Firm-level Adoption of Technology Survey
Methodology Note - Croatia

The World Bank

1 Introduction

This note describes the Firm Adoption of Technology (FAT) Survey implemented in **Croatia in 2022**.[1] The methodology and approach of the FAT survey is described in more detail in Xavier Cirera, Diego Comin and Marcio Cruz (Forthcoming). The survey is a nationally representative firm-level survey covering firms in agriculture, manufacturing, and services. It is conducted and managed by the World Bank. The survey applies a standardized sampling methodology and survey questionnaire to generate data that are comparable across countries. Particularly, the FAT survey measures the adoption and use of more than 300 technologies across over 60 business functions. It also collects information about the firm and owner/manager characteristics, subjective perceptions of firms regarding the adoption of technology, and detailed balance sheet information.

Users of the data, please cite:
"Cirera, X., Comin, D., and Cruz, M. (Forthcoming). Technology Sophistication Across Establishments. The Quarterly Journal of Economics."

This note has two main parts. The first part describes the general structure of the survey, the sampling design and stratification, survey implementation and weight construction. The second part provides country-specific implementation information.

[1] Management and coordination of the survey design and implementation was implemented by Xavier Cirera, Marcio Cruz and Kyung Min Lee. Data cleaning for disclosure by Charmaine Robles Crisostomo, Harneet Singh, Aman Mahajan and Yuheng Ding. Field coordination, data quality checks and regional support; Antonio Soares Martins Neto, Caroline Nogueira, Todor Milchevski and Ana Budimir.

2 The FAT survey

2.1 Structure of the Survey

2.1.1 Modules

The FAT survey is comprised of five modules:

Module A – Control and General information
Module B – General Business Function Technologies
Module C – Sector Specific Business Function Technologies
Module D – Drivers and Barriers for Technology Adoption
Module E – Labor, Balance Sheet, and Performance

Module A collects information about general characteristics of the firm, such as sector of operation, ownership, and owner and manager characteristics. Module B covers technologies used to perform general business functions that are common across all firms, while Module C focuses on sector-specific technologies. Module D focuses on questions about barriers and drivers of technology adoption, while Module E collects information about the firm's balance sheet and employment.

2.1.2 Business functions

In Modules B and C, the FAT survey measures technologies adopted by a firm at the business function level (see Cirera, Comin and Cruz (Forthcoming) for a detailed description). Business functions are divided into two groups: general business functions (GBFs) and sector-specific business functions (SBFs). The GBFs include tasks that all firms conduct regardless of the sector in which they operate, such as business administration, production planning, sourcing and procurement, sales, payment, and quality control methods. SBFs cover production tasks relevant only to companies in a given sector - for example, harvesting in agriculture, cooking in food processing, or sewing in apparel.

2.1.3 Sectors

To attain a wide coverage that allows a meaningful study of sector-specific technologies, Module C was developed for 12 different sub-sectors in the economy, which include: (1) agriculture (crops), (2) livestock, (3) food processing, (4) wearing apparel, (5) leather and footwear, (6) motor vehicles, (7) pharmaceuticals, (8) wholesale and retail, (9) financial services, (10) land transport services, (11) accommodation

(later in 2021), and (12) health services.[2] These sectors have been selected based primarily on their share in a developing country's aggregate value added and employment, and in order to cover all three major sectors: agriculture, manufacturing, and services.

While all these sector-specific modules are used for firms that belong to each particular sector, the selected stratification sectors used in the survey design are country specific (see section 3). Given sample size considerations and different economic structures, the final selection of stratification sectors only includes a subset of all sectors with sector-specific modules and two aggregate sectors without: "other manufacturing" and "other services". As a result, any sector statistics generated with the data are only representative for sectors that have been stratified in the survey design.

2.1.4 Technologies

We construct a technology grid that identifies first the key business functions and then the technologies used to carry out the tasks for each business function. To design Modules B and C, the survey draws upon the knowledge of experts in production and technology in various fields and sectors. These experts provided information on: i) the key general and sector-specific business functions, ii) the different technologies used to conduct the main tasks in each function, and iii) how different technologies relate both in terms of their sophistication and the degree of substitutability between them.

For each business function in the grid, the FAT survey measures the adoption of various technologies at different levels of sophistication, from manual to more advanced. The survey measures three key dimensions or margins of adoption: the adoption of each technology in the grid, the most intensively used technology in each business function, and the year of adoption when advanced technologies are adopted.

2.2 Sampling Methodology

The survey draws on sampling frames available with the most comprehensive and up-to-date information, such as establishment censuses available from national statistical agencies or administrative business registers.

[2]More recently. some energy-intensive sectors have been developed: Bricks, Cement, and Iron and Steel; and added to the FAT surveys conducted from 2023.

The universe of study includes formal establishments with five or more employees in the private sector including agriculture, manufacturing, and services.[3] Micro-firms with fewer than five employees are excluded from the survey because especially in developing countries, they are more likely to be informal (Ulyssea, 2018), often resulting in their omission from standard sampling frames. This exclusion helps ensure the consistency of the sampling frame across countries.

The survey is stratified by geographic regions, firm size (small firms 5-19 workers, medium 20-99 workers and large 100+ workers) and sector of activity. Geographic regions are often aggregated to include several provinces. The sample is representative across these dimensions.

2.3 Data Collection

2.3.1 Screening

Before the main interviews, the screening questionnaire is applied to verify and complete information contained in the sampling frame. At the time of implementation of the screening, establishments are asked to participate in the survey. If they refuse, the screening questions are used to record the refusal and collect information on several characteristics of the establishment that refused. Establishments that refuse to participate are substituted, in almost all cases, with establishments in the same strata. When an establishment is determined to be out of business, has changed its line of business so that it is no longer in the target population, cannot be located, or cannot be motivated to finalize the appointment after several attempts, the establishment is also eligible for a substitution from the sample. Using the information

[3]The survey excludes the following list of sectors from the ISIC, revision 4.0: Forestry and logging (ISIC 02), Fishing and aquaculture (ISIC 03), Mining of coal and lignite (ISIC 05), Extraction of crude petroleum and natural gas (ISIC 06), Mining of metal ores (ISIC 07), Other mining and quarrying (ISIC 08), Manufacture of tobacco products (ISIC 12), Manufacture of coke and refined petroleum products (ISIC 19), Electricity, gas, steam and air conditioning supply (ISIC 35), Water collection, treatment and supply (ISIC 36), Sewerage (ISIC 37), Waste collection, treatment and disposal activities; materials recovery (ISIC 38), Remediation activities and other waste management services (ISIC 39), Public administration and defence; compulsory social security (ISIC 84), Education (ISIC 85), Residential care activities (ISIC 87), Social work activities without accommodation (ISIC 88), Creative, arts and entertainment activities (ISIC 90), Libraries, archives, museums and other cultural activities (ISIC 91), Gambling and betting activities (ISIC 92), Sports activities and amusement and recreation activities (ISIC 93), Activities of membership organizations (ISIC 94), Other personal service activities (ISIC 96), Activities of extraterritorial organizations and bodies (ISIC 99).

taken from the screening, only the WBG Task Managers of the project are authorized to make substitutions.

2.3.2 Survey Implementation

Data collection is implemented by national statistical agencies, when available, or by data collection companies with demonstrable experience in nationally representative firm-level surveys. To maximize participation, data collection agencies were supported by endorsement letters from local industry and government organizations. Each data collection organization followed a standard protocol in which each firm was contacted to schedule an interview.

The preferred mode for data collection is face-to face interviews, but due to the COVID-19 pandemic in some countries, data collection was implemented by phone or online. Data collection companies ensure that the interviews are arranged with the appropriate person or persons; such as main managers (and other managers, like plant managers and accountants, in larger firms). To reduce measurement error in respondent's answers, the questionnaire has no open ended questions and mostly questions requiring a "YES" or "NO" response. We also pre-tested the questionnaire in each country to ensure that all the questions are clearly worded within the specific geographical and cultural contexts of each country. The duration of survey implementation ranges from 6 to 12 months depending on the country, from contracting to finalization of data collection.

2.4 Construction of Sampling Weights

The sampling weights of establishments are constructed in two steps.

First, design weights are computed as reciprocals of inclusion probabilities. Then, to mitigate the risk of non-response bias, these design weights are adjusted for non-response.

The survey adopts a stratified one-stage element sampling design and randomly selects establishments with equal probabilities within strata. Therefore, the inclusion probability of establishment k, within stratum isr (identified by industry i, size s, and region r) is:

$$\pi_{isr,k} = \frac{n_{isr}}{N_{isr}} \tag{1}$$

where n_{isr} is the number of establishments targeted by the survey for stratum isr,

and N_{isr} is the number of establishments in the sampling frame for the same stratum. Accordingly, the design weights of establishments are:

$$d_{isr,k} = \frac{1}{\pi_{isr,k}} = \frac{N_{isr}}{n_{isr}} \tag{2}$$

To adjust the design weights in equation 2 for non-response, a simple Response Homogeneity Groups (RHG) approach is applied based on the groups determined by the strata (Särndal, Swensson and Wretman, 1992; Kott, 2012), in which establishment response probabilities are assumed to be the same within each stratum, but differ across different strata. Under the RHG approach assumptions, response probabilities can be estimated using the observed response rates within each group, and bias protection is obtained by dividing design weights by group-level response rates.

Denoting with $\hat{\theta}_{isr}$ the estimated response probability in stratum isr, and with m_{isr} the number of respondent establishments in the stratum (so that $m_{isr} \leq n_{isr}$), the non-response adjusted weights can thus be written as follows:

$$w_{isr,k} = \frac{d_{isr,k}}{\hat{\theta}_{isr}} = \frac{d_{isr,k}}{m_{isr}/n_{isr}} = \frac{N_{isr}/n_{isr}}{m_{isr}/n_{isr}} = \frac{N_{isr}}{m_{isr}} \tag{3}$$

Note that the adjusted weights in equation 3 are such that the distribution of the respondent sample across strata exactly matches the distribution of establishments in the sampling frame:

$$\sum_{k \in R_{isr}} w_{isr,k} = N_{isr} \tag{4}$$

where R_{isr} denotes the respondent sample for stratum isr.

3 Survey implementation and Stratification in Croatia

In Croatia, the sampling frame used correspond to the Financial Agency (FINA) data. The survey was administered online in 2022. Overall response rate was 15%. [4]

[4]The survey was funded by the World Bank project DIGIT: Digital, Innovation, and Green Technology Project (P180755).

In the geographic stratification, we use four sub-national regions: Adriatic Croatia, Northern Croatia, Pannonian Croatia, and City of Zagreb. In the firm size stratification, there are three stratum: small firms (5-19 employees), medium firms (20-99 employees), and large firms (100 or more employees).

Regarding sector stratification, in Croatia, the survey is stratified in eight sectors: Agriculture (ISIC 01), food processing (ISIC 10), wearing apparel (ISIC 14), "other manufacturing", retail and wholesale (ISIC 46, and 47), land transport (ISIC 49), accommodation (ISIC 55), and "other services". During data collection, we ask firms to identify the main sector of their current business (i.e., recorded by the variable "a5a"). Thus, we allow potential discrepancies between the sampling sector and the reported sector since the firm's main business may change across different sectors over time.

Table 1 provides the population distribution of establishments in Croatia by region, size, and sector.

Table 1: Population Distribution of Establishments across Strata - Croatia

Region	Size	Agriculture	Food Processing	Wearing Apparel	Other Manufacturing	Accommodation	Retail & Wholesale	Land Transportation	Other Services	Total
Pannonian Croatia	Small (5-19)	198	129	27	589	37	623	217	1,125	4042
	Medium (20-99)	60	63	32	307	10	116	45	273	
	Large (100+)	19	28	7	74	1	15	11	36	
Northern Croatia	Small (5-19)	95	134	33	728	27	688	267	1,377	4571
	Medium (20-99)	18	55	34	376	16	149	77	250	
	Large (100+)	3	17	14	129	2	36	10	36	
Adriatic Croatia	Small (5-19)	83	216	14	836	267	1,370	276	3,122	7656
	Medium (20-99)	10	74	9	272	103	211	64	519	
	Large (100+)	2	12	1	57	38	37	6	57	
City of Zagreb	Small (5-19)	27	127	26	635	71	1,416	186	2,072	6081
	Medium (20-99)	7	29	15	214	29	377	34	533	
	Large (100+)	2	15	2	57	7	98	7	95	
Total		524	899	214	4274	608	5136	1200	9495	22,350

Note: This table provides the population distribution of establishments by region, size, and sector. The sample includes the formal firms with five or more employees. Small = 5 to 19 employees; Medium = 20 to 99 employees; Large = 100 or more employees.

For each stratum, the minimum sample size is calculated with a 7.5% margin of error and 90% confidence intervals.[5] Based on these minimum requirements, an optimal allocation of the total sample across strata is then computed using an algorithm that balances statistical precision and fieldwork efficiency.[6] Table 2 provides the sampling distribution across the three strata in Croatia.

[5]For the details of sample size, see World Bank Group (2022).

[6]A similar approach is applied in the World Bank Enterprise Survey.

Table 2: Population Distribution of Establishments across Strata - Croatia

		Agriculture	Food Processing	Wearing Apparel	Other Manufacturing	Retail & Wholesale	Land Transportation	Accommodation	Other Services	Total
Pannonian Croatia	Small	11	7	3	14	20	15	3	26	154
	Medium	8	8	5	5	1	5	1	5	
	Large	4	3	1	2	2	1	1	3	
Northern Croatia	Small	8	5	4	21	19	11	7	27	161
	Medium	2	7	6	11	0	10	7	3	
	Large	1	4	5	1	0	1	0	1	
Adriatic Croatia	Small	13	9	2	33	36	9	10	27	212
	Medium	1	8	0	5	2	5	16	16	
	Large	0	3	1	3	3	1	8	1	
City of Zagreb	Small	5	4	6	14	49	8	11	37	183
	Medium	0	5	2	2	6	2	6	16	
	Large	0	3	0	1	2	3	0	1	
Total		53	66	35	112	140	71	70	163	710

Note: This table provides the sample distribution of establishments by region, size, and sector. The sample includes the formal firms with five or more employees. Small = 5 to 19 employees; Medium = 20 to 99 employees; Large = 100 or more employees.

References

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