PRODUCTIVITY IN DEVELOPED ASIA-PACIFIC: A FIRM-LEVEL PERSPECTIVE

By
the Productivity Research Network (PRN) Task Force,[1]
coordinated by

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DISCLAIMER: All opinions expressed are of the authors and do not necessarily reflect those of the individual data-providers and the Institutions they respectively belong to.

[1] The list of contributing Institutions and researchers is in the following page. Thanks to Swee Joo Ong and Jeanette Pang from Ministry of Trade & Industry (MTI) Singapore for their comments. Jipeng Fei and Ziwei Liu provided excellent assistance.

List of participating Institutions (and Representatives), by Country

Country	Institution	Representatives
Australia	Australian Dept. of Industry and Science	Sasan Bakhtiari
Japan	Japan Productivity Center	Kazuma Edamura
New Zealand[2]	New Zealand Productivity Commission	Guanyu Zheng

[2] The New Zealand team requested a special disclaimer to ensure data confidentiality, which is in Annex 4.

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Executive Summary

Although productivity is one of the deciding factors for firm's performance, research on this topic is hampered by the scarcity of firm-level data and lack of streamlined methods to perform cross-country analysis. This Report introduces the Productivity Research Network dataset and methodology, which address the aforementioned problems. We focus on Asia-Pacific countries, with some comparisons made with developing Asia and EU region.

This is the second report of the Productivity Research Network (PRN) at the National University of Singapore (NUS)-Business School. The PRN was launched in mid-2017 to foster research and bolster firm-level data collection across Asia on issues related to productivity and its potential drivers. Since then, the PRN has organised three Workshops and gathered substantial interest from scholars and researchers.

Following the first Report on developing Asia, this second Report presents and documents findings from the PRN dataset for a number of developed Asia-Pacific countries (APAC) including Australia, Japan and New Zealand, originating from firm-level micro datasets within countries (details can be found in the text and Annex 1). It also provides productivity developments from a firm-level perspective, as well as information on a number of its possible covariates, namely resource reallocation, export, firm size, labour cost, financial structure and mark-ups.

To sum up the main findings:

- *Productivity growth in APAC was heavily impacted by the Global Financial Crisis (GFC). In the countries considered in this report, it took a notable dip during this period, which is more significant than for developing Asia and the EU. However, in all APAC countries, productivity also bounced back rather strongly during the post-crisis period.*
- *The GFC tended to widen even further the productivity gap between the least productive (p10 of productivity distribution) and the most productive (p90 of productivity distribution) firms.*
- *There is not univocal indication on whether the GFC tended to improve resource reallocation. Using the Olley-Pakes (OP) gap – a widely-used standard indicator - allocative efficiency improved in the post-crisis period in New Zealand, while remained virtually unchanged in Australia and actually declined in Japan.*
- *Using the Foster decomposition instead, as an alternative measurement of allocative efficiency, we find that most of the aggregate productivity growth in countries and sectors was generated by resource reallocation across firms, while the contribution provided by the productivity generated within individual firms was much smaller. This is actually very much in line with expectations for developed economies.*
- *Distinguishing firms with regard to their trade activities, exporting firms tended to be more productive than the non-exporters, as shown by positive export premium in all reported countries; a result quite common in the empirical literature. In addition, APAC countries recorded higher export premium than the one we documented for a number of developing Asian countries, which means the productivity difference between exporters and non-exporters in APAC is more significant. Going deeper into the premium measured for three kinds of exporters (temporary, new, permanent), new exporters recorded the highest premium among the three, implying that firms seem to enjoy the largest productivity boost during their initial years of exporting.*
- *Looking at the changes overtime in the individual firm size, there is quite large heterogeneity across countries. In Australia and New Zealand, the share of firms becoming larger declined overtime, while increasing in Japan. As for the share of shrinking firms, it tended to increase over time for New Zealand and Japan while declining for Australia.*
- *Our dataset provides important insights on the dynamics of the firms Unit Labour Cost (ULC), which is a standard proxy for their cost-competitiveness. More specifically, the dataset allows to distinguish the ULC dynamics across different segments of the productivity distribution, namely most productive (frontier) vis a vis*

lowest productive (laggard) firms. The patterns of the firms competitiveness are remarkably different across the three countries considered:

- *In Australia, the ULC for frontier firms increases (and therefore their competitiveness decreases) over time, while the one for laggards stays at almost the same level during the whole period, except for a spike in 2008. This results from labour costs that are higher and growing for frontier firms, despite productivity growth patterns are similar to the one recorded in least productive firms.*
- *In New Zealand, both ULC of laggard and frontier firms show upward trends, with higher growth index for laggard. However, cost-competitiveness divergence across firms decreases at the end of period, due to labour costs for frontier firms growing faster than their respective productivity.*
- *There is an opposite trend in Japan, where the ULC of both laggard and frontier firms decrease over time.*

- *As a novel feature, the dataset identifies now the firms that can be considered 'financially distressed'. For all countries, there is a clearly negative correlation between firms' investment and the share of financially distressed firms.*
- *We study the competitive environment firms are facing by examining the mark-up trends in all APAC countries:*
  - *In Australia and New Zealand, mark-ups show a generally upward trend. By contrast, mark-ups growth is rather flat in Japan.*
  - *We analyse how market power varies when trade activities are taken into account. For Australia and New Zealand, exporters have higher mark-ups growth (opposite to Japan). This result is in line with the findings of De Loecker and Warzynski (2012), who argue that exporters can exert more market power than non-exporters.*

All the above findings illustrate the richness of the PRN dataset as well as the potential for more applications for research and policy. This dataset can be used not only for cross-country comparison (which is the main focus of this Report), but also for study at the sector and sub-sector level within each country. We are committed to address all the possible comparability issues and to ensure that our dataset can reach the best usability possible.

1. Introduction

This Report presents the most recently updated PRN dataset of productivity indicators. We will focus on three developed economies in the Asia-Pacific region (e.g. Australia, New Zealand and Japan). We compare the new productivity indicators for APAC with the ones previously computed for five developing Asia countries (see ***PRN First report, June 2018***[3]), as well for eighteen European Union (EU) countries. The latter data come from the recently updated CompNet dataset (www.comp-net.org), which uses the same PRN methodology.

With this addition, PRN provides a novel contribution to the existing literature in term of coverage for Asia-Pacific region and its comparison to a large set of EU countries.

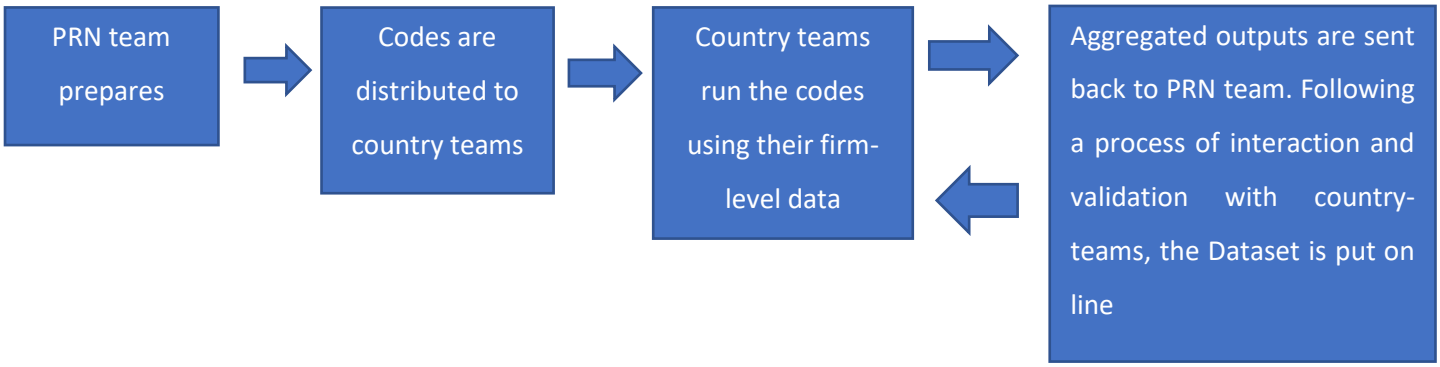
The Report is structured as follows. Section 2 describes the data collection procedure and PRN methodology, and Section 3 introduces the main variables. Section 4 compares the productivity development in APAC to the other regions. Section 5 assesses the resource reallocation in APAC using the OP gap and Foster decomposition approach. Section 6 to 10 analyses the productivity developments and its association with a number of factors such as trade, employment dynamics, labour cost, financial structure and mark-ups.

2. The PRN dataset

Similar to the previous report, we use the "micro-aggregated" approach, which involves country teams running a unified set of codes on their proprietary firm level data (Bartelsman, 2005). The set of output variables obtained (e.g. productivity, labour cost, etc.) are aggregated at the sector (2-digit), macro sector (1-digit) and country level. Subsequently, all these data are collated and analysed by a team of researchers at the NUS-Business School. In addition to simple averages, the codes generate moments of the distribution (e.g. median, skewness, 10 deciles) for every variable in the dataset. A number of joint distributions for relevant pairs of variables (e.g. productivity and firms' employment or labour cost) are also computed.

[3] The Report can be downloaded from PRN website: https://bschool.nus.edu.sg/strategy-policy/productivity-research-network

Figure 2.1: Data collection procedure



Data sources, Coverage and Representativeness

Table 2.1 provides an overview of the data used in this report. Data providers from participating country teams run the codes using their country's firm-level data and send the output back to the PRN team.

Since Japan's data only contains firms with 50 or more employees and a minimum capital of 30 million yen, there is a bias toward larger firms. Therefore, comparisons with Japan throughout our Report needs to be treated with care.

Table 2.1: Brief description of input data sources across countries

Country/region	Data source name	Period of survey	Firms included in dataset	Source specific information
Australia	Business Longitudinal Analysis Data Environment (BLADE)	2002-2016	All firms registered for goods and services tax.	Census data
Japan	Basic Survey of Japanese Business Structure and Activities (BSJBSA)	1995-2013	All firms in Japan with minimum capital of 30 million yen and 50 or more employees.	Census data
New Zealand	Longitudinal Business Database (LBD) & Integrated Data Infrastructure (IDI)	2001-2016	Cover all firms which are economically active in the NZ economy.	Census data
EU region	CompNet database (18 countries)	Depend on countries, general timespan is 2000-2015.	All firms excluding those from mining and agriculture, utilities, financial sector and public administration.	

Developing Asia	PRN database (5 countries: China, India, Indonesia, Malaysia, Vietnam)	Depend on countries, general timespan is 2000-2015.	Only manufacturing firms are included.	

3. Analysing potential productivity drivers: The PRN Methodology

The PRN dataset includes rich information related to the covariates of productivity developments, generated from the "modules" that the overall code was subdivided into, namely: Productivity, labour, financial structure, trade, and mark-up.

3.1. Modules

Table 3.1 shows the five main modules used in this report, with a breakdown of indicators included.

Table 3.1: Main modules collected

Productivity	Labour	Financial	Trade	Mark-up
Total Factor Productivity (VA-based)	Employment dynamics (firm size)	Investment ratio	Export premium for exporters – all firms	Mark-ups growth for all firms
Allocative efficiency (OP gaps & Foster decomposition)	- Unit Labour Cost - Labour Cost	Financially distressed firms (conditional on negative profits and not displaying high employment growth)	Export premium for different types of exporters	Mark-ups growth for exporters vs non-exporters

3.2. Levels of aggregation and statistics

The dataset contains four levels of aggregation: (1) the country level, (2) the macro-sector level (sectors at 1-digit according to the NACE REV.2 sector classification), (3) the macro-sector and firm size class[4] level and (4) the sector level (sectors at 2-digit in NACE REV.2).

Table 3.2 lists the distributions measures included for every indicator in our dataset.

Table 3.2: Definitions of distribution measures

Moment	Definition
p1, p5, p10, p25, p50, p75, p90, p95, p99	Percentiles of the variable's distribution
mean	Mean of the variable's distribution

[4] Firm size is divided into 5 classes: 1-9 employees, 10-19 employees, 20 to 49 employees, 50 to 249 employees and 250 or more employees.

Sd	Standard deviation of the variable's distribution
skew	Skewness of the variable's distribution
kurt	Kurtosis of the variable's distribution
tot_mark, count, obs	Number of observations of the variable's distribution

3.3. Joint Distributions

Notably, the PRN dataset includes many "Joint Distributions" across pairs of main indicators in the dataset, at each aggregation level. For continuous variables, we split firms into deciles from p10 to p100. For variables which take discrete values (i.e., dummy variables which take the value of 0 or 1), we split firms based on these values. After splitting the firms, we look at the characteristics of firms within each group.

For instance, when computing the "Joint Distributions" for Total Factor Productivity (TFP), we first divide firms into 10 deciles based on their TFP. We then compute the moments of labour, financial, and trade indicators for firms in each decile using various distribution measures (refer to table 3.2). These measures allow researchers to assess the extent in which (including the sign) the lowest and highest productive firms tend to be correlated to potential productivity drivers. For instance, we are able to gauge the extent to which high productive firms are associated with higher exports/employment/labour costs and whether this differs across countries. Table 3.3 shows the main indicators used for joint distributions, subject to data availability in each country.

Table 3.3: Main Indicators used for the Joint Distributions

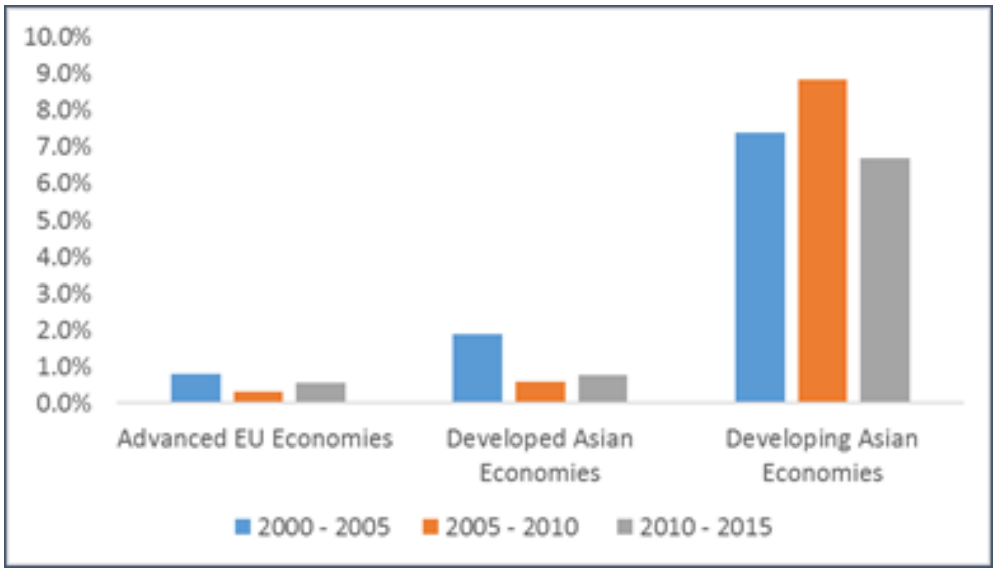
Main variables		
Topic	**Name**	**Definition**
Productivity	TFP	Data conditional on deciles of TFP from a Cobb-Douglas estimation at different levels of aggregation
Labour	l	Data conditional on deciles of the size distribution, according to employment
Financial	Financially distressed firms	Distribution conditional on firms being in a distressed status, using methodology based on negative profits conditional on not displaying high growth
	Investment Ratio	Growth rate of capital plus depreciation, divided by capital
Trade	Dummy Export	Data for exporting and non-exporting firms

4. Productivity development

4.1. The Macro Perspective

As widely pointed out in recent literature, productivity growth has been rather lacklustre and declining since the early 2000 for the advanced economies, both in Asia[5] and in the EU[6]. In comparison, productivity growth was several folds higher for the Developing Asian countries, though with a tendency of slowing down in the aftermath of the GFC (Figure 4.1).

Figure 4.1: Macro-level productivity growth in selected regions



Source: World Economic Outlook (April 2018), CEIC, National Statistical Office

4.2. The Micro Perspective

The PRN dataset allows us to delve deeper into productivity developments in the Asia-Pacific region using rich firm-level data, which help identifying major drivers. The productivity measures included in the dataset are as follows:

- Non-parametric measures of labour productivity: Labour productivity is computed as real value added per worker.
- Parametric Total Factor Productivity (TFP): We estimate value added and gross output production functions at the 2-digit (sector) and 1-digit (macro sector) NACE level, following Wooldridge (2009). We provide value added-based TFP estimates and marginal productivities of labour, capital and intermediate inputs derived from these functions. Parametric TFP (value-added based) will be our main indicator of productivity in this Report.

[5] Developed Asian Economies refer to Singapore, Hong Kong, South Korea, Taiwan, Japan, and Australia, New Zealand
[6] Advanced EU Economies refer to Denmark, Finland, Germany, Sweden, United Kingdom, Netherlands, Switzerland, Italy, Spain, Greece, Portugal

Figure 4.2 shows the development of TFP for the APAC countries in our dataset[7]. Despite being affected by the crisis as evidenced by the sharp decline in productivity during the GFC period, these countries see their TFP rebound post-2010.

In Figure 4.3, we compare the productivity growth patterns between the APAC and EU regions, where the latter region is split into the Eastern and Western region[8]. Overall, APAC has a lower productivity growth rate than that of the Western EU and all EU until the end of the GFC in 2009, then starts to outpace EU growth during post-crisis period.

Eastern EU starts with a strong growth in the early years but registers sluggish productivity growth during the crisis and post-crisis period[9]. By contrast, TFP in Western EU and the EU as a whole (both largely driven by Western EU) appear to grow slowly over time[10].

Figure 4.2: TFP Index – APAC countries

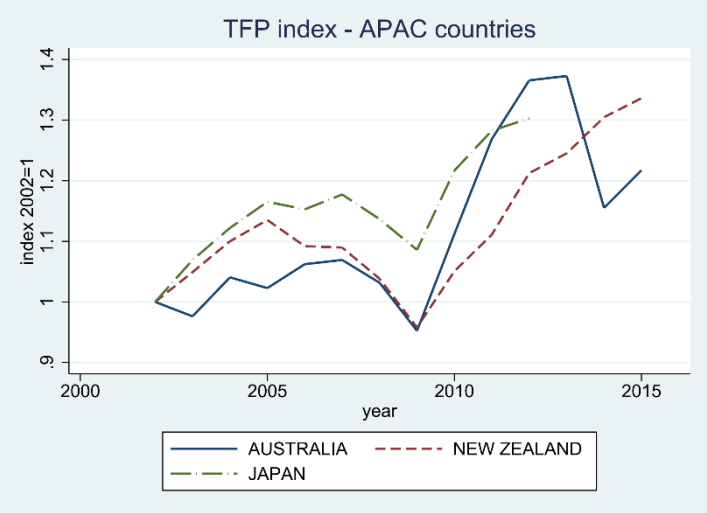
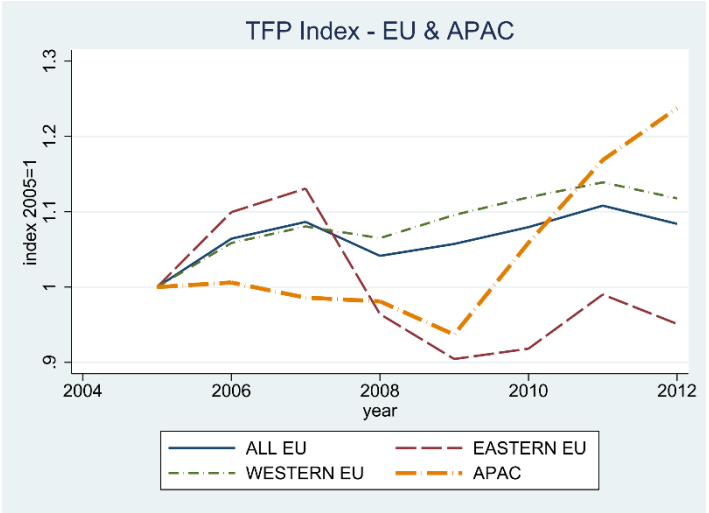


Figure 4.3: TFP index – APAC and the EU region



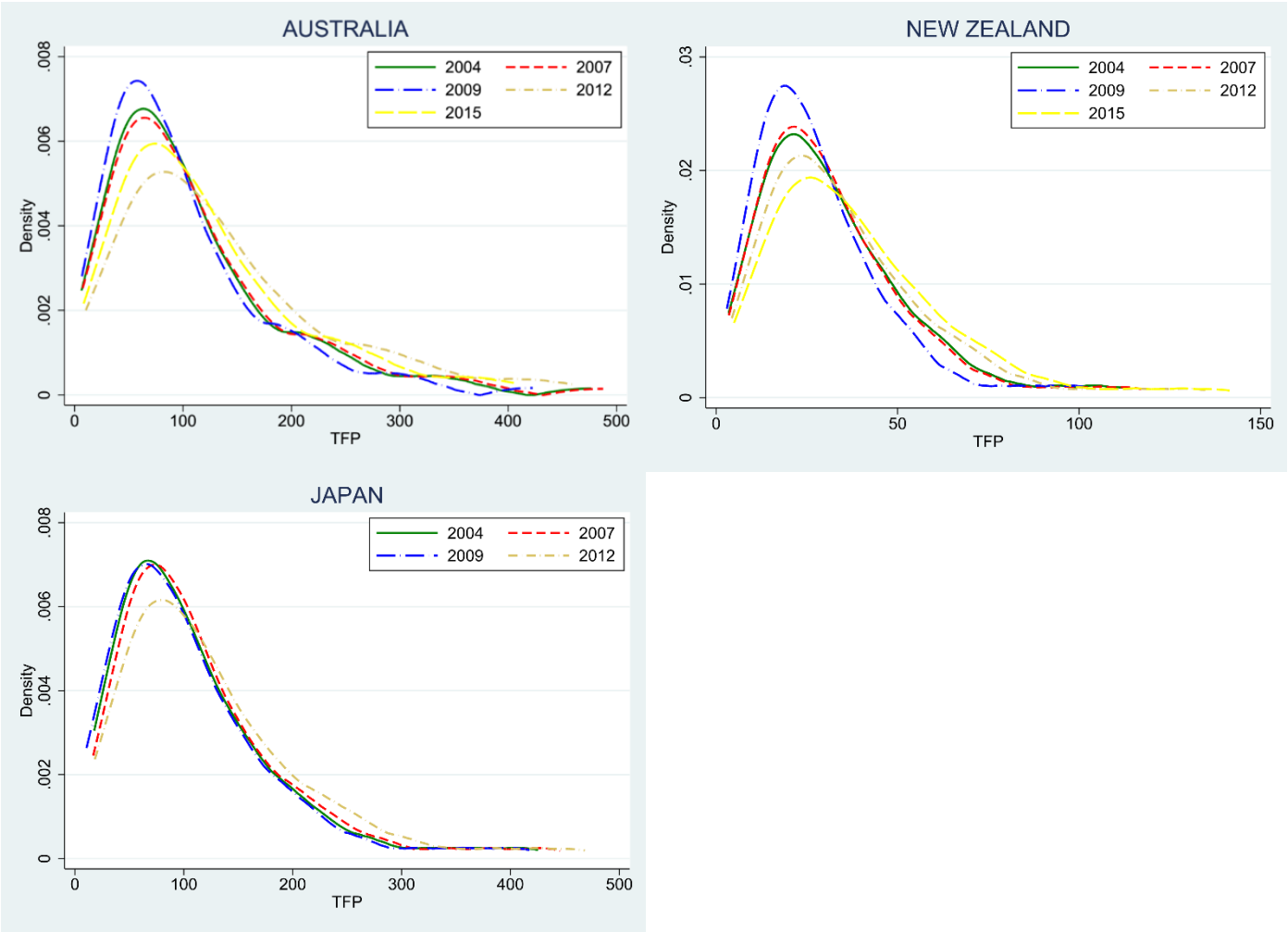
4.3. Going deeper using Micro level Information: Looking at Productivity Distributions[11]

Productivity outcomes are largely heterogeneous across firms resulting in highly skewed productivity distributions. By using firm-level data rather than average figures, we are able to capture important information over time and across countries more accurately.

[7] We use the Cobb-Douglas value-added production function to compute TFP values at 2-digit (sector) level, aggregated to country level. See similar concepts by Olley and Pakes 1996, Wooldridge 2009, Ackerberg et al. 2016.
[8] To calculate the regional TFP index, we take the average of TFP indicators from countries within each sub-region, using country GDP per capita as weight. We choose the period for cross-regional comparison as 2005-2012 to include as many countries as possible.
[9] Eastern EU consists of Croatia, Czech Republic, Hungary, Lithuania, Romania, Slovakia and Slovenia.
[10] Western EU consists of Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain and Sweden.
[11] In order to best compare productivity distributions across countries, we select the most commonly available years (with 3-year intervals when possible) for the different countries, centred around Global Financial Crisis (2007-2009).

With regard to TFP, all APAC countries feature long tails on the right-hand side of the productivity distribution. Such pattern implies a large performance gap between a small share of highly productive firms and the large mass of low productive firms (Figure 4.4).

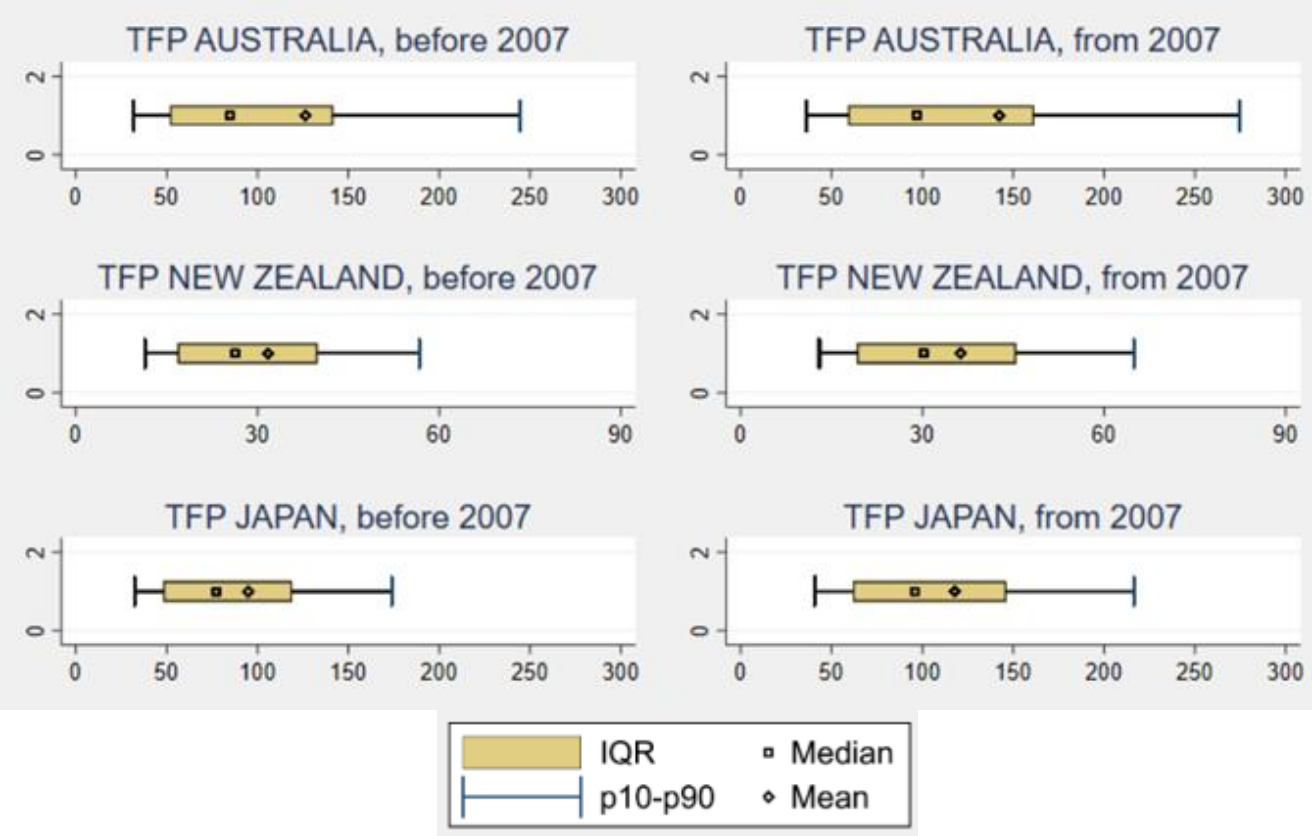
Figure 4.4: TFP distributions by country, in selected years



The impact of the GFC (2007-2009) on the productivity levels of APAC countries can be seen clearly in Figure 4.4. The TFP distributions in Australia and New Zealand show notable leftward shifts at the end of the GFC in 2009, before bouncing back towards higher average and skewness in 2012. Japan also shows similar pattern but with a less significant shift in 2009.

To assess the extent of productivity shifts before and after the crisis more precisely, Figure 4.5 presents TFP box plots for the two periods.

Figure 4.5: Box plot - TFP dispersion



For all countries, the TFP dispersion (i.e. the difference between the most and least productive firms) widens after 2007. Firms appear to have become more productive on average after 2007, with higher mean and median TFP, largely driven by the top performers (p90).

5. Assessing the Efficiency of Resource Reallocation

At the overall economy level, productivity growth can be driven by two factors. First, it can be the result of within firm growth in productivity as incumbents, especially the large incumbents, constantly invest in innovation and new technologies. Second, it could be driven by a reallocation of resources (capital and labour) towards more efficient uses within the economy, either across firms in the same sector, or across sectors. The latter is known in the literature as “allocative efficiency”. There are a number of proxies for resource reallocation. In this PRN Report, we cover the measures introduced by Olley-Pakes (1996) and Foster et al. (2006).

5.1. The Olley-Pakes (OP) gap

Olley and Pakes (1996) measure allocative efficiency by looking at the covariance between firm size and firm productivity. The idea is that if there is allocative efficiency (as shown by the so-called OP gap), productive firms tend to grow larger. Such dynamics will create a positive covariance. Technical details of the OP gap can be found below.

OP gap: technical background

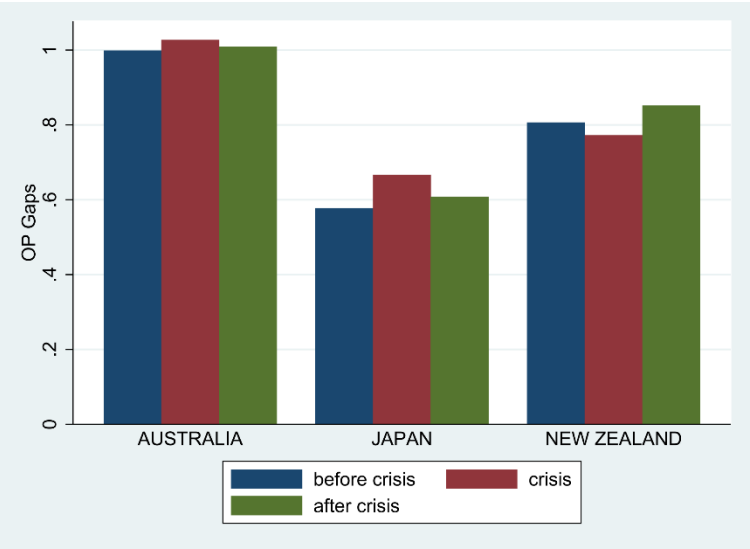
Olley and Pakes (1996) measure the degree of allocative efficiency by decomposing an index of industry-level productivity into an unweighted average of the labour productivity of all firms in the industry and a covariance term between relative labour productivity and the relative size of the firm. The covariance term reflects the contribution to an industry's productivity resulting from a more efficient allocation of resources across firms operating in that industry relative to a situation in which resources are allocated randomly. Specifically:

$$y_{st} = \sum_{i \in S} \theta_{it} \omega_{it} = \bar{\omega}_{st} + \sum_{i \in S} (\theta_{it} - \bar{\theta}_{st})(\omega_{it} - \bar{\omega}_{st}),$$

where y_{st} is the weighted average productivity of sector *s* at time *t*, *S* is the set of firms in industry *s*, θ_{it} and ω_{it} represent the size and productivity of firm *i* at time *t*, $\bar{\theta}_{st}$ and $\bar{\omega}_{st}$ represent the unweighted mean size and productivity of industry *s* at time *t*.

Figure 5.1 shows the average OP gaps of APAC in 3 periods: before crisis (2007), crisis (2007-2009), and after crisis (2009)[12]. New Zealand shows better resource reallocation after the GFC with higher OP gap value, whereas the OP gap in Australia is broadly the same across the three periods. Japan exhibits a different trend from the other countries, since its OP gap reaches the highest during the crisis.

Figure 5.1: OP gaps before, during, and after GFC



[12] The OP gap tends to be highly volatile on a year-to-year basis, so it is common practice to compute multi-year periods.

5.2. Generic Foster Decomposition

An alternative approach to estimate allocative efficiency is to look at how resources are reallocated over time within established firms in the sector. We follow the traditional aggregate productivity decomposition from Foster et al. (2006) and identify 3 sources of productivity growth[13]. The first source is the contribution of productivity changes for continuing firms with initial weights ("within component"). The second source is the effect of reallocating resources among continuing firms given their initial productivity ("between component"). The third source is the cross-effect of reallocation and productivity changes for continuing firms ("covariance or cross component"). The decomposition formula is as follows:

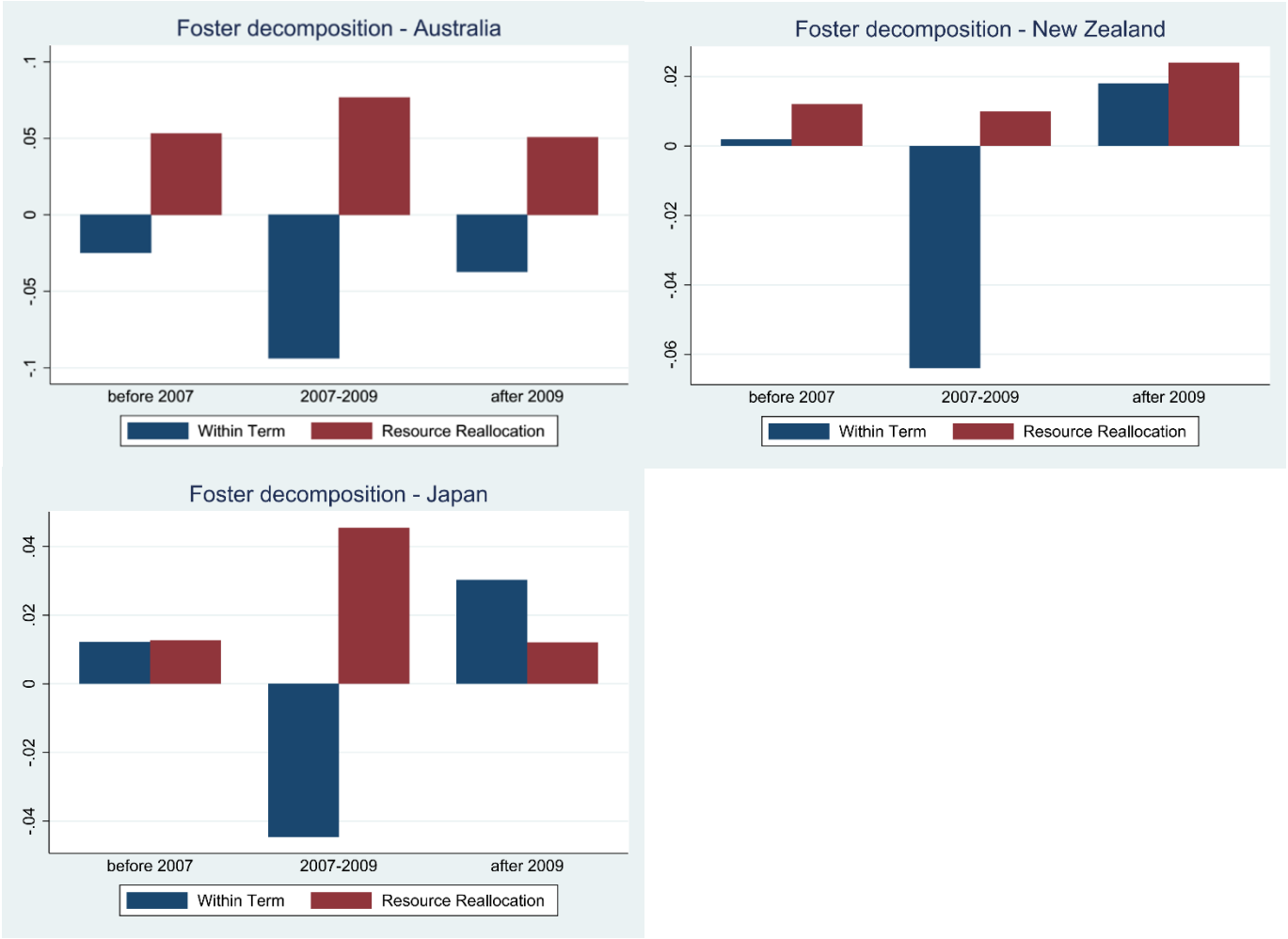
$$\Delta y_{st} = \underbrace{\sum_{i \in C} \theta_{it-k} \Delta \omega_{i,t}}_{\text{within}} + \underbrace{\sum_{i \in C} (\omega_{i,t-k} - \overline{\omega_{s,t-k}}) \Delta \theta_{it}}_{\text{between}} + \underbrace{\sum_{i \in C} \Delta \theta_{it} \Delta \omega_{i,t}}_{\text{cross-effect}}$$

Where Δ is the differential operator between *t-k* and *t* and y_{st} is the sector productivity defined as the sum of the three components mentioned above, in logs. *C* denotes continuing firms; θ_{it} and $\omega_{i,t}$ represent size and productivity of firm *i* at time t respectively, while $\overline{\omega_{s,t}}$ represents the weighted mean size and productivity of sector *s* at time *t* respectively[14].

[13] We do not have information on the age of firm and entry/exit. Therefore, this report does not distinguish between young and mature businesses, and does not account for reallocation through the entry and exit margin.

[14] We use real value-added as weights for the TFP decomposition.

Figure 5.2: Contribution of the "within" component and the reallocation of resources to productivity growth in APAC countries[15]



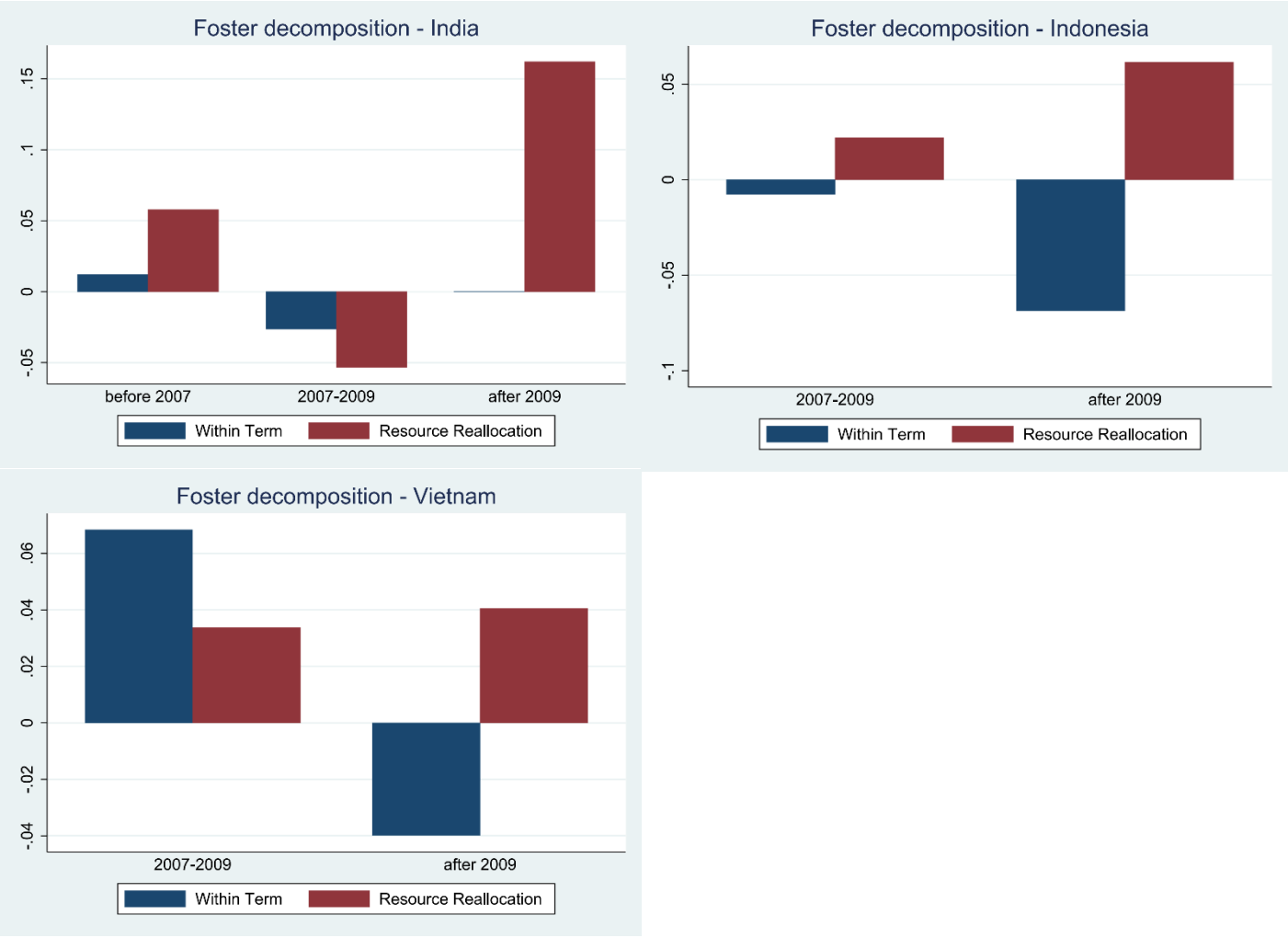
In all countries, the "within" term is consistently low and often negative during the three periods considered: before 2007, during the GFC (2007-2009), and after 2009. By contrast, the "resource reallocation" term- the sum of "between" component and "covariance of cross component" – contributes positively to productivity growth in all periods. The only exception is Japan during post-crisis period, when its "within" component surpasses the cross-effect component.

The difference between the two terms is the largest during the 2007-2009 period for all countries, mostly driven by the sharper decline in the "within" term while the "resource allocation" term increased or stayed broadly unchanged during this period. This suggests that most firms experienced large productivity declines due to the financial crisis, which was partially countervailed by an improved resource reallocation.

[15] All values are calculated at sectoral level, then aggregated to country level using common sector weights. Finally, we use the unweighted average across the corresponding years for both "within" term and "resource reallocation" term.

To get a broader perspective on allocative efficiency in Asia, we look at Foster decomposition for developing Asian countries, as well. Productivity growth here is also largely driven by the cross-effect of resource reallocation (Figure 5.3). The impact of the GFC in less evident in these countries, particularly for Indonesia and Vietnam where the "within" term actually decreased after the crisis.

Figure 5.3: Contribution of the "within" component and the reallocation of resources to productivity growth in developing Asian countries[16]



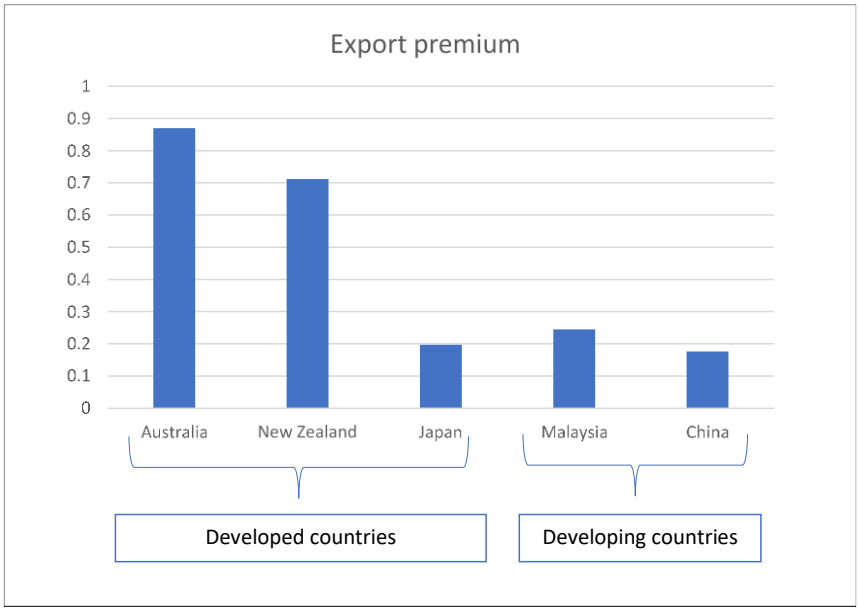
[16] The time span of the developing Asian country datasets are as follows: India 1995-2011; Indonesia 2007-2014; Vietnam 2007-2014.

6. Export Premium

A firm is considered an exporter if its export value in any given year is above the equivalent of 1,000 EUR, and exports represent at least 0.5% and does not exceed 150% of its total turnover.[17] Only manufacturing sectors are considered tradable goods sectors.

Using the PRN dataset, we examine how productivity differs between exporters and non-exporters. First, we find that firms which are exporters tend to have higher productivity ("export premium") than non-exporting firms, in line with existing empirical evidence[18] (Melitz, 2009).

Figure 6.1: Export premium for each country



Note: Export premium is computed as the value of the coefficient of the export dummy (i.e. whether the firm exports or not) of an OLS regression, where the dependent variable is the natural logarithm of TFP. The chart includes only countries for which the coefficient is significant.

Second, we observe that Australia and New Zealand have significantly higher export premia as compared to the developing Asian countries (i.e. the productivity difference between exporters and non-exporters is significantly higher in developed Asian countries). The better performance of exporters in Australia and New Zealand is possibly caused by their geographical isolation (which helps avoid the processing stages of most global supply chains) and large endowment of natural resources (Kelly & La Cava, 2014).

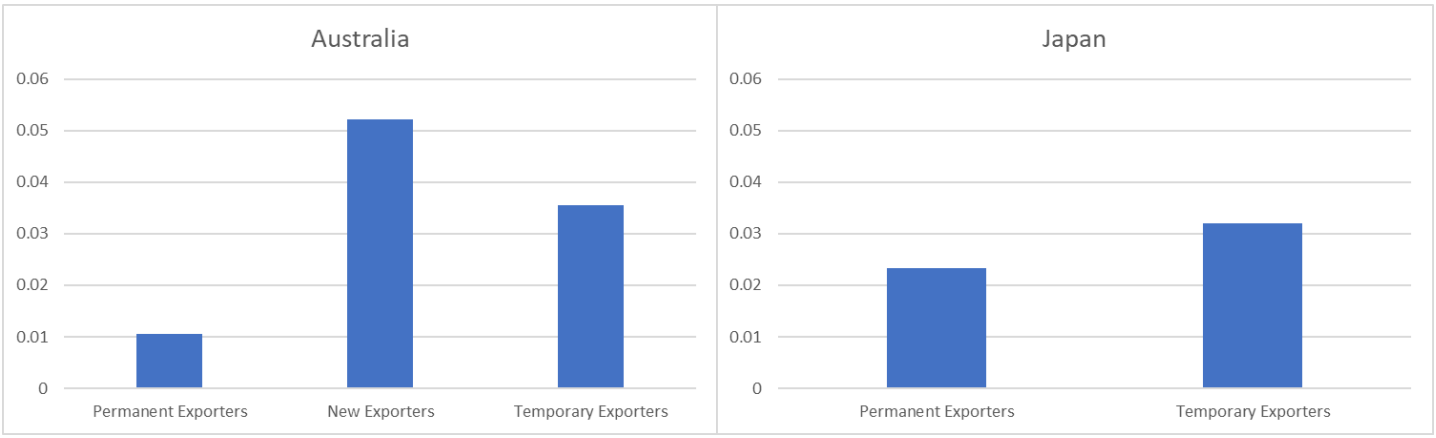
Japan, on the other hand, has relatively low export premium, similar to the developing Asian countries. This could be due to the bias in the Japanese database used as input towards larger firms.

[17] Firms with exports that exceed 150% of its total turnover will be considered as misreported and omitted from the analysis.
[18] Melitz (2009) argues that exporters are more productive than non-exporters since only relatively large and productive firms can access export markets, given the high entrance costs such as marketing and logistics. In addition, faced with the highly competitive environment of export markets, exporting firms are constantly pushed to uplift their productivity efforts in order to remain cost competitive.

We further classify exporters into three different categories:

1. Permanent exporters where firms export for three consecutive years.
2. New exporters where firms export in the current year and following year, but not the previous year.
3. Temporary exporters where firms only exports in the current year.

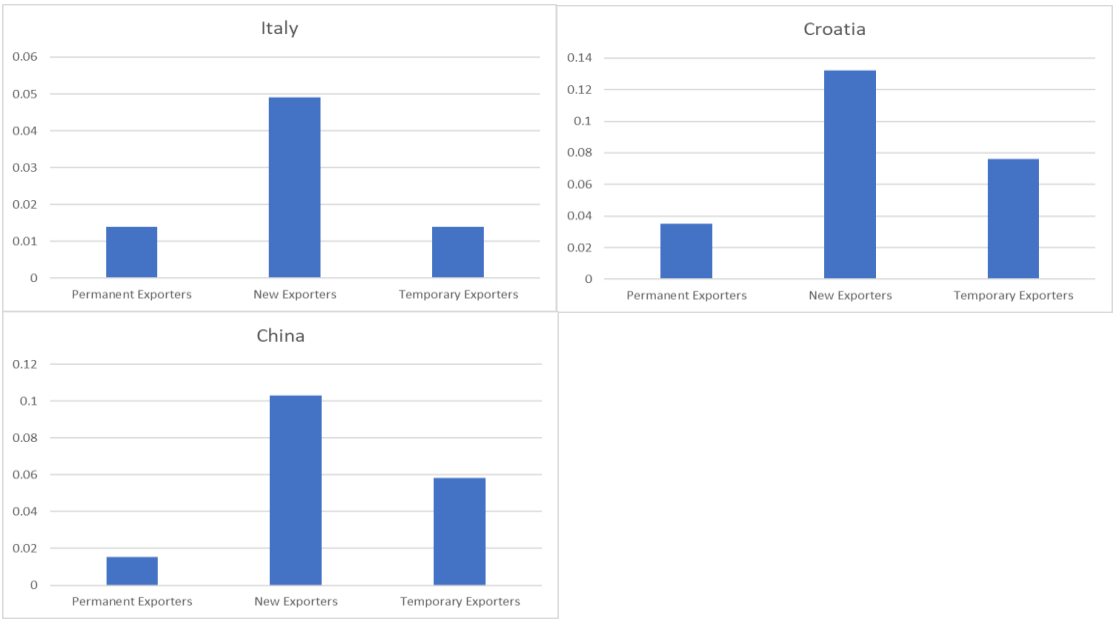
Figure 6.2: Export premium in selected APAC countries, by type of exporter



Note: we use annual change in productivity as the LHS variable.

All types of exporters in both Australia and Japan (with significant coefficients from export estimation) have positive export premia, indicating that becoming exporters is beneficial in improving firms' performance. We compare these results with export premia in other selected countries from EU and China and find similar trends[19]. Across countries, **new exporters** tend to have the highest premium, which implies that exporters broadly see the largest productivity boost in the initial export year.

Figure 6.3: Export premium in other countries, by exporter type



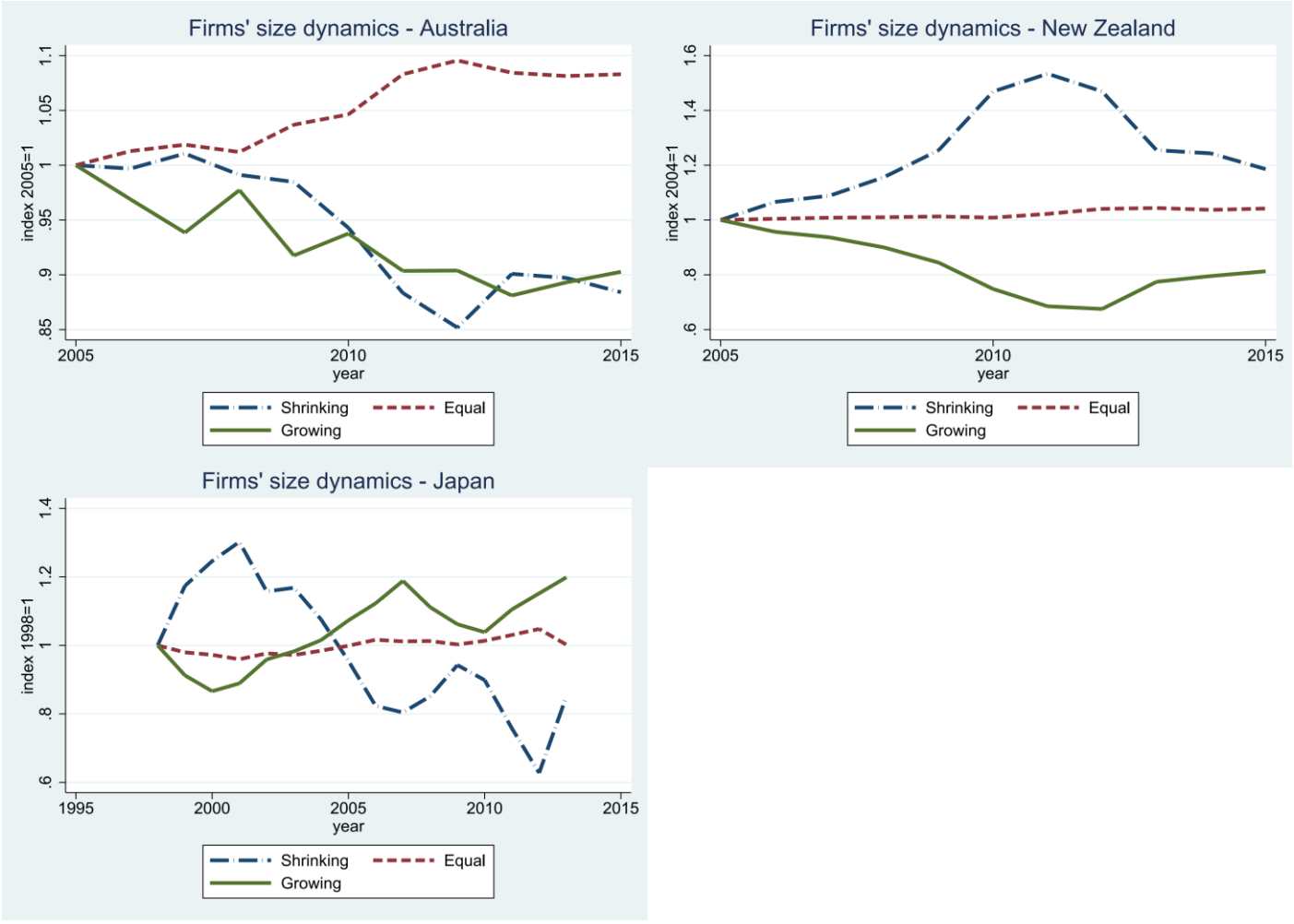
[19] The time span of the country datasets are as follows: Italy 2001-2014; Croatia 2002-2016; China 1998-2006.

7. Employment Dynamics

In a growing and increasingly productive economy the expectation is that firms will tend to become larger. We test this hypothesis using our 3-year rolling "labour transition matrices" included in our dataset.[20] Firms are divided into the following 3 categories[21]:

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.

Figure 7.1: Employment size dynamics in APAC countries



Both Australia and New Zealand appear to have experienced a dynamic in the evolution of their firms' size which is contrary to expectations. For both, the share of "growing" firms is trending downwards. Japan instead appears

[20] We compare firms' sizes between t-3 and t to create "transition matrices". Firms are divided into 5 size quintiles according to their sizes in the respective year.

[21] We calculate the shares of firms in 3 categories over the total number of firms, then normalize them.

to have experienced a more "virtuous" dynamic with the share of "growing" firms increasing continuously since 2000, with the exception of a short drop between 2007 and 2010.

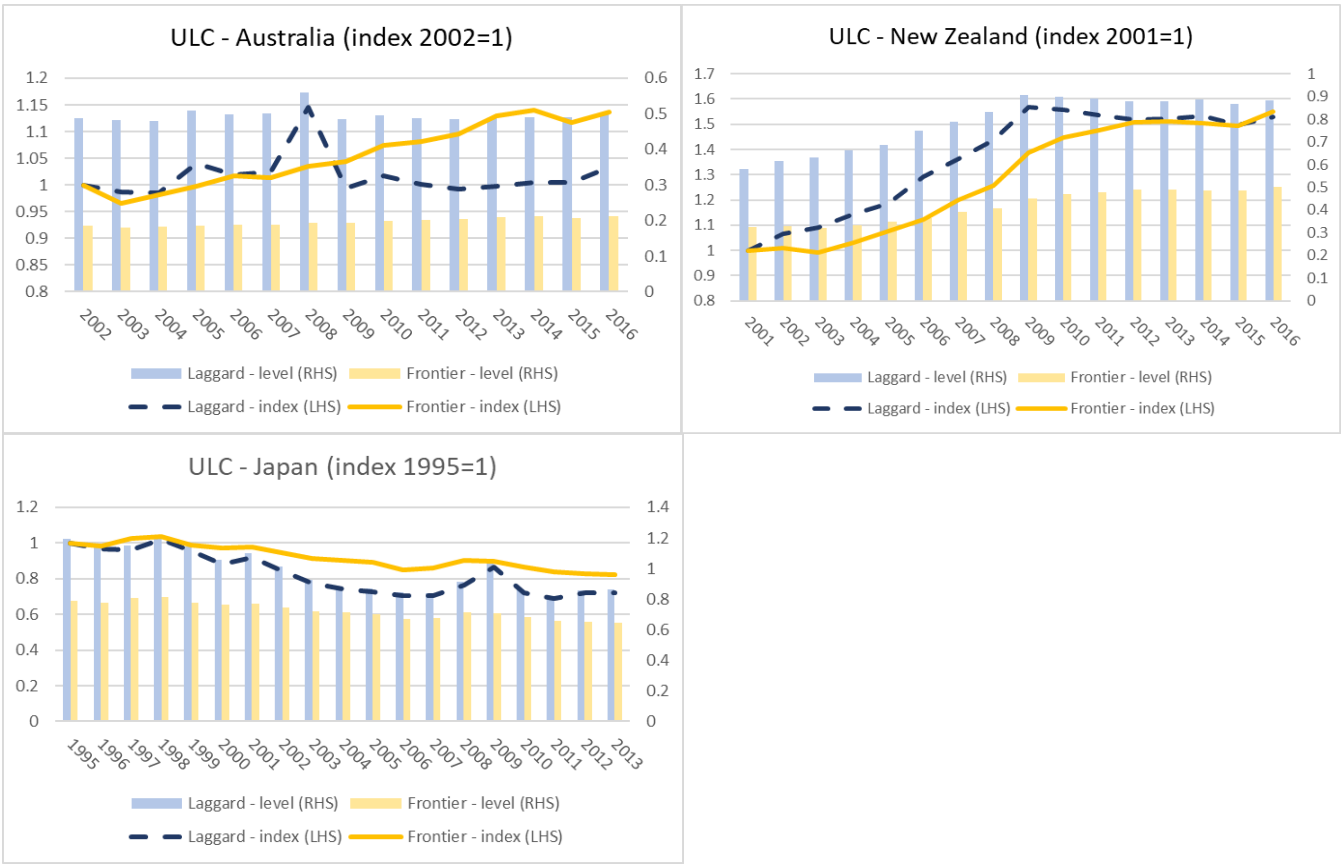
The share of firms keeping their size unchanged ("equal") remains relatively stable overtime for New Zealand and Japan. In Australia instead, such share is strongly increasing, which is rather atypical in the international comparison, denoting firms becoming increasingly static.

8. Labour cost

In this section, we compare the median Unit Labour Cost (ULC), labour cost, and TFP between low productive (laggard) and high productive (frontier) firms. Laggard and frontier firms are defined as firms at p10 and p90 of the productivity distribution respectively.

Unit Labour Cost (ULC) — defined as the ratio between labour compensation and real value added (adjusted by deflator) is widely used to assess the cost-competitiveness of economies. It measures the extent to which labour costs rise in line with productivity gains. When the ULC increases, labour compensation must have been rising faster than productivity, indicating worsening cost-competitiveness.

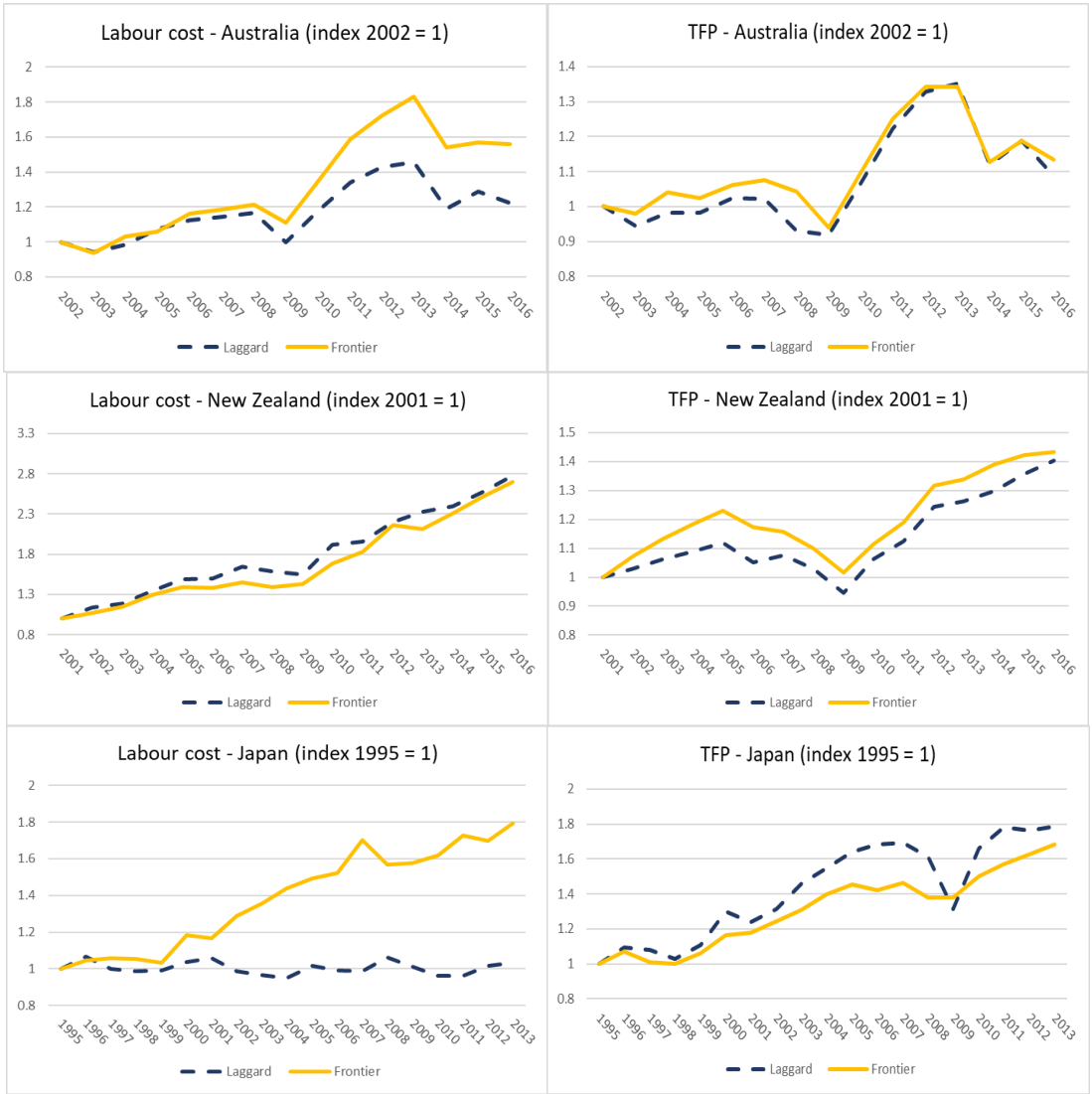
Figure 8.1: Unit Labour Cost – level and growth - APAC



The ULC of laggard firms is noticeably higher than the ULC level of frontier firms across all countries. In Australia, ULC levels for laggard firms remained stable with a one-off spike in 2008, while frontier ULC gradually rose over time. ULC levels of both tiers in New Zealand increased over time, with a higher rate of growth for laggard firms. By contrast, Japan records decreasing ULC (thus higher competitiveness) for both types of firms. This tendency is likely due to Japan data only including large firms.

The change in ULC varies with the dynamics between labour cost and TFP (which is proportional to real value-added). Therefore, by studying the changes in these two components, we can determine the primary contributor to the change in ULC (Figure 8.2).

Figure 8.2: Labour cost and TFP index - APAC



For Australia and Japan, frontier firms tend to display a stronger dynamic of labour cost with respect to laggard ones, against the background of rather similar productivity patterns. The divergence in labour cost levels is much larger than the divergence in productivity for these countries, which results in a higher index for frontier ULC in

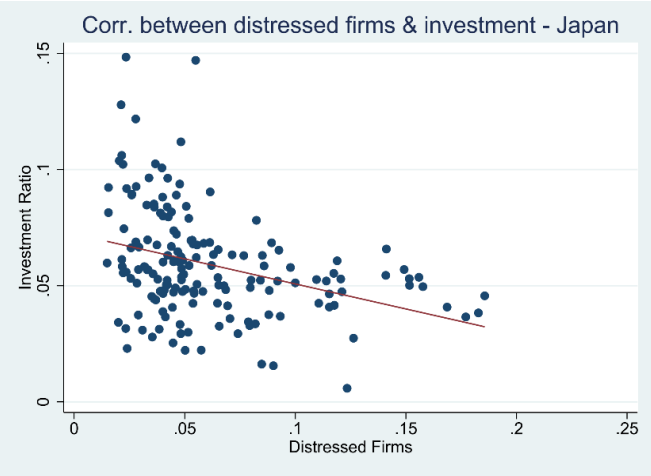
Figure 8.1. It is notable that in Japan, labour cost of laggard firms stays at almost the same level for the whole period, implying that these firms have their productivity increased without the need to raise wage.

By contrast, labour cost for laggard firms increased faster than for frontier firms in New Zealand. This, combined with a slower pace of laggard productivity growth, leads to a high ULC growth for laggard firms.

9. Financial structure[22]

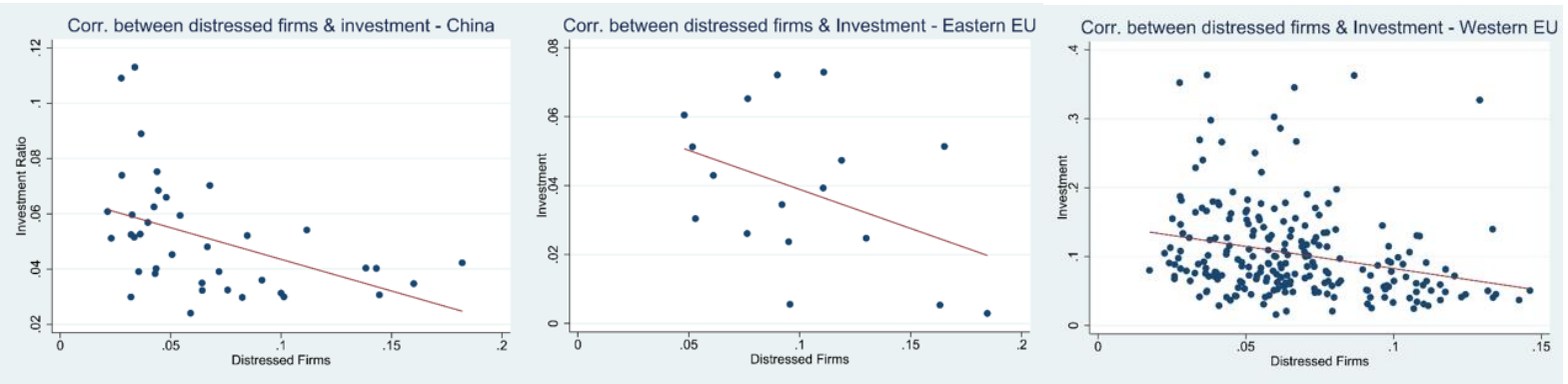
In this section, we study the impact of financially distressed firms on median sectoral investment ratio for a given country-sector-year[23]. We define distressed firms those with persistently negative profits (three consecutive years), excluding firms that experienced high growth over the same period[24]. This definition prevents to flag as financially distressed firms which have front loaded investment efforts to facilitate growth. A similar rationale is applied by the OECD when choosing firms with more than 10 years of activity (McGowan et al., 2017).

Figure 9.1: Correlation between the share of distressed firms and investment ratio in Japan (manufacturing sectors)



In line with expectations, the correlation between the share of distressed firms and their respective investment ratio is negative for Japan; this implies that when there is high concentration of distressed firms, investment typically goes down. We find similar correlations for China and the EU region (Figure 9.2). [25]

Figure 9.2: Correlation between share of distressed firms and investment ratio in other regions (manufacturing sectors)



[22] The topic of financially distressed firms, especially in Asia context, is gathering more attention recently. For example, please see IMF Background Paper No. 3 (2018).
[23] Investment ratio is defined as ratio between change in capital (factored in depreciation) over capital of last period.
[24] High growth firms are defined as firms undergoing average annual employment growth of more than 20% over the t-3 year period.
[25] Unfortunately, for lack of data, we are not able to identify financially distressed firms in Australia and New Zealand

10. Market power

Firm market power can influence various aspects of economic activities: innovation, resources reallocation, market shares and demand. We determine market power using mark-ups, which are computed based on different gross output production function specifications using the framework of De Loecker & Warzynski (2012). The associated mark-up formula is as follows:

$$\mu_{it} = \alpha_{it}^{M} * \frac{P_{it}Q_{it}}{P_{it}^{M}M_{it}},$$

where μ_{it} denotes the mark-up, α_{it}^{M} is the output elasticity of intermediate inputs, and $\frac{P_{it}Q_{it}}{P_{it}^{M}M_{it}}$ is the inverse of the share of intermediate input expenditures in revenues. We recover α_{it}^{M} from estimating a production function based on different aggregation levels and different functional form assumptions.

In Australia and New Zealand, the mark-up index fluctuates rather strongly, in particular during the 2005-2010 period, but the overall trend is positive. Such dynamics of mark-ups are in line with previous work on the US by De Loecker and Eckhout (2017).

In Japan, mark-up development is instead rather flat with a downward trend.

Figure 10.1: Mark-up index for APAC

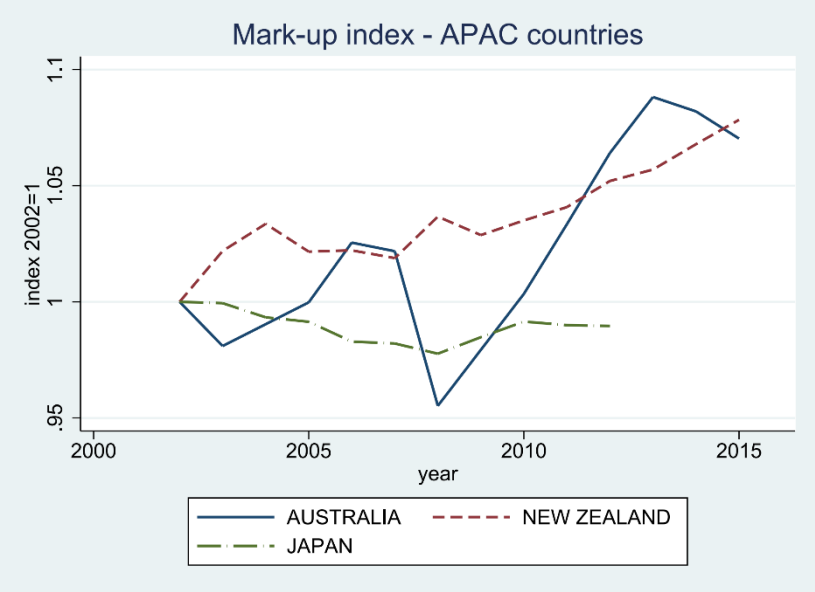
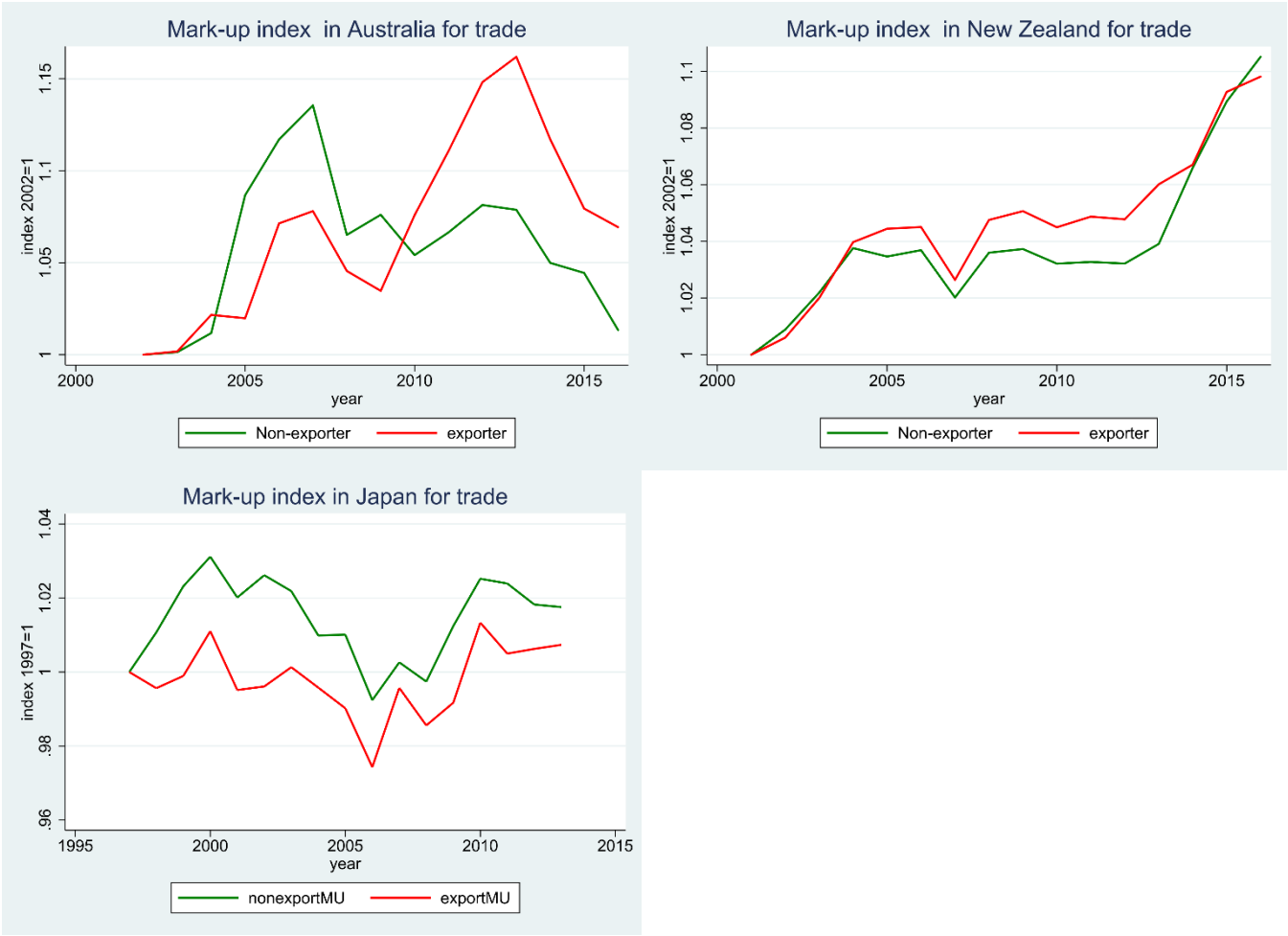


Figure 10.2: Mark-up index for exporters and non-exporters



We further decompose the mark-up index into components for exporters and non-exporters[26]. The rate of growth for mark-ups among the exporters is generally higher than that of non-exporters in most countries. The higher mark-up growth for exporters is consistent with findings of De Loecker and Warzynski (2012), who argue that exporters are more productive and as a result can undercut their rivals.

Japan shows again different patterns, as the growth of mark-ups for non-exporter tend to outpace the one for exporters. This indicates that exporters in Japan lack a distinct advantage over non-exporters, which is in line with the previously reported low (productivity) export premium in Japan (see section 6 above). However, this pattern could potentially be due again to the biased sample.

[26] Our full data includes exporters, non-exporters and uncategorized firms (which do not report export values). Figure 10.2 is created using the sub-sample of exporters and non-exporters only.

At the moment, there are quite limited number of studies on the empirical link between trade and mark-up[27]. We hope that our novel dataset will provide more opportunities to go deeper into this topic in the future.

11. Conclusion

This Report presents a number of applications of our novel dataset. We show the patterns of productivity as well as several other indicators for three developed Asia-Pacific countries. We are able to make comparisons between APAC and other developing Asian countries plus the EU region, thanks to the fact that these different datasets utilise a common methodology to compute the productivity related indicators. To sum up some of our findings, the APAC countries are the most heavily affected by the GFC with respect to the other regions considered, but show also the strongest rebound post-crisis. They have better resource reallocation after the GFC, which is quite different from the stagnant allocative efficiency in developing Asia (di Mauro et al, 2018). The developed part of Asia-Pacific also shows significantly higher export premia than those computed for its developing counterpart.

After the first round of data collection exercise, our dataset includes now complete coverage of 9 Asia-Pacific countries: Australia, Japan, New Zealand, Turkey, China, India, Indonesia, Malaysia, and Vietnam[28]. Certainly, the full dataset comprises a much wider range of variables than what are initially included in this Report. Therefore, research using the PRN dataset, which will soon be make accessible to external researchers, is warmly encouraged.

[27] See also Edmond et al. 2016.

[28] Due to confidentiality issues, Turkey is not included in this Report. However, we are working with the Turkish team to solve the pending problems. Turkish data should be available in the near future.

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ANNEX

ANNEX 1: Input definition

Before running the PRN codes, all data providers are required to prepare their dataset with the necessary variables defined in Table A1.1.

Table A1.1: Definition of input variables

Variable	Definition	Australia	Japan	New Zealand
Capital (Tangible fixed assets)	Tangible fixed assets	Available	Available	Available
Raw materials (intermediate inputs)	Use of materials + energy + services	Available	Available	Available
Labour cost	Compensation of employees (wages and salaries plus social contributions)	Available	Available	Available
Value added	Turnover - Raw materials	Available	Available	Available
Number of employees.	Number of workers	Available	Available	Available
Turnover	Total sales net of VAT at basic prices	Available	Available	Available
Unadjusted export value	Total exports by the firm, not adjusted for reporting threshold	Available	Available	Available
Import value	Total imports by the firm, as reported		Available	Available
Total assets	Total assets of the firms	Available	Available	Available
Cash and cash equivalents	Cash and balances at banks			
Cash flow (from profit/loss statement)	Net income + depreciation+ extraordinary income			
Profit/loss	EBIT	Available		
Interest paid (or financial charges)	Interest on financial debts + other financial expenses	Available	Available	
Long term debt	Loans due in more than 1 year		Available	
Short-term debt	Loans due within 1 year		Available	

Total inventories	Inventories and consumable biological assets	Available		
Depreciation	Depreciation on tangible assets	Available	Available	
Trade credit (accounts payable)	Trade credit or Accounts payable (Liabilities related to purchased goods and services)	Available	Available	
Trade debt (accounts receivable)	Trade debt or Accounts receivable	Available		
Current liabilities	Short term debt + trade credit + other current liabilities	Available	Available	
Non-current liabilities	Liabilities - (Short term debt + trade credit + other current liabilities)	Available	Available	
Shareholder funds (equity)	Equity	Available	Available	
Profits and losses before taxes	Earnings before taxes (EBT)		Available	
Other current assets	Current assets – Trade debtors – Total inventories	Available	Available	
Other non-current liabilities	Provisions		Available	
Other fixed assets	Total fixed assets - tangible fixed assets - intangible fixed assets - financial assets		Available	
Intangible fixed assets	Total intangible fixed assets		Available	
Current assets	Cash and other assets expected to turn in cash within a year	Available	Available	
Other current liabilities	Current liabilities - Short term debt - Trade credit		Available	

These definitions serve as guidelines for data providers to maintain certain degree of consistency among countries. However, the actual definitions from individual countries may vary due to different natures of datasets. We have been working with the providers to ensure that their variables are as close as possible to our proposed definitions. Table A1.2 provides definitions of the basic variables from the country teams.

Table A1.2: Definitions of basic variables

	Definition of basic variables					
	Capital	**Raw Materials**	**Labour Cost**	**Value- Added**	**Employee**	**Turnover**
PRN definition	Tangible fixed assets	Use of materials + energy + services	Compensation of employees (wages and salaries plus social contributions)	Turnover - raw materials	Number of workers	Total sales net of VAT at basic prices
Australia	Non-current asset in first year and perpetual inventory model with capital expenditures after that	Purchases and other costs	Total salary, wages and other payments	Turnover-Purchases	Full-time equivalent employment	Total sales
New Zealand	Sum of depreciation and rental and leasing costs and cost of borrowing	Sum of purchases and total expenses, excluding salaries and wages, bad debt write-offs, interest paid and depreciation	Wages and salaries received from employee's employment monthly schedule at Inland Revenue Department	Turnover - raw materials	Average of number of employees over 12-month period within firm's financial year	Total income, adjust for change in stocks and excluding income from interest and dividends
Japan	Tangible fixed assets	Use of materials + energy + services (outsourcing)	Wages with bonus	Turnover - raw materials	Number of workers	Total sales without VAT

ANNEX 2: Data cleaning and preparation

A2.1. Variable cleaning

Firstly, we perform checks to determine if the input variables are in feasible range:

- The majority of variables should have expected minimum value of 0.
- Their means need to be in certain range of expected means, to make sure that the input currency is in thousands of Euros.
- The sector variable should be capped at 82, and the year should not exceed 2017.
- All observations should have a value unless missing.

In case one or more of the above conditions are violated, the code will provide a warning so that the user can double check the inputs.

We include another check for impossible values of some indicators. In this check, if any value is non-positive, it is flagged and replaced by missing value. The indicators included are: turnover, capital, labour, total asset, cash, long-term debt, creditors, debtors, interest paid, other fixed assets, current assets, dividend, and depreciation.

A2.2. Outlier treatment

For each variable, we flag outliers based on the following conditions, at 2-digit level in a year:

- Observations with value below or above 3 Standard Deviations from median value.
- Observations with value in top or bottom 1%.
- Observations with annual growth rate in top or bottom 1%.

If all of these conditions are violated, the observation will be flagged and replaced by missing.

A2.3. Confidentiality procedure

Although the literature has long recognized that firm-level data delivers crucial information for economic research, obtaining such data has been so far hampered by issues of confidentiality and comparability. Our data collection and indicator construction process has been designed in such a way that both issues are resolved. We describe the confidentiality procedure in two parts, one part focusing on the raw firm-level data and another covering the output indicators. Both parts contribute to the fact that the user of the final data will not be able to uniquely identify individual firms based on the aggregated data.

A2.3.1. Raw variables

The conditions of handling firm-level information and the obligations surrounding confidentiality differ across countries and across member institutions. Given the large heterogeneous amount of data providers in the

project, the process of raw variable compiling is decentralized. We work with the individual data providers intensively to compile the dataset, but the codes are run in a decentralized way in each of the respective institutions. In this way, each member institution can satisfy their individual confidentiality constraints.

A2.3.2. Output indicators

The second aspect of the confidentiality procedure is to ensure that the eventual output indicators leave no room for the identification of individual firms. In this regard, each member institution has specific conditions to satisfy. A specific routine is included in the PRN code ran in the final stage of the computation, which checks the eventual output cells. It includes thresholds for the minimum number of observations to guarantee that no individual firm can be identified and tests for statistical dominance. If a cell is computed based on a limited amount of underlying micro-observations, making the identification of individual firms possible, the cell is dropped. This information is not eliminated from the total distribution; it is only left out of the specific cell. The second test tests for statistical dominance and contains thresholds for the largest permissible size share a single observation takes on in a given cell.

These thresholds can be set a-priori by the data providers to satisfy their country or institution specific conditions. These are the parameters which can be chosen:

1. The minimal number of observations for the 1% and 99% percentiles can be adjusted.
2. The minimal number of observations for the 5% and 95% percentiles can be adjusted.
3. The parameter for statistical dominance can be adjusted. This is the largest permissible share an observation takes on in a cell.

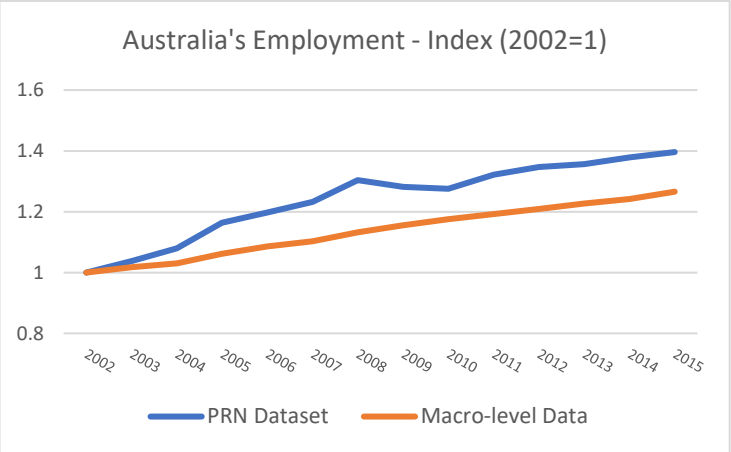
ANNEX 3: Data validation from a macro perspective

In order to check whether the results drawn from the PRN dataset are consistent with the macro-level trends, we compared a number of basic indicators using both our PRN micro-level data and macro-level data from World Bank Database. In general, we find that indicators such as employment, labour productivity, and labour cost, present similar growing trends over time for both data.

A3.1. Employment

The PRN micro-level index and macro-level data show that employment is generally increasing over the years of observation. For instance, as shown in Figure A3.1, both indexes indicate upward trends in Australia's employment from 2002 to 2015, despite the growth from employment of micro-level PRN data being slightly higher than that of macro-level data.

Figure A3.1: Employment based on PRN dataset and Macro-level data

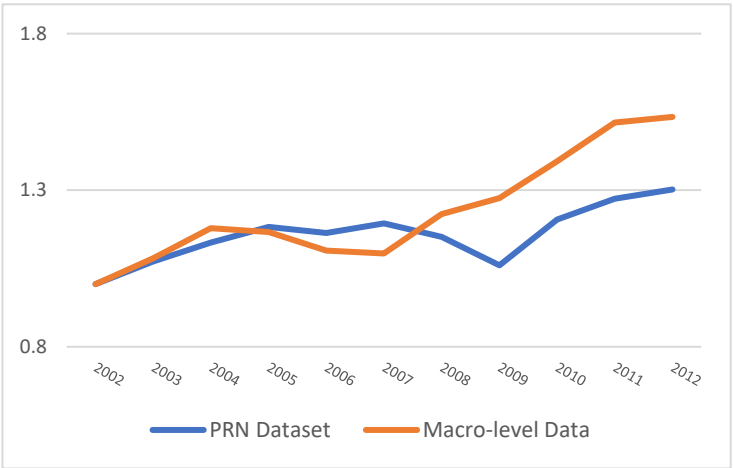


A3.2. Labour Productivity[29]

For Japan, the upward pattern is slightly volatile but still rather clear (Panel A, Figure A3.2). For Australia and New Zealand, both micro-level and macro-level indexes show an increasing trend in Labour Productivity, although there are some fluctuations over the year of observation, such as during financial crisis in 2009 (Panel B&C, Figure A3.2). The scale differences between PRN micro dataset and macro-level dataset for Australia and New Zealand might be caused by different measurements in micro and macro dataset.

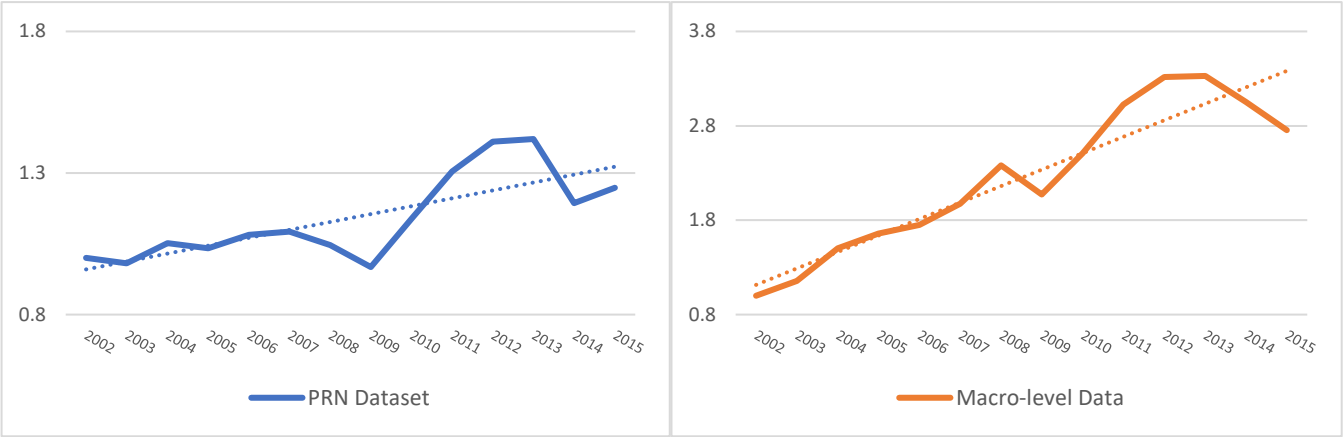
Figure A3.2: Labour Productivity based on the PRN dataset and Macro-level data

Panel A: Japan's Labour Productivity - Index (2002=1)

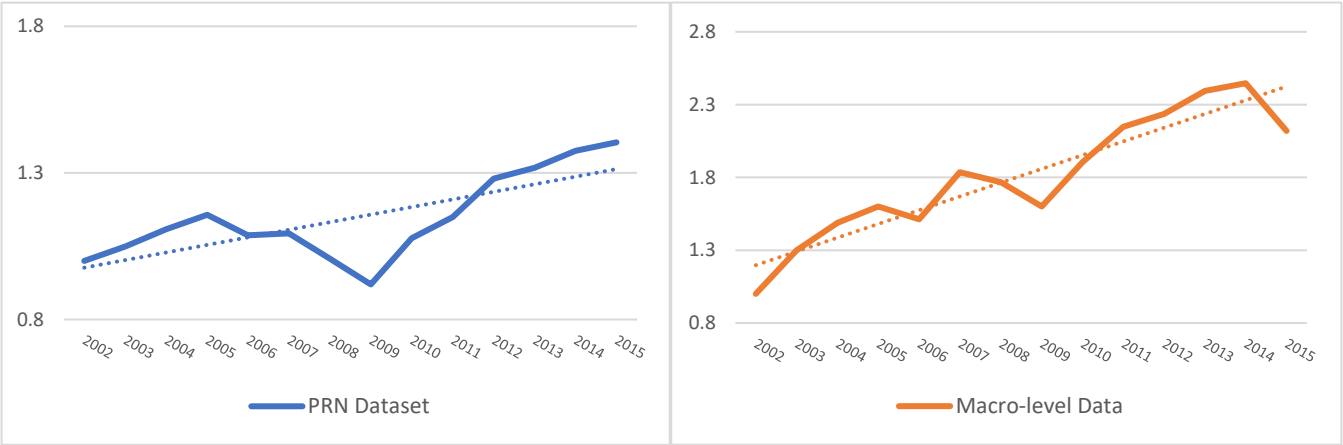


[29] Macro-level Labour Productivity is calculated by Gross Value-added (GVA) over Employment.

Panel B: Australia's Labour Productivity - Index (2002=1)



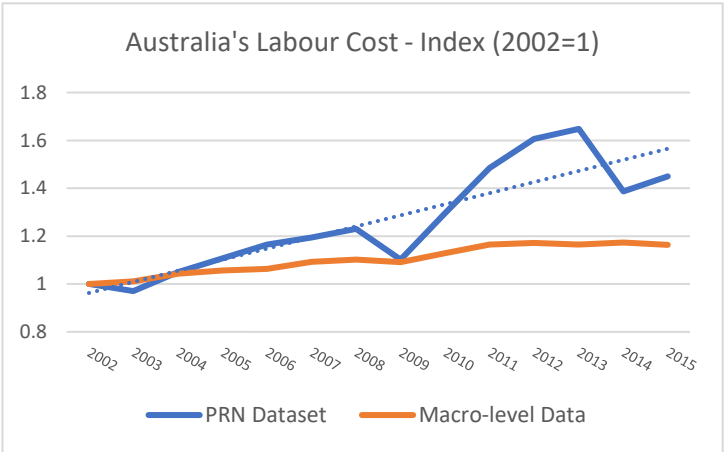
Panel C: New Zealand's Labour Productivity - Index (2002=1)



A3.3. Labour Cost

Both data indicate a rising trend in Australia (Figure A3.3), although the trend is less clear at macro level. Similar to the pattern of previous figures (Figure A3.2), we also observe a drop in labour cost in around year 2008 and 2013 for PRN dataset, but the general movement is still upward.

Figure A3.3: Labour Cost based on the PRN dataset and macro-level data



ANNEX 4: Disclaimer – New Zealand dataset

To ensure data confidentiality, the following disclaimer is requested by the New Zealand team:

"The results in this Report are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand.

The opinions, findings, recommendations, and conclusions expressed in this Report are those of the author(s), not Statistics NZ.

Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this Report have been confidentialised to protect these groups from identification and to keep their data safe.

Statistics NZ confidentiality protocols were applied to the data 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.

Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz."