levels of aggregation: (1) the country level; (2) the macro-sector level (sectors at the one-digit level according to the NACE Rev. 2 sector classification); and (3) the sector level (sectors at the two-digit level of NACE Rev. 2).

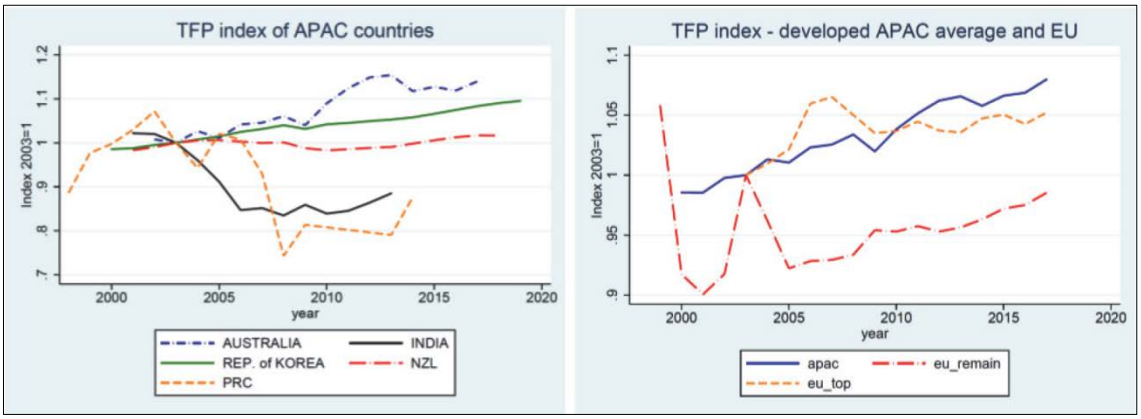
The distribution measures that we included for every indicator in our dataset are the following:

- Percentiles of the variable's distribution (p1, p5, p10, p25, p50, p75, p90, p95, and p99)
- Mean of the variable's distribution
- Standard deviation of the variable's distribution
- Skewness of the variable's distribution
- Kurtosis of the variable's distribution
- Number of observations of the variable's distribution

3. PRODUCTIVITY DEVELOPMENT IN APAC AND THE EU

TFP performance has differed widely between the developed countries and the developing countries in the APAC region (Figure 1). All three developed countries have generally maintained or increased their TFP level. The Republic of Korea achieved the most rapid growth, with a minor setback during the Global financial crisis (GFC). Australian firms show lower TFP growth but still had overall positive rates after the crisis. On the other hand, New Zealand recorded a virtually zero TFP rate of growth throughout the period but still maintained an index of approximately one.

Figure 1: TFP Index[a]



[a] Due to the difference in time coverage, the comparison with the EU only includes developed APAC countries.

Source: Authors' calculation with PRN and CompNet seventh vintage data.

The developing countries, namely the PRC and India, show more negative development. The post-crisis TFP in both countries was significantly lower than the pre-crisis levels.

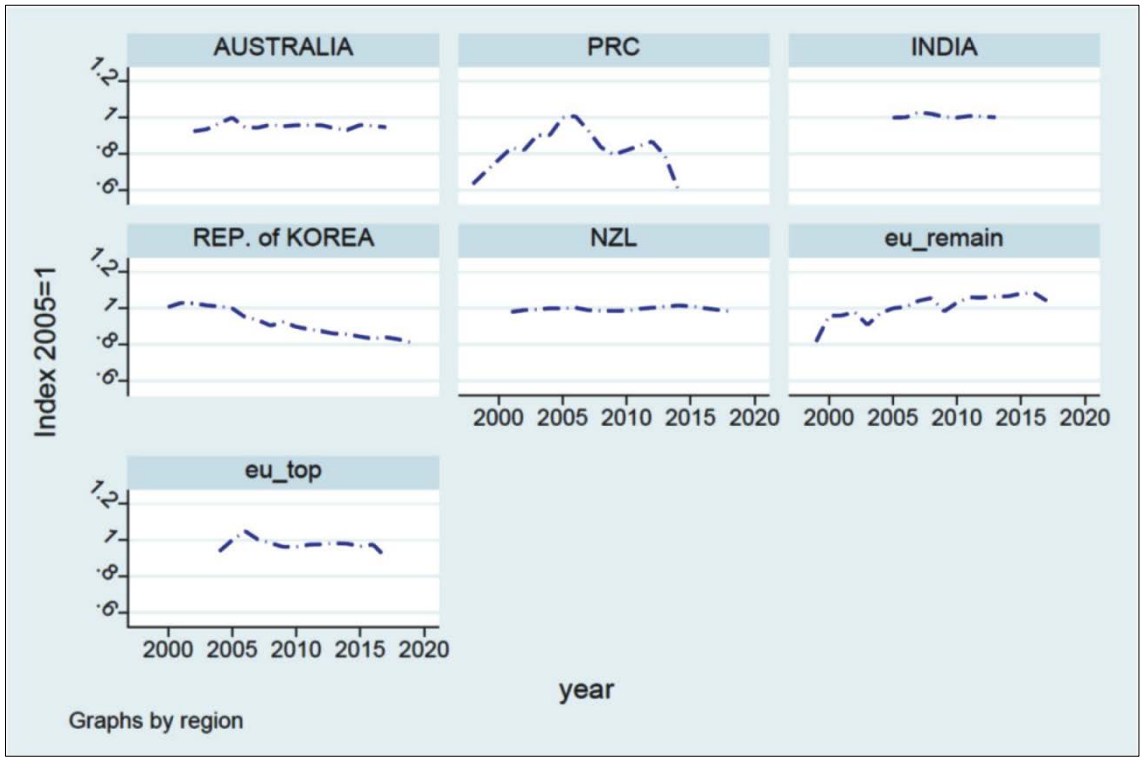
The TFP growth of the developed APAC countries is comparable to the growth that the top EU countries recorded before the crisis. After the crisis, however, the APAC developed countries as a group—mostly due to the Republic of Korea—outperformed the EU, the TFP growth of which has been stagnating since then.

Searching for clues on the drivers of these developments, we exploit our unique dataset and consider the extent to which aggregated productivity developments are diversified across firms, namely between the most and the least productive. The question that we want to answer is whether the increasing divergence between the productivity performance of the "best" vis à vis the "rest" of the firms is also a feature of our sample of APAC developed countries—similar to what the literature has extensively reported in recent years for most countries (CompNet 2020). The results are clear. Among the developed APAC countries, the TFP dispersion (log difference between p90 and p10 of firm productivity distribution) in Australia and New Zealand is virtually constant (Figure 2). For the Republic of Korea, instead, the dispersion decreases rather significantly. What this suggests is that, for the latter, a catching up of less productive firms accompanies higher overall productivity, which may signal a virtuous process of innovation diffusion taking place over time. Similar results appear for the richest EU countries, albeit against the background of much less dynamic aggregate productivity developments.

Within the developing APAC region, the PRC dispersion features a "parabolic" shape, reaching a peak and a turning point around the time of the GFC.

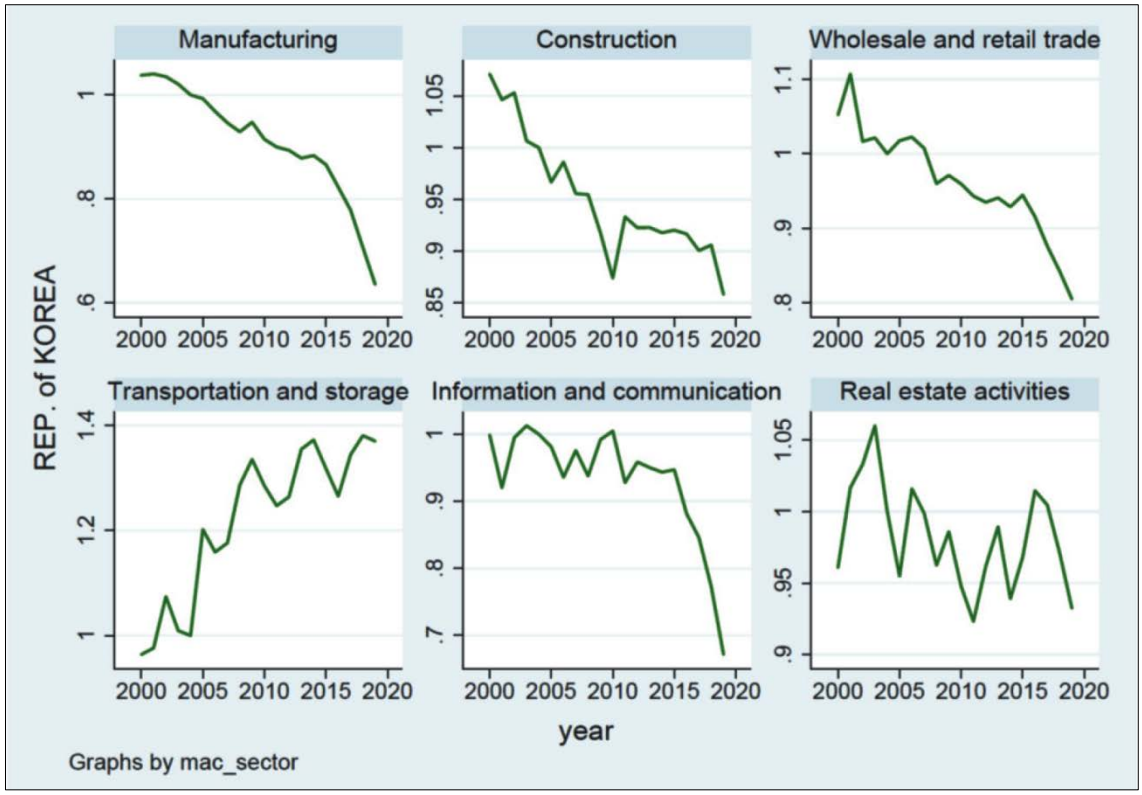
To investigate the issue further, we examine the TFP dispersion at the one-digit sector level in the Republic of Korea. As Figure 3 shows, most sectors in the Republic of Korea follow the overall downward trend of dispersion, indicating that the catching-up of laggard firms is not sector dependent except in the transportation and storage sector.

Figure 2: TFP Dispersion



Source: Authors' calculation with PRN and CompNet seventh vintage data.

Figure 3: TFP Dispersion—One-Digit Sectors in the Republic of Korea



Source: Authors' calculation with PRN and CompNet seventh vintage data.

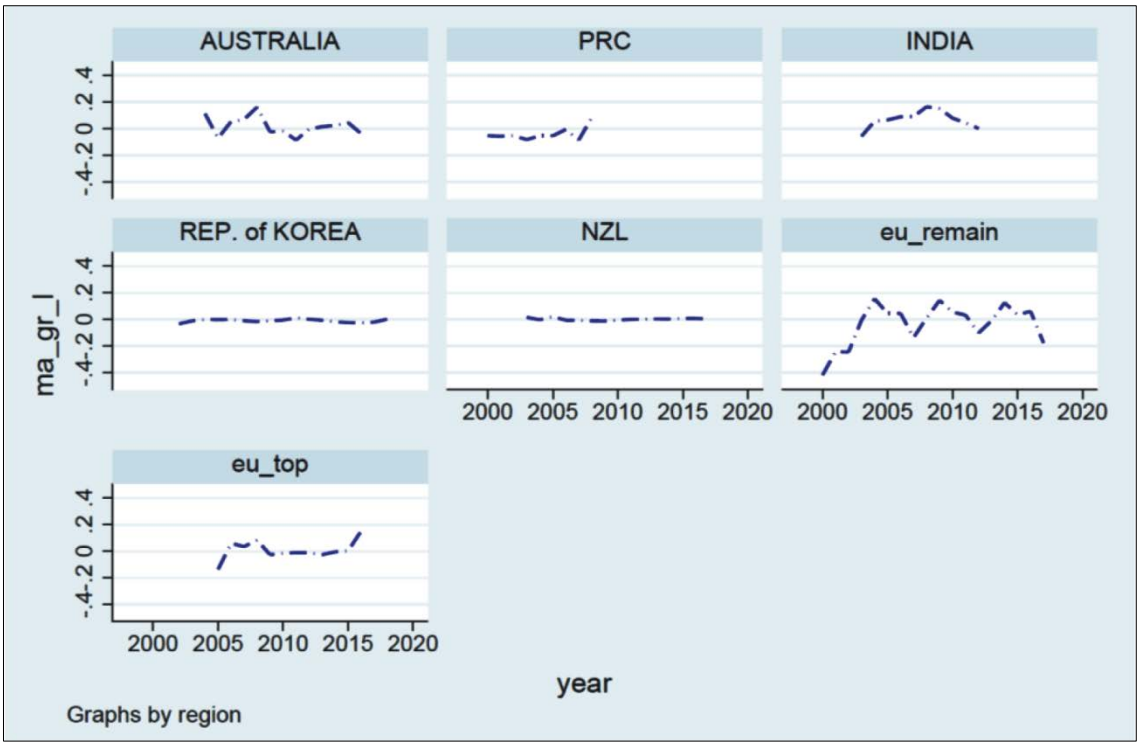
4. EMPLOYMENT AND LABOR COSTS

Employment and labor costs have—theoretically and empirically—a strong interaction with TFP developments. In this section, we investigate how such interaction varies across regions to shed light on the underlying transmission mechanisms.

4.1 Labor and Firm Size

Overall, the employment growth in all regions has been stagnant over the period of observation, with the exception of a short post-GFC spike i) in the PRC and India and ii) in the top EU countries after 2015 (Figure 4).

Figure 4: Labor Growth



Authors' calculation with PRN and CompNet seventh vintage data.

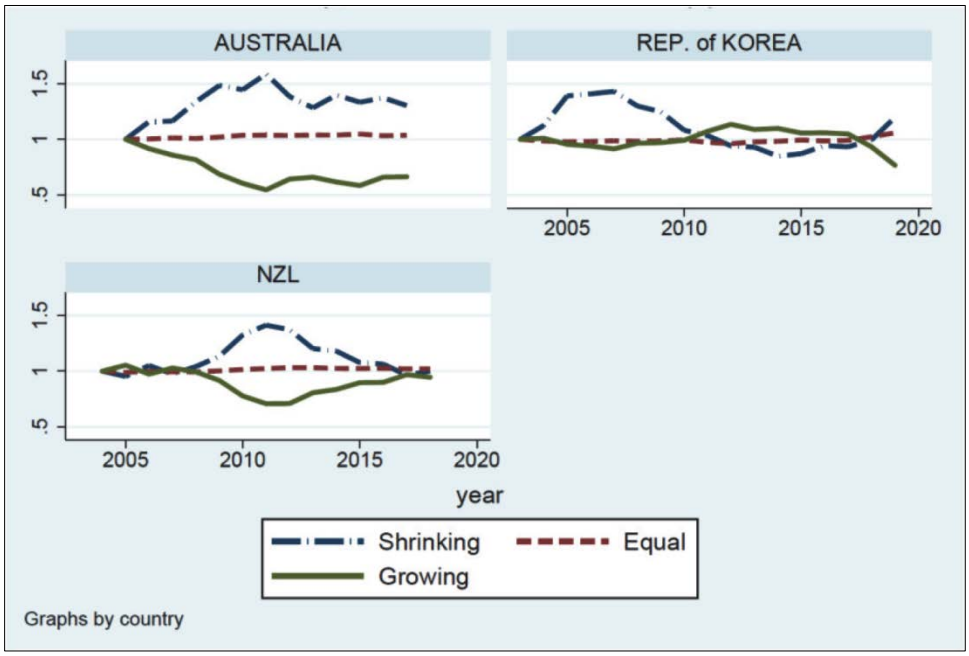
In a growing and increasingly productive economy, the expectation is that good firms will gain market shares and become bigger. We test this hypothesis using the three-year rolling "labor transition matrices" that we included in our dataset. We divide firms into the following three categories:

1. "Shrinking": firms moving from a higher to a lower size quintile.
2. "Equal": firms staying at the same size quintile.
3. "Growing": firms moving from a lower to a higher size quintile.

Firms' dynamism—which we define as the extent to which firms tend to change, and most notably increase, in size—has been rather stagnant for the three developed APAC countries (Figure 5). This is apparent from the rather flat and actually slightly increasing red dotted line. As for the share of growing firms, the developments were particularly negative in Australia, where such shares declined with a peak at the GFC,

without any apparent changes thereafter. In New Zealand, the share of growing firms tended to recover after the GFC. These patterns help to explain the low productivity growth in the two countries.

Figure 5: Firms' Size Dynamics—Developed APAC Countries



Source: Authors' calculation with PRN and CompNet seventh vintage data.

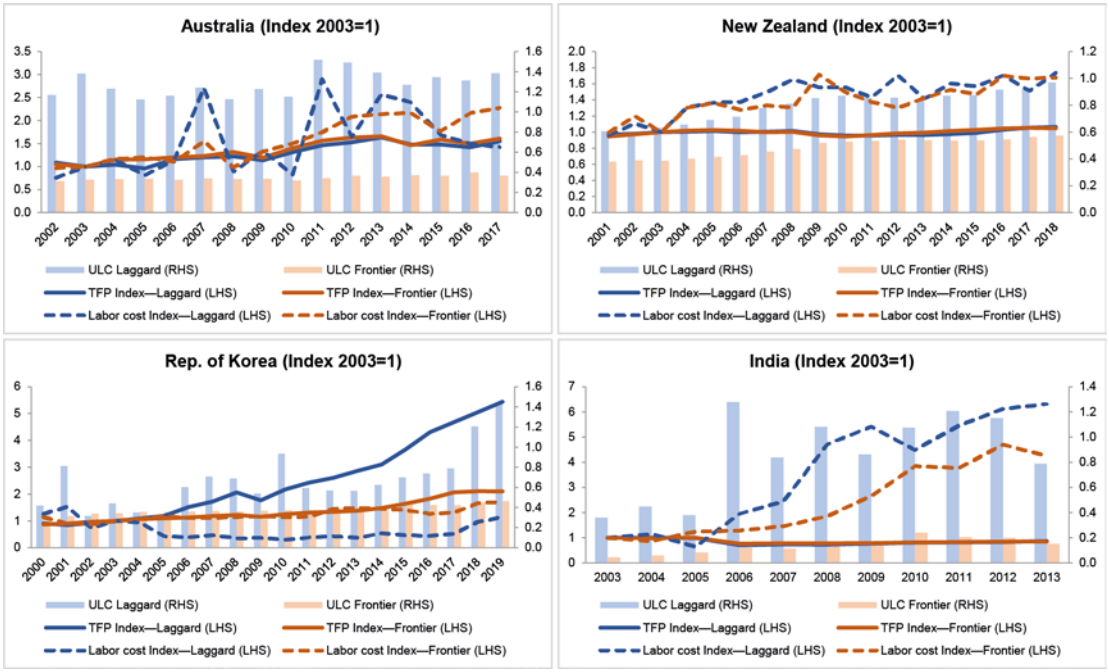
The Republic of Korea, while also showing a higher index for shrinking firms before the crisis, recorded a much healthier share of growing firms after 2010. This increase in firm size is consistent with the strong TFP growth in the Republic of Korea after the crisis.

4.2 Labor Costs

The unit labor cost (ULC) is a standard indicator of competitiveness as it shows the extent to which labor costs are in line with the growth in productivity. It is not surprising, therefore, that the ULCs are much higher for laggard firms in all the APAC countries that we consider (Figure 6), possibly explaining their lower performance. The difference in ULC levels between laggard and frontier firms is most notable in Australia and India, which also have the lowest levels of the ULC for frontier firms. Overall, the ULC does not increase much for both firm tiers in the APAC countries. The only exceptions are Korean laggards and Indian laggards, which show a sharp spike from 2017 and 2006, respectively. The labor cost in India also started to rise sharply from 2006. It seems that these spikes for the Republic of Korea and India had a minimal impact on their TFP, signaling that other factors than labor costs may have been supporting their strong economic performance.

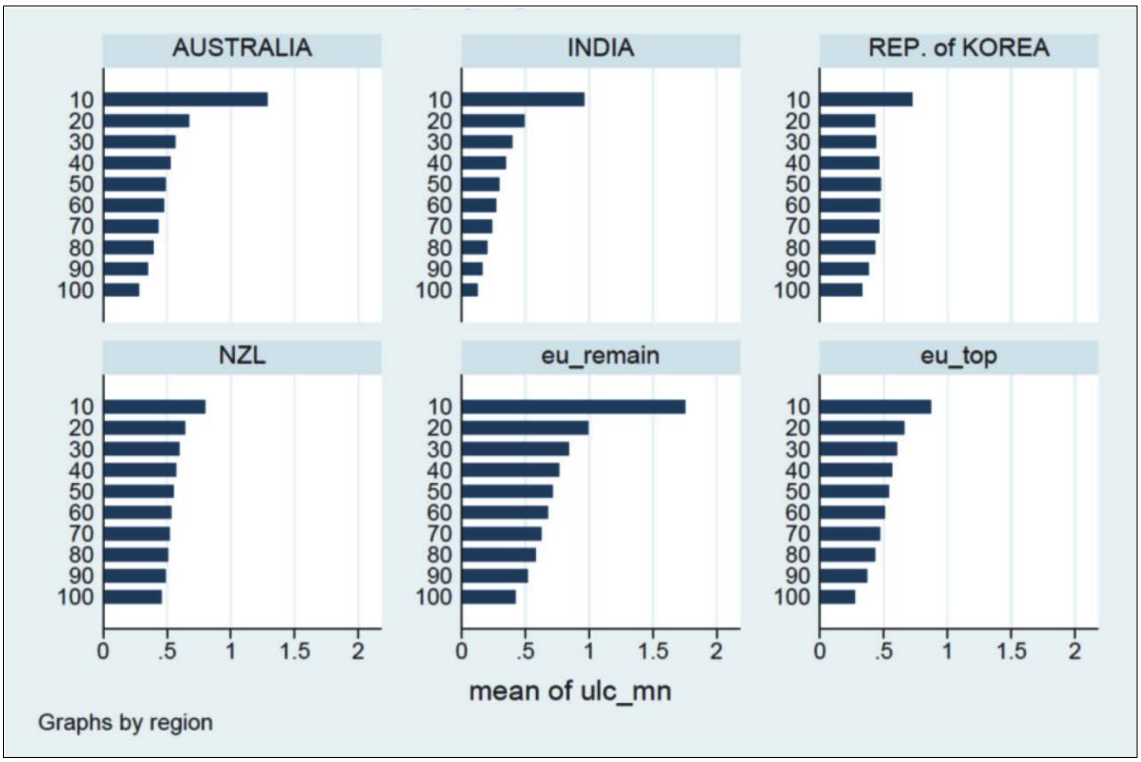
Examining the whole firm distribution in greater depth, the ULCs are lower the more productive the firms are in all the countries (Figure 7). It is notable that the bottom laggard firms have a significantly higher ULC than all the other tiers across all the groups. Australia and the EU countries outside the top five show the largest difference between their laggards and their top firms.

Figure 6: ULC-TFP Index—Labor Cost Index



Source: Authors' calculation with PRN and CompNet seventh vintage data.

Figure 7: ULC by TFP Decile



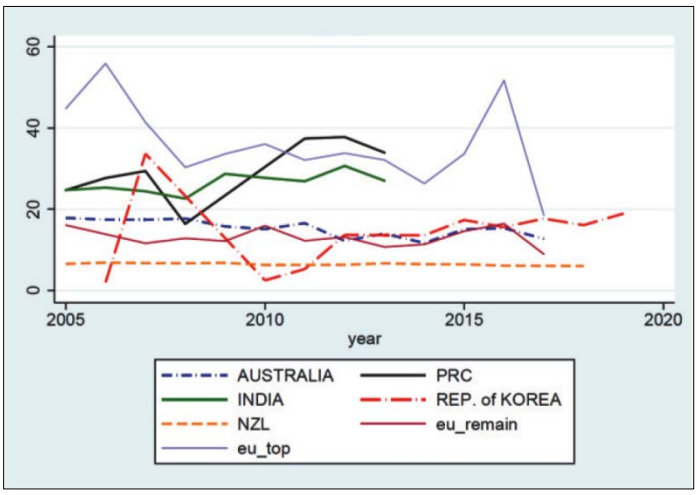
Source: Authors' calculation with PRN and CompNet seventh vintage data.

Korean firms, while having a low overall ULC, have quite evenly distributed ULCs across firm tiers. The middle-tier firms even have a higher ULC than firms in the

p20–p40 tier, pointing to a rather solid structure of competitiveness for the whole economy, which is in line with the remarkable productivity outcomes.

What can we say about the underlying skills prevailing in the labor force? As a proxy, we use the "wage premium," that is, the ratio of the average wage in a given firm to the median wage that firms operating in the same two-digit industry pay. The idea is that, if a firm pays more than its competitors in a narrowly defined sector, this means that its workers are more skilled.

Figure 8: Wage Premium[a]



[a] No wage data are available for 2009 and 2010 for the PRC.

Source: Authors' calculation with PRN and CompNet seventh vintage data.

According to this proxy, the labor force of the top EU countries tends to be more skilled than that in other regions (Figure 8). The premia of most other countries are quite close together. The Republic of Korea's wage premium initially fluctuates during the pre-crisis period, but it also stabilizes at around the average level after the crisis. Those patterns imply that pay differentiation—also in accordance with skills—tends to be rather limited in the APAC countries that we considered (as well as in the rest of the EU), which of course may be a factor hampering productivity growth.

5. EMPLOYMENT AND WORKERS' SKILLS' IMPACT ON PRODUCTIVITY

To measure the impact of employment on productivity, we need to consider two dimensions: the quantity of workers and the quality of workers (Ramirez and Nembhard, 2004). We develop an estimation that uses the number of workers to measure the quantity and the wage premium as a proxy for the skills, or the quality, of workers. We expect that, when the wage premium is higher, knowledge (white-collar) workers will gradually replace manual (blue-collar) workers. As the role of automation is also increasing, industries are gradually shifting their dependence from manual laborers to knowledge-based workers. As a matter of fact, the share of knowledge workers is increasing, most notably in developed countries (Drucker 1999; Helton 1988).

We conduct the base estimation at the sectoral level as follows:

$$\Delta TFP_{st} = E_{st-1} + WP_{st-1} + k_{st-1} + \gamma_t + \varepsilon_{it}$$

where ΔTFP_{st} is the log difference of TFP in sector *s* between year *t* and year *t-1*. E_{st-1} and WP_{st-1} are the employment and the wage premium in sector *s* in year *t-1*, respectively. We include real capital *k* as a control variable. We also include year fixed effects γ_t.

Table 4 reports the coefficients for employment and the wage premium.

Table 4: Estimation Results

	Developed APAC	Developing APAC	EU Top	Remaining EU
Employment	0.008**	0.071*	-0.002	-0.002
	(0.004)	(0.040)	(0.006)	(0.005)
Wage premium	0.003	0.010	0.006***	0.005**
	(0.005)	(0.024)	(0.002)	(0.002)
Observations	968	282	2013	3698
R-squared	0.149	0.768	0.219	0.074

Standard errors in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

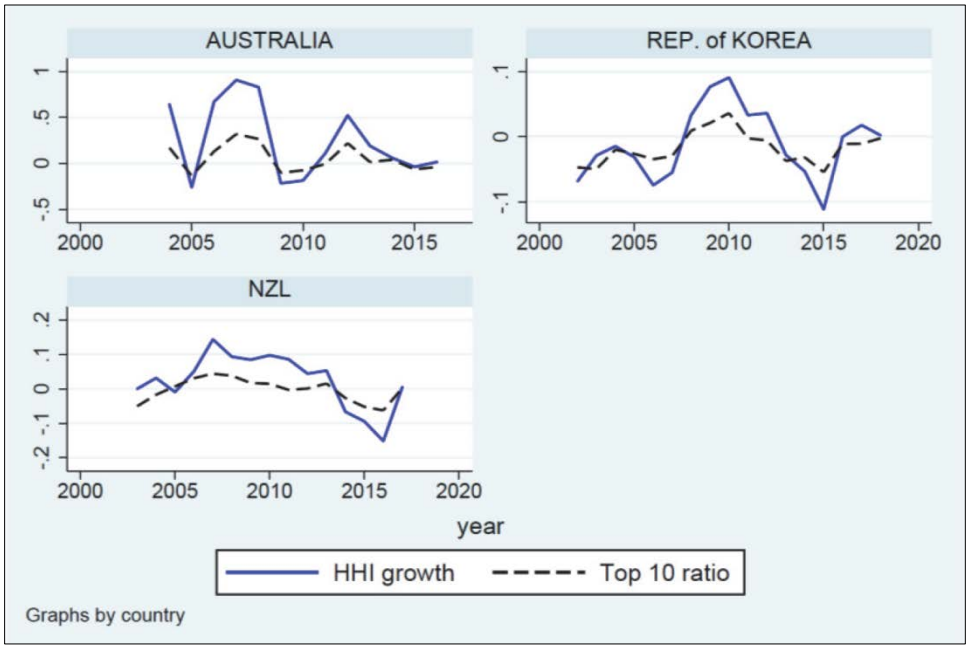
The regression results clearly show the difference between the APAC region and the EU. The quantity of workers tends to be the deciding factor in the APAC countries, more so for the developing APAC countries. On the other hand, in the EU, workers' skills (using the wage premium as a proxy) appear to be correlated more strongly with productivity. The size of employment is not significant in the EU region, while workers' skills are not as influential in the APAC region. All of the above appear to have a logical connection to the different demographics and stages of developments between the developing APAC (e.g., PRC and India) and the EU. It is less clear why the wage premium is more important in the EU than in the developed APAC, a matter that deserves more investigation, including further checking, as soon as the data for Japan become available.

6. OTHER INDICATORS

In this section, we cover selected other indicators that we included in the dataset: market concentration and financial constraint. A firm is financially constrained when its total investment is positive and larger than its cash flow, conditional on a negative annual change in debt and equity.

We benchmark the HHI growth with the revenue share of the top 10 firms at the country level (Figure 9). Overall, the firm concentration tends to move in the same direction as the top 10 revenue share. All the APAC countries have high HHI growth immediately before the GFC, then start to slow down after the crisis. They reach one of their lowest points around 2015. Most notably, Australia shows a sharp spike in the 2006–2007 period.

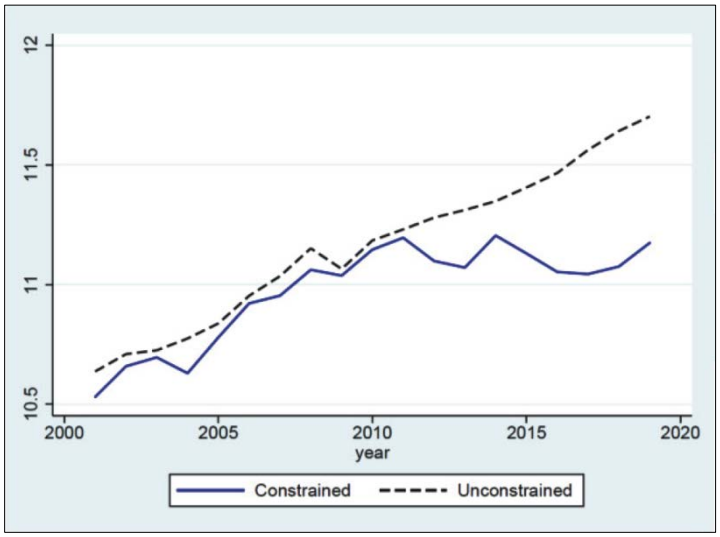
Figure 9: HHI—Benchmarked against the Top 10 Revenue Share in Developed APAC



Source: Authors' calculation with PRN and CompNet seventh vintage data.

Figure 10 shows the impact of financial constraints on firm labor productivity in the Republic of Korea (value added). As expected, unconstrained firms are more productive than constrained firms. The productivity boost after the crisis mainly comes from the unconstrained group. The productivity of constrained firms struggles after the crisis and falls behind that of the unconstrained group.

Figure 10: Financial Constraint Impact—Republic of Korea



Source: Authors' calculation with PRN and CompNet seventh vintage data.

7. CONCLUSIONS

This study presents a number of applications of our novel firm-level dataset for the APAC region, which we built using the seventh vintage CompNet codes. We show the development of productivity, employment, and other indicators in selected countries in Asia and the Pacific and EU regions. To sum up our findings, the developed APAC countries have the strongest TFP growth among all the groups—mainly as a result of the Republic of Korea's growth and most notably after the GFC. The productivity of developing APAC countries (for now the PRC and India) tends to fall behind after the GFC. The TFP dispersion generally does not show drastic changes in most regions, except for the Republic of Korea and the PRC. Employment growth remains quite stagnant in most regions, while the unit labor cost and firm size dynamics vary differently across the included countries. There is a clear difference regarding the impact of employment on productivity between the APAC region and the EU. APAC countries tend to rely more on the size of their workforce, while the EU region is more knowledge based.

Due to the delay resulting from the Covid-19 pandemic, this study only included three developed and two developing APAC countries. In our opinion, however, it contains enough food for thought to address productivity issues arising from the post-Covid reality as well. The addition of the remaining countries will be instrumental in that.

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APPENDIX A

Production Functions

We estimate the production functions by pooling all the firms operating in each macro-sector or sector level and by assuming the Cobb–Douglas production function. The output measure of the firm that we use in the regression is either the real value added or the real turnover.

We explain the functions using the real value added in this section. The estimations using the real turnover are the same except that we replace the dependent variable.

We derive the total factor productivity from the Cobb–Douglas production function in sector *i* and year *t*:

$$RVA = AK^{\beta}L^{\omega} \quad (1)$$

where RVA is the real value added, A is TFP, K is the real value of capital stock, and L is labor. Building on the approach that Wooldridge (2009) developed, we take the natural logarithm of the above equation and estimate the firm-level TFP at both the two-digit and the one-digit level.

To obtain the output elasticity of input β and ω, we apply a control function approach following Olley and Pakes (1996) and Levinsohn and Petrin (2003). Assuming that productivity evolves according to a Markov process, we can write the control function as follows:

$$\begin{aligned} rva_{it} = {} & \beta_0 + \beta_1 k_{it} + \beta_2 k_{i(t-1)} + \beta_3 m_{i(t-1)} + \beta_4 k^2_{i(t-1)} + \beta_5 m^2_{i(t-1)} \\ & + \beta_6 k^3_{i(t-1)} + \beta_7 m^3_{i(t-1)} + \beta_8 k_{i(t-1)} m_{i(t-1)} + \beta_9 k^2_{i(t-1)} m_{i(t-1)} + \\ & \beta_{10} k_{i(t-1)} m^2_{i(t-1)} + \gamma Year_t + \omega L_{i(t-1)} \end{aligned} \quad (2)$$

We express all the variables in logs. We measure the material inputs with m_{it}. Since we determine labor and TFP simultaneously, while capital takes time to build, we instrument labor with its first lag. The equation contains several higher-order and interaction terms between capital and materials to control for non-linearities. We include a full set of year dummies to control for sector-specific trends. We perform the estimation via GMM following Wooldridge (2009). We cluster standard errors at the firm level.

We perform estimations at the sector and macro-sector levels. We estimate Cobb–Douglas and translog production functions, once separately for all the firms within a two-digit sector and once separately for all the firms within a macro-sector.

To obtain consistent estimates with sufficient degrees of freedom, we require a minimum of 200 observations per sector and year.

Following estimation (2), we retrieve the firm-level (log) TFP as the difference between the (log) real value added and the fitted values for (log) real capital and (log) labor.

$$TFP_{it} = rva_{it} - \hat{\beta_1} k_{it} - \hat{\omega} L_{i(t-1)} \quad (3)$$

APPENDIX B

Disclaimer—New Zealand Dataset

The results in this study are not official statistics. We created them for research purposes from the Integrated Data Infrastructure (IDI), which Statistics New Zealand manages. The opinions, findings, recommendations, and conclusions that this study expresses are those of the author(s), not those of Statistics NZ.

Statistics NZ provided access to the anonymized data that we used in this study under the security and confidentiality provisions of the Statistics Act 1975. Only people whom the Statistics Act 1975 authorizes are allowed to see data about a particular person, household, business, or organization, and we maintained the confidentiality of the results of this study to protect these groups from identification and to keep their data safe.

We applied Statistics NZ's confidentiality protocols to the data that we sourced from the New Zealand Customs. Any discussion of data limitations is not related to the data's ability to support these government agencies' core operational requirements.

We gave careful consideration to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further details are available in the privacy impact assessment for the Integrated Data Infrastructure from www.stats.govt.nz.

APPENDIX C

Brief Note on the Indian Dataset

In the 6th Vintage, the Indian data came from PROWESS, the Centre for Monitoring India (CMIE), which lacked employment data. This was a major drawback of the Indian 6th Vintage data. We calculated the Indian TFP with other proxies; therefore, we had to be more careful when comparing it with other countries' TFP.

In the latest seventh vintage, most other countries only have slight modifications or updates of their time coverage to include recent years. The Indian dataset, on the other hand, underwent major changes from the 6th Vintage to the seventh vintage. The PROWESS data merged with data from the Annual Survey of Industries (Ministry of Statistics). With this merging, employment data are available for the Indian dataset, which makes the Indian TFP more comparable with that of other countries. The Indian seventh vintage dataset contains an average of more than 2,000 firms annually from 2001 to 2013. This is an improvement from the previous vintage, which ends in 2011, thus reducing the viability of post-crisis analysis for India. The manufacturing sector accounts for around 44% of firms, which is the largest sector in the sample.