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# Strengthening scientific and research capacity of the Institute of Economics, Zagreb as a cornerstone for Croatian socioeconomic growth through the implementation of Smart specialization strategy

**Policy Brief, SmartEIZ**

## Demand for high-skilled labour: Lessons from the Online Vacancy Index

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| List of key messages |
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| • Interest in smart skills essentially reflects recent changes in the structure of employment and creation of entirely new occupations, brought on by technological change, globalisation, and higher mobility of labour<br>• The researchers at the Institute of Economics, Zagreb developed a “smart” index that ensures “smart” labour market diagnostics on the needs for “smart” skills<br>• After 2012, demand for high-skilled labour in Croatia started to increase considerably, as did the demand for unskilled and skilled work, indicating significant and rising polarisation<br>• Economic recovery did bring increasing demand for labour but it changed the structure of offered contracts from full time contracts to temporary and training without commencing employment<br>• More than 10 percent of total demand reflects the demand for information technologies experts, especially programmers for which there is a steady increase in the number of jobs offered as of late 2014 |

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## 1 Introduction

The labour market is going through deep structural changes manifested in growing skill polarisation, wage gap widening, and new forms of employment, to name a few. Frictions between differing concepts that stand behind labour demand and labour supply come to surface emphasised by a growing need to accurately and timely provide labour market feedback in the form of trends and changes in demand for different types of labour, occupations, and skills.

Globalisation and technological progress are considered to be the main culprit behind labour market polarisation that especially intensified after the recent recession (Jaimovich and Siu, 2012). Broadly-speaking, polarisation manifests in substitution of human work, is caused by technological progress, and (at least directly) results in reduced employment and altered employment structure mostly in favour of high-skilled labour (David and Dorne, 2013). Walwei (2016) argues that computerization and automation will change entire industries, occupations, as well as the required set of skills, leading to a dramatic job creation and job destruction process. In that process workers will either be replaced by those who own the set of necessary skills, or they will have to requalify. Although some jobs are directly destroyed, creation of high-tech jobs can generate additional jobs in other sectors, as for example almost 5 new jobs are generated in the US by each high-tech job (Peña-López, 2016).

In advanced economies, the share of employed population (25–54) with advanced education (short-cycle tertiary education, a Bachelor's degree or an equivalent educational level, a Master's degree or an equivalent educational level, or a doctoral degree or an equivalent educational level) exceeded one third of total employment in 2016 (International Labour Organization database). The corresponding share in Croatia is somewhat below that rate, and stood at 30.1 percent in 2016, although the share has been growing rapidly during and following the transition process as the switch to the market economy transformed the demand for skills and led to a tertiary education boom (Tomić and Tyrowicz, 2010). Regarding the quality of education in math and science (World Economic Forum, 2016) Croatia ranked 31st out of 139, while the availability of scientists and engineers positioned the country on the 95th place among 137 countries (Global Competitiveness Report 2017–2018). According to Mondekar (2017) around 2 percent of graduates in Croatia are in the

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STEM (Science, Technology, Engineering and Mathematics) area, while the share of the adult population (25–64) participating in education and training in 2016 was only 3.0 percent, greatly below the rates in advanced economies that are even five times larger.

Looking closely into one of the sectors mostly associated with high-skilled labour, the ICT (information and communication) sector, its share in total employment in the OECD countries amounted up to 3–5 percent (Peña-López, 2016). In Croatia, the share in 2016 has been approaching that of advanced economies having 3.1 percent of total employment coming from the ICT sector. Most of that employment, almost one third, was found in the telecommunications sector as this branch of ICT is the most developed one in the whole Western Balkans (Barbić et al., 2018).

As labour markets are dramatically changing worldwide, the Croatian Government also recognised the need to assess the need for skills, especially smart skills, and incorporated this objective into its Smart Specialization Strategy (S3). S3 in Croatia is a substantive framework in the amount of more than a billion euros allocated to transforming the economy, mainly by improving its competitiveness, supporting research and development, innovation, investment into knowledge, technology transfer, and development of smart skills. The latter objective makes a rather small part of the total S3 budget, around five million euro, and in the centre of the smart skills objective lays the assessment of future skill needs. The ultimate goal of smart skills however, is to eventually create and/or upgrade qualifications and smart skills following “smart” detection of gaps in the existing skillset of the workforce, but also of the future workforce that has not yet entered the labour market.

Interest in smart skills essentially reflects recent changes in the structure of employment and creation of entirely new occupations, brought on by technological change, globalisation, and higher mobility of labour. McGowan and Andrews (2015) emphasize that well designed economic policies for both the supply and demand for skills are the preconditions for reducing skills gaps. According to OECD (2013), innovation can only strive in an environment that encourages investment in technology and knowledge-based assets, where there is plenty of skilled workforce that can generate new ideas and technologies, and with policies that encourage firms to engage in innovation and entrepreneurial activity.

Although smart skills have been recognised by policy-makers, researchers at EIZ so far focused mostly on traditional labour market research and studied for example educational

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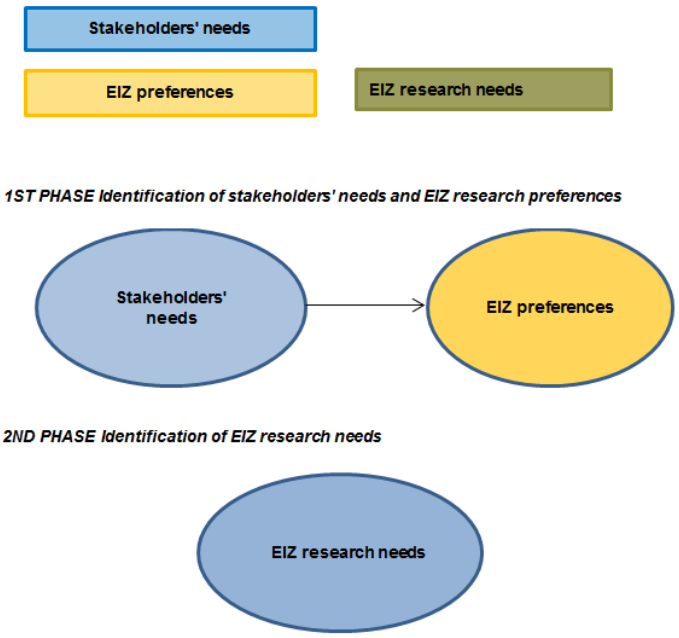
attainment of the workforce, demand for occupations, and wage dynamics. This missing link between policy and academics in the smart skills segment was identified in the SmartEIZ Twinning strategy in which a number of major policy- and academically- driven issues related to the project were outlined (Figure 1). SmartEIZ early in the implementation of the project was followed by interviews with the Ministry of Economy, Entrepreneurship and Crafts, Croatian Agency for SMEs, Innovations and Investments, and with the Agency for Investments and Competitiveness—all major policy makers and stakeholders in the country—where smart skills were identified as one out of five most important policy-driven needs regarding S3 implementation in Croatia. Meanwhile, a gap between EIZ researchers and policy makers was also identified, in the sense that researchers are not particularly familiar with S3 nor they have interest in those relevant topics from a policy perspective. Therefore, linking policy makers' needs with those of researchers imposed as one of the challenges of the Twinning strategy for EIZ.

Figure 1: Revealing EIZ research needs within S3 framework




Source: Twinning Strategy.

In order to reduce the gap in the assessment of skill needs, EIZ researchers initiated a project in which they developed tools and used cutting-edge methodologies to analyse the

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Croatian labour market, especially the demand side, and the high-skill segment in particular. Their research on the demand for high-skilled labour in Croatia (obtained from the newly-constructed Online Vacancy Index) was presented at the fifth SmartEIZ training workshop on "Skills and technical change: policy issues" held from October 30 to 31 at the Institute of Economics, Zagreb.

In the context of S3, labour force demand analysis in specific technological sectors can also be considered as part of smart skills. Horizontally, S3 consists of five key areas: health and quality of life, energy and sustainable environment, transport and mobility, security, and agro-food. Vertically, these areas are integrated through ICT and Key Enabling Technologies (KET) implying that all programs must be related to one of the horizontal sectors and additionally to either ICT or KET. ICT is therefore a cross-cutting theme, an additional criterion for prioritising thematic fields in S3, which supports them in the process of value-creation.

## 2 Dimensions of "smart": high-skilled labour demand diagnostics in Croatia using the Online Vacancy Index

Smart skills are often synonymous for a technologically-advanced segment of high-skilled labour demand, mostly associated with, but not restricted to, information technology, statistics and mathematics, medical care, mechanical engineering, etc. The "smart" in the name suggests these are highly-qualified professionals who can perform complex and abstract tasks and ideally provide above proportionate value added. Driven by the need to detect smart skill needs in Croatia, **the researchers at the Institute of Economics, Zagreb developed a "smart" index that ensures "smart" labour market diagnostics on the needs for "smart" skills**. The three dimensions of "smart" are reflected in the way the index is created, disseminated and used.

The online vacancy index itself is "smart" as it uses state-of-the-art methodology and creates an entirely new dataset to provide labour market information. The index also offers "smart" labour market diagnostics as it provides a detailed reflection of the demand for labour in Croatia, both statistically and economically. For example, the index reveals the demand for occupations, educational attainment, job location, and type of contract, all given through time

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on a monthly basis with only one day of delay. The third "smart" in the index reflects the specific segment of labour demand for high-skilled workers.

## 3 "Smart" Index: Online Vacancy Index (OVI)

The Online Vacancy Index was constructed at the Institute of Economics, Zagreb in order to fill an existing gap in labour market statistics and provide up-to-date information on labour demand in Croatia. It was constructed in collaboration with MojPosao, the most popular vacancy search and posting website in Croatia. New vacancies are accessed every month via an application programming interface (API) access enabling regular publication of the index on a monthly basis.[1]

The database (up to September 2017) consists of altogether more than 328 thousand posted vacancies that are filled every month by new input. As these are vacancies posted by the employers they mirror demand for labour, mostly by the private sector, as firms have a tendency to post vacancies on MojPosao. The reason for that is the fact that MojPosao is among the top 20 most visited websites in Croatia, it has more than 770 thousand visitors per month, and more than 54 thousand clients recruiting through them. The official vacancy statistics published by the Croatian Employment Service mostly reflects labour demand from the public sector, as posting is not obligatory for firms in the private sector, but usually is obligatory for institutions in the public sector. Therefore, the new information that sheds more light on the labour demand from the private sector is a complement to the official statistics.

Table 1: Data hierarchy

| Dimension | Number of possible outcomes | Reduced number of outcomes | Used number of outcomes |
|---|---|---|---|
| Job location | 2,011 | 8 | 4 |
| Educational attainment | 600 | 15 | 5 |
| Type of contract | 181 | 8 | 6 |
| Occupation | 1,020 | 619 | 35 |

Source: calculations of the authors.

[1] An example of the report can be found here: http://www.eizg.hr/indices-351/ovi-index/356.

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Vacancies posts are made by employers themselves and normally they are not uniformed resulting in hardly usable data. For example, employers can enter data for the occupation of “Prodavač” (salesperson) as either “Prodavač”, “Prodavac”, “prodavač”, “prodavac” or even “Osoba u prodaji” (person in sales), “osoba u prodaji”, “Asistent u prodaji”, (sales assistant) “asistent u prodaji”. Although all these examples basically represent the need for a salesperson, after accessing the data via API, the computer software reads them as different occupations. Regarding job location, educational attainment and type of contract the number of possible outcomes was unreasonably high so in order to grasp employers’ needs we applied a hierarchy to the data in order to obtain four regions, five educational attainment levels, and six contract types (Table 1). To do that it was necessary to apply machine learning methods to clean the data and group similar occupations in order to correctly measure the need for a specific occupation. As represented by Figure 2, machine learning is a part of the set of skills used in data science. Data science lies at the intersection of three essential skills: hacking (programming) skills, math and statistics knowledge and substantive expertise in a field of science (economics and labour market in our particular case). Hacking skills ensure large amounts of electronic data are acquired, prepared and manipulated in a fast and efficient manner. Math and statistics knowledge provides adequate and rigorous methods that create correct data analysis. Finally, substantive expertise provides scientific motivation and inference from data analysis. If either one of the three skills is lacking, we are either in the danger zone, doing machine learning or simply traditional research. From a perspective of traditional research, adding programming skills and handling big data ensures, but is not limited to, new and enhanced datasets that can provide meaningful insights about the problem at stake.

Figure 2: Data science skillset

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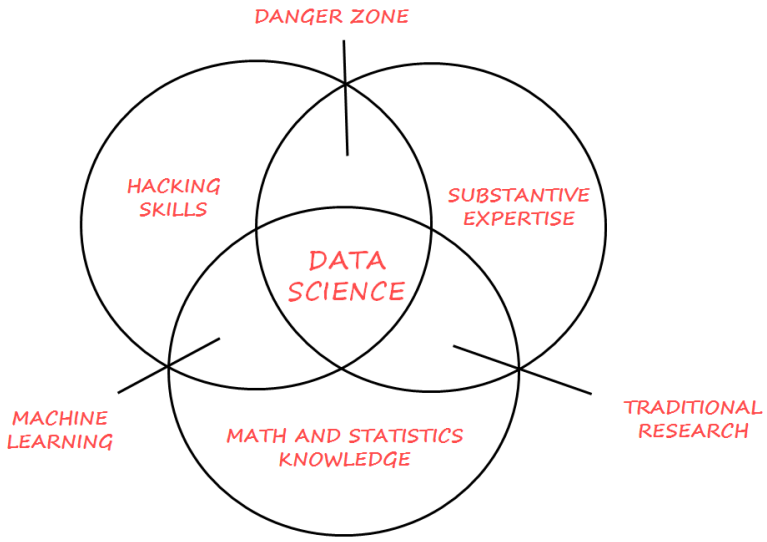


Source: Berkeley Science Review.

We use statistics and time series econometric modelling to calculate an easily interpretable online vacancies index. The index is constructed from 2005 to September 2017, with 2015 being the base year, in which the index amounts to 100. Besides the original value of the base index, we also do seasonal adjustments as labour demand in Croatia is significantly affected by the tourist season with demand for seasonal workers peaks in early spring. Due to the high seasonality in the original index, when interpreting long-term development, we use the trend version of the index (Figure 3). Finally, in order to interpret the values of the index and the underlying vacancies characteristics and trends, we consult labour market experts familiar with Croatian labour market specificities.

Figure 3: OVI

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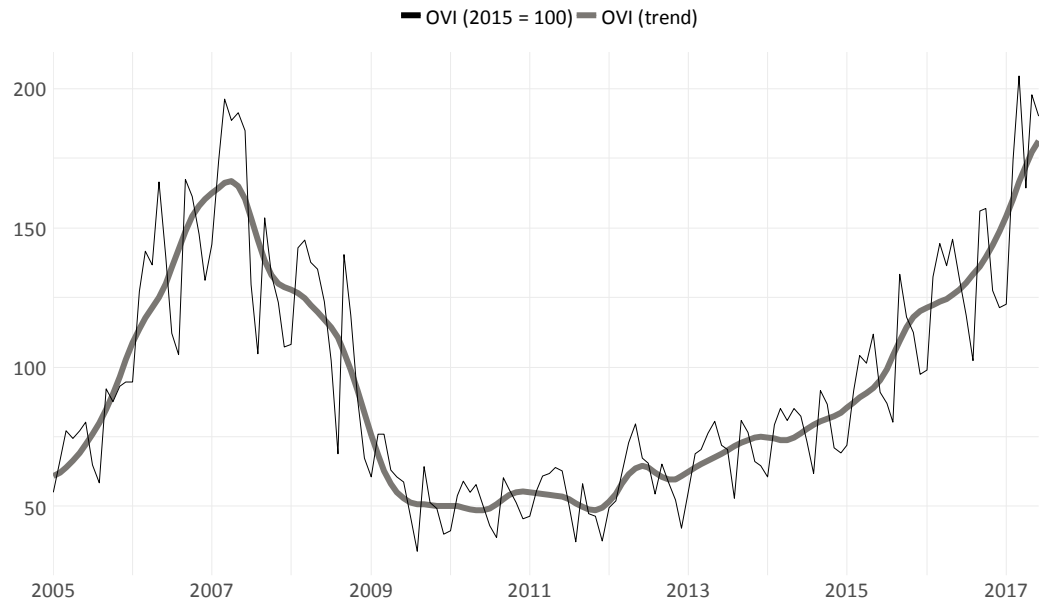


Source: calculations of the authors.

## 4 High-skilled labour demand in Croatia

As S3 is concerned with smart skill needs, we focus our analysis on high-skilled labour demand and use our online vacancy index for this specific segment. Figure 4 represents this part of labour demand with the light-blue colour, as it indicates university degree educational attainment. We can see that the share of university degree was rather stable until the end of 2012. After that year, demand for high-skilled labour started to increase considerably, as did the demand for unskilled and skilled work, indicating significant and rising polarisation in the last five years.

Figure 4: Labour demand by education level

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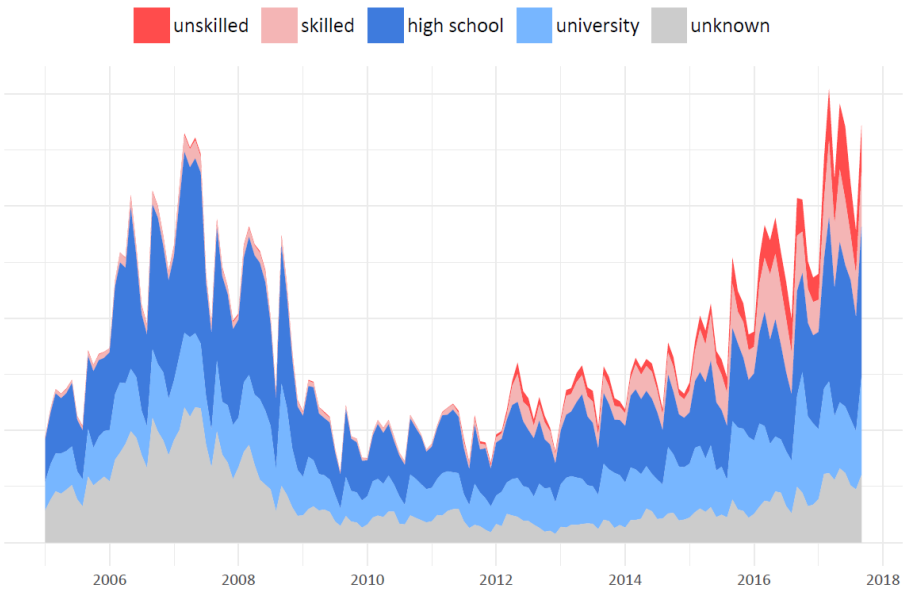


Source: calculations of the authors.

Taking a closer look into the specific diplomas behind the high-skilled education group (the light-blue in Figure 4), Figure 5 implies that most of the growth in high-skilled labour demand came from university (vss), and college (vshs) graduates and much less from other categories introduced in the Bologna process, such as Bachelor, or postgraduate studies such as MBA (mba) or PhD (doc). Figure 6 presents demand for high-skilled labour by contract type. Before the crisis, full time contracts were the dominant type of contracts in Croatia (deep-pink colour). When the crisis hit, the offering of full time contracts by employers significantly decreased, and it barely recovered after the crisis and six-long recession. In the recovery phase, temporary contracts (light-pink colour) had the biggest contribution to overall growth followed by special type of contracts that was introduced in 2012 called training without commencing employment (light-blue colour). Training without commencing employment is a traineeship program created for young people who have no work-experience related to their profession. The most relevant features of the program are its duration, 12 months, and the amount of net compensation, which started at around 200 euro monthly to be increased to the level of minimum wage. Therefore, economic recovery did bring increasing demand for labour but it changed the structure of offered contracts from full time contracts to temporary and training without commencing employment. Temporary contracts thus introduced more uncertainty for employees, while temporary training without

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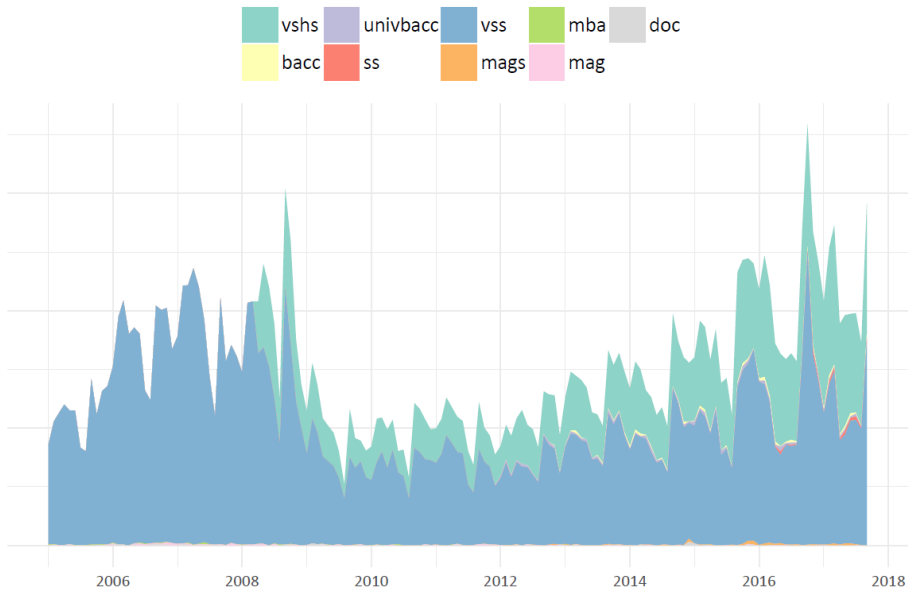
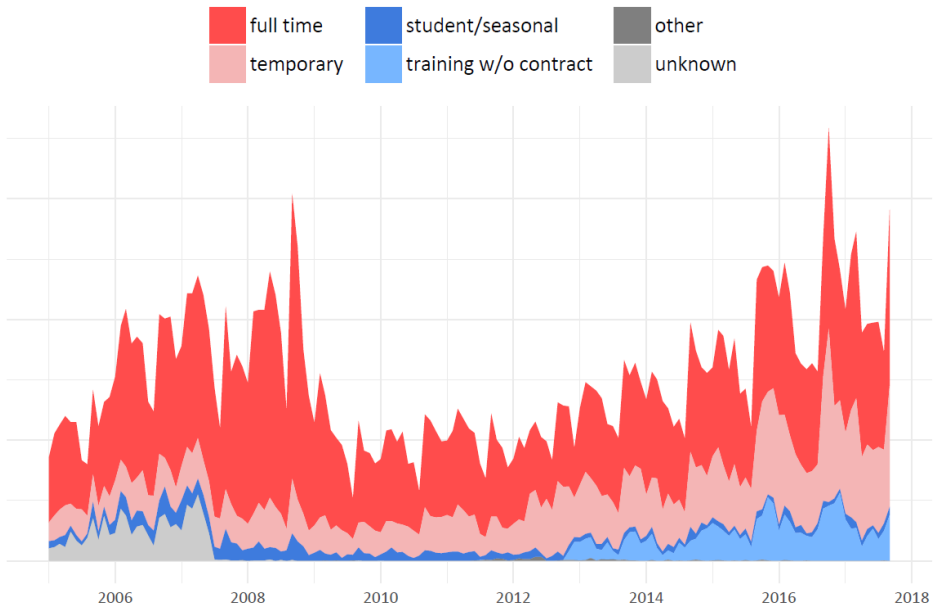
commencing employment introduced both uncertainty and well-below-average monetary compensation.

Figure 5: High-skilled labour demand




Source: calculations of the authors.

Figure 6: High-skilled labour demand by contract type




Source: calculations of the authors.

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Table 2 provides figures on the share of top 10 high-skilled occupations employers were demanding in the 2010–2017 period. The first position is taken by "salesman" with its 6.95 percent share and it mostly represents demand for business graduates, high-skilled persons employed in marketing and/or sales. Programmers are following with 6.84 percent, while teachers took the third place with a bit more than 5 percent of all high-skilled vacancies. The rest of the table is filled with accountants (business graduates), computer technicians, construction engineers, professors, physicians, marketing experts, and designers. These 10 occupations account for 42 percent of all high-skilled vacancies. Out of these 42 percent a quarter reflects the demand for information technologies experts, or more than 10 percent of total demand.

Table 2: High-skilled labour demand: occupations (since 2010)

| Occupation | Share |
|---|---|
| Salesman | 6.95% |
| Programmer | 6.84% |
| Teacher | 5.22% |
| Accountant | 4.91% |
| Comp. technician | 3.99% |
| Constr. engineer | 3.51% |
| Professor | 2.77% |
| Physician | 2.76% |
| Marketing | 2.66% |
| Designer | 2.39% |

Note: "Salesman" refers mostly to business graduates, high-skilled persons employed in marketing and/or sales.

Source: calculations of the authors.

As the demand for programmers is rather high, we have decided to take a closer look into the specific titles of occupations among the programmer vacancy. Table 3 suggests that the general term "Programmer" was still the dominant title, with more than 60 percent of ads asking for this occupation. Java programmers accounted for almost 10 percent, .NET and PHP programmers for less than 5 percent, while Web developers, Project, Front-end, Oracle, iOS, and Android programmers each accounted for less than 3 percent of Programmer ads.

Table 3: Programmer demand (since 2010)

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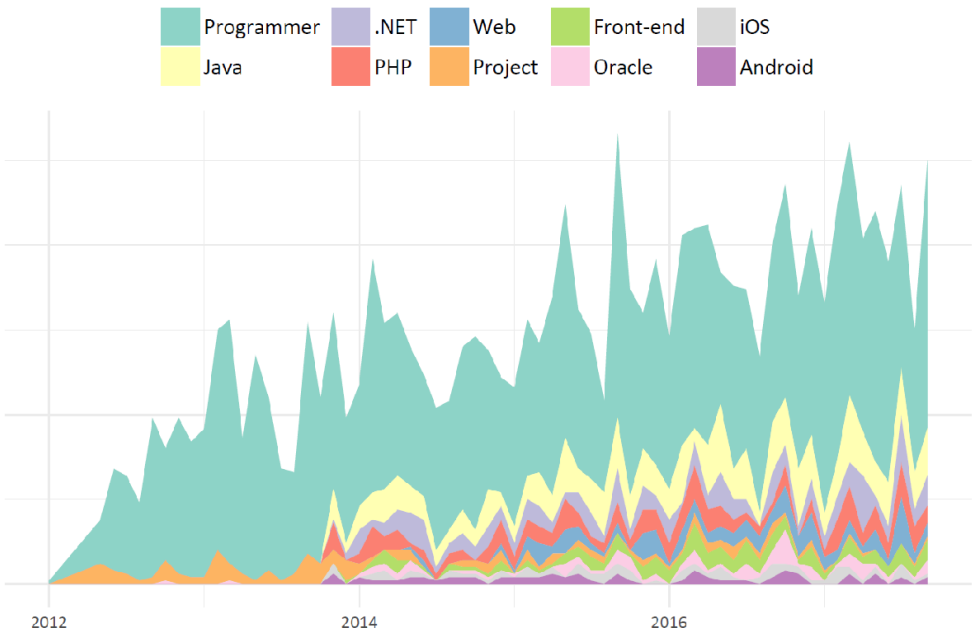
| Title | Share |
|---|---|
| Programmer | 61.86% |
| Java | 9.20% |
| .NET | 4.90% |
| PHP | 4.35% |
| Web developer | 2.87% |
| Project | 2.79% |
| Front-end | 2.64% |
| Oracle | 1.67% |
| iOS | 1.48% |
| Android | 1.31% |

Source: calculations of the authors.

Figure 7 implies that overall we notice a steady increase in the number of jobs offered to programmers. Also, a fine difference in different programmer jobs became apparent in 2014, and especially in 2015. It seems that inside this specific labour demand there is growing differentiation in competences. For example, project programmers are being replaced by different Java, .NET,, iOS and Android programmers.

Figure 7: Programmer demand (since 2010)




Source: calculations of the authors.

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## 5 Final thoughts

The Online Vacancy Index was designed in order to fill the gap in labour market statistics by detecting labour market demand in Croatia. We have shown that it can also be used in order to detect specific demand for smart skills—demand for highly-qualified professionals who can perform complex and abstract tasks. The index itself is "smart" by construction; it ensures "smart" labour market diagnostics on the needs for "smart" skills. The Index revealed that the labour market in Croatia significantly polarised after the crisis as the demand for high-skilled, skilled, and unskilled workers increased at the expense of high school graduates. It also suggested that high-skilled labour demand recovered after the crisis but at the expense of full time contracts, as we clearly observe a disproportionate rise in temporary contracts and training without commencing employment. The latter brought more uncertainty and lower wages to (young) high-skilled workers.

As smart skills are often related to a technologically-advanced segment of high-skilled labour demand, information technology, we have also turned to the index to provide some evidence regarding that specific segment. More than 10 percent of vacancies in the 2010–2017 period was addressed to information technology experts, mostly programmers. Demand for different programmer jobs became apparent in 2014, and has been growing since.

## References

Aralica, Z. (2018). S3 lessons learnt from Croatia, *Smart Specialisation in the Western Balkans Workshop*, Ljubljana, Slovenia.

Barbić, T., Bieber, F., Broz, T., Buturac, G., Mikulić, D., Stojčić, N., Tkalec, M., Tomić, I., & Vizek, M. (2018). *The Impact of Digital Transformation on the Western Balkans: Tackling the Challenges towards Political Stability and Economic Prosperity*. Deutsche Telekom, Bonn.

David, H., & Dorn, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. *American Economic Review*, 103(5), 1553-97.

Jaimovich, N., & Siu, H. E. (2012). *The trend is the cycle: Job polarization and jobless*

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 692191.

*recoveries* (No. w18334). National Bureau of Economic Research.

McGowan, M. A., & Andrews, D. (2015). Labour market mismatch and labour productivity: Evidence from PIAAC data. *OECD Economic Department Working Papers*, (1209), 0_1.

Mondekar, D. (2017). *The digital economy in Southeast Europe: Opportunities and challenges*. Zagreb: Friedrich Ebert Stiftung.

OECD (2013). Innovation–driven Growth in Regions: The Role of Smart Specialisation, *Organisation for Economic Co-operation and Development (OECD)*, Paris, France.

Peña-López, I. (2016). *World development report 2016: Digital dividends*.

Tomić, I., & Tyrowicz, J. (2010). *What Happened to the Middle Class in the New Market Economies? The Case of Croatia and Poland*. Croatian Economic Survey, (12), 9-44.

Walwei, U. (2016). *Digitalization and structural labour market problems: the case of Germany* (No. 994936693502676). International Labour Organization.

World Economic Forum (2016). *White paper digital transformation of industries: Societal Implications*. World Economic Forum, Geneva.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 692191.