New Dual Education Program in Serbia. Do Benefits exceed Costs for Participating Companies?

Report

Author(s):
Bolli, Thomas; Caves, Katherine Marie; Pusterla, Filippo; Renold, Ursula

Publication date:
2021-03

Permanent link:
https://doi.org/10.3929/ethz-b-000477795

Originally published in:
CES Studies 9

ETH zürich

Chair of Education Systems

New Dual Education Program in Serbia

Do Benefits exceed Costs for Participating Companies?

Bolli Thomas
Caves Katherine M.
Pusterla Filippo
Renold Ursula

CES Studies, No. 9, March 2021

DMTEC

The production of this Report was supported by the Government of Switzerland. The Report material does not necessarily represent the official standpoints of the Swiss Government.

Report prepared by the Chair of Education Systems team at ETH Zurich in Zurich, Switzerland (http://www.ces.ethz.ch/) in collaboration with the Chamber of Commerce and Industry Serbia in Belgrade, Serbia (https://pks.rs/) within the Swiss Cooperation Office project “Support and Development and Establishment of the National Model of Dual Education”.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

ETH zürich

Acknowledgements

We thank the Chamber of Commerce and Industry Serbia for translating the survey, organizing company contacts, contacting companies by phone and providing important information about the new dual education program. We would like to thank all companies from Serbia who participated in the survey and/or in interview sessions. We also thank the Statistical Office of the Republic of Serbia for providing data of the Serbian Labor Force Survey.

Table of Contents

List of Figures

List of Tables

Executive Summary

Research question and methodology

Dual education offers graduate from compulsory education in Serbia the chance to combine school classes with work-based learning in firms. During the 3 years of the program, students divide their time between classroom education at vocational school and real work experience in firms. The program started as a pilot project in 2013 and has involved an increasing number of students and firms since then. In 2018, the Law on Dual Education Serbia (LDE) was approved by the Parliament. The scaling-up and fine-tuning of this program raises the question of whether providing training places is profitable for firms. These very preliminary results will stimulate the discussion regarding the total revision of the LDE as foreseen in the law itself.

The methodology used to answer this question follows a simple accountancy framework that compares costs and benefits of the dual education program from the perspective of firms. Benefits refer to the productive value students create while working in the firm. Furthermore, if students remain in the firm after completing the program, firms benefit from saved adjustment and recruitment costs. Costs include remunerations paid to the students. Furthermore, they include the costs of instructors and other employees engaged in work-based learning, safety equipment, travel and food costs, as well as machines and materials used for training the students rather than production. The costs also account for the time used to hire the student, to plan and to administer the training. Finally, costs include expenses for classroom education, if they are provided by either companies or other providers.

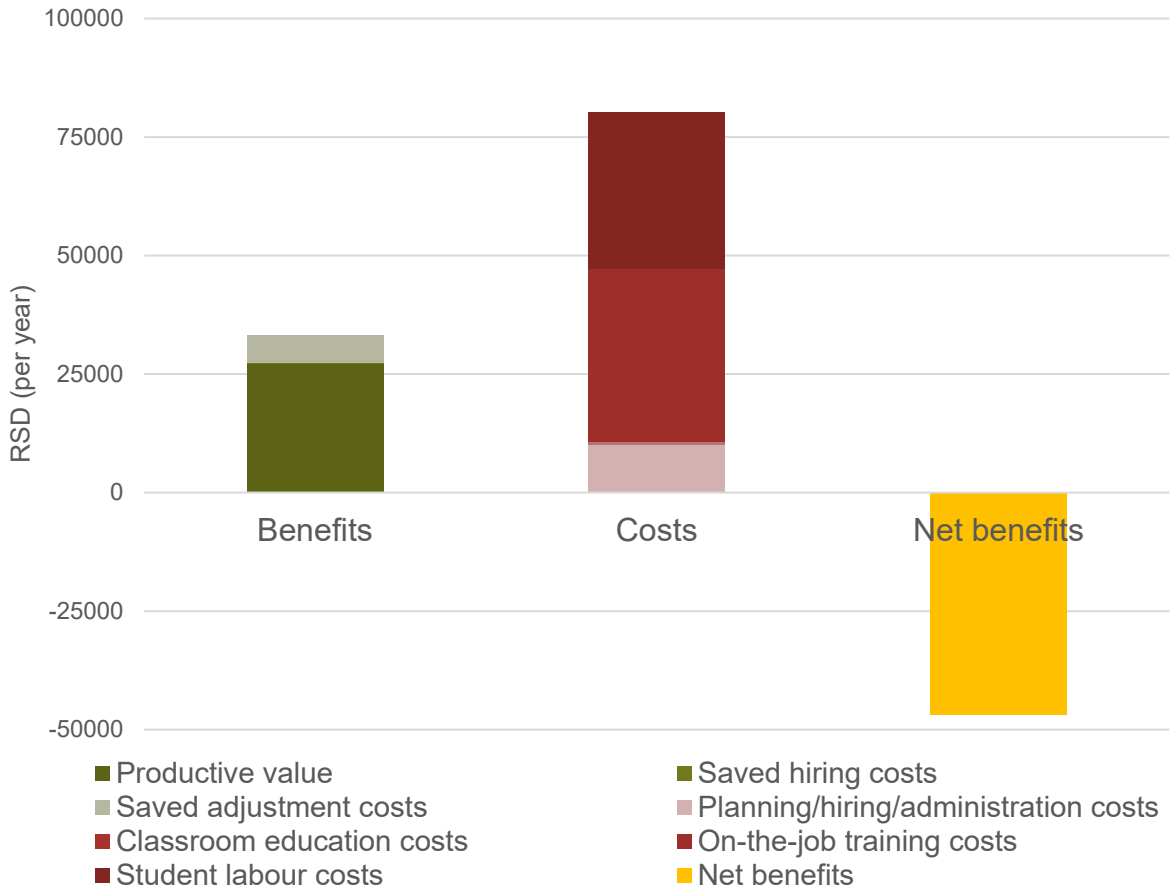
The data is based on two sources. First, in May 2020, we sent a quantitative online survey to about 400 training firms, which represent approximately all firms who had started to train students between 2013 and 2019. About 30 firms provide answers to most questions of the survey. Around 170 companies started the survey but did not complete. Second, we combine the survey with information from the labor force survey of the year 2014 to 2018 to obtain information regarding gross wages.

Results

Figure I summarizes the results of the cost-benefit analysis. The first bar shows that firms incur costs of about 80,000 RSD per year. Student labor costs and on-the-job training costs are the most important cost types. The second bar displays firms' benefits, which amount to about 33,000 RSD per year. The productive value is the most important benefit component. As total costs exceed total benefits, dual education yields total net costs. The third bar shows the net costs, which are about 47,000 RSD per year.

Further analyses suggest that net costs strongly differ by firm size. Small- and medium-sized firms experience notably higher costs, mainly due to the fact that supervision time is higher in these firms. Additionally, small- and medium-sized firms have lower benefits due to the fact that the retention rate in these firms is extremely low, so they accrue no benefits in terms of saved adjustment or hiring costs. Large firms, in contrast, are more able or willing to retain students after the end of the program and so experience higher total benefits. Furthermore, large firms have relatively lower costs. As a consequence, net costs are much lower for large firms (about 30,000 RSD per year) than they are for small- and medium-sized firms (about 88,000 RSD per year).

Figure I: Net benefits of the dual education program



Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places.

The figure shows for example that benefits amount to about 37,000 RSD per year of which productive value is the most important component. Yearly costs of about 80,000 RSD yield net costs of about 42,000 RSD per year.

Policy Options & Recommendations

Our main results suggests that the average firm that trains students in the work-based learning program faces net costs of about 47,000 RSD per year per student. These net costs correspond to about one month's gross wage for a skilled employee. Hence, the program's features must be carefully analyzed to identify necessary changes in the design of the educational process and the curricula. To support the discussion among reform leaders, the CES team has conducted a sensitivity analysis that shows in which direction the LDE program could be improved so that a small net benefit can be achieved in the medium term.

The sensitivity analyses we performed show that changes in some parameters might strongly affect the cost-benefit ratio. Concretely, we show that a shift towards more productive work would improve the results substantially. These changes would be particularly effective if they are combined with a larger share of time spent in the companies, resulting in net benefits. Also an increase in the retention rate would increase after-training benefits and so improve the cost-benefit ratio. Nevertheless, the results of these analyses should not be taken for granted as these provide only indications of how the cost-benefit ratio might change, and not certain predictions. A discussion among reform leaders and the involved stakeholder groups is necessary to find a consensus for the improvement of the LDE program.

Aside from considering which parameters could improve the cost-benefit ratio from the firms' perspective, we also recommend considering the implications that any measures would have on training from the students' perspective. For instance, increasing the time students spend in the firms would make the training more narrow, and would therefore have negative consequences on students' mobility after the end of the program. On the other hand, depending on the competences, students might learn more from workplace training than classroom education. The high satisfaction of students with workplace training suggests that this might be the case (Renold et al. 2020).

Another important recommendation is to further monitor the program in the next years. We highly recommend to conduct cost-benefit analyses again in the future based on a higher sample of companies who have experienced the implementation of the new LDE program. A regular evaluation of cost and benefits from the firms' perspective would allow to adjust or further develop the program. Finally, one question raised by this report consists of why the retention rate is only about 10%. Understanding more about the reasons for this finding might help Serbia's leaders design policies in a way that increases retention rates.

Резиме

Тема истраживања и методологија

Дуално образовање пружа могућност ученицима да, након завршене основне школе, наставе школовање у формалном систему средњошколског образовања у Србији, тако што ће учити теорију у средњој стручној школи и развијати вештине у оквиру учења кроз рад у реалном радном окружењу у компанији. Током три или четири године школовања, ученици стичу теоријско образовање у учионици у средњој стручној школи и стварно радно искуство у компанији. Развој дуалног образовања је почео пилот пројектом 2013. године и од тада су се повећавали и број компанија и број ученика, заинтересованих за овај вид стручног образовања. Народна скупштина Републике Србије усвојила је Закон о дуалном образовању (ЗоДО) у новембру 2017. године. У циљу веће примене и даљег развоја дуалног образовања потребно је одговорити на питање да ли је обезбеђивање места за учење кроз рад ученика "профитабилно" за компаније. Циљ прелиминарних резултата добијених овим истраживањем је да подстакну дискусију у вези са комплетном ревизијом ЗоДО, како је предвиђено и самим законом (члан 40, Закон о дуалном образовању, "Службени гласник РС", бр. 101/2017, бр. 6/2020).

Методологија коришћена за одговор на претходно постављено питање следи једноставан рачуноводствени оквир који упоређује трошкове и користи дуалног образовања из перспективе компанија. Термин користи односи се на продуктивну вредност коју ученици "стварају" док реализују учење кроз рад код послодавца. Поред тога, ако ученици остану у компанији након завршетка школовања, компаније имају користи од уштеде у трошковима који прате селекцију кадрова, као и увођење новозапослених у посао, јер је период њиховог прилагођавања краћи. Термин трошкови укључује пре свега накнаду исплаћену ученицима. Поред накнаде, као и материјалног обезбеђења ученика предвиђеног Законом, у трошкове су укључени и трошкови запослених у компанији који се ангажују као инструктори у дуалном образовању, као и средстава за рад, односно машина и материјала који се користе за обуку ученика, а не за производњу. У трошкове је, такође, урачунато време које је потребно за планирање и администрирање учења кроз рад. Коначно, трошкови укључују и трошкове обука у компанијској учионици, организованој од стране запослених у компанији или других провајдера.

Подаци за истраживање потичу из два извора. Прво, у мају 2020. године на адресе око 400 компанија је упућен позив за учешће у онлајн анкети, односно свих оних компанија које су почеле да обучавају ученике у периоду између 2013. и 2019. године. На ову анкету, око 30 компанија је дало одговоре на већину питања. Око 170 компанија је започело анкету, али је није попунило у целости. Други извор података су подаци из анкета о радној снази за период од 2014. до 2018. године, који су коришћени како би се добиле информације у вези са бруто зарадама.

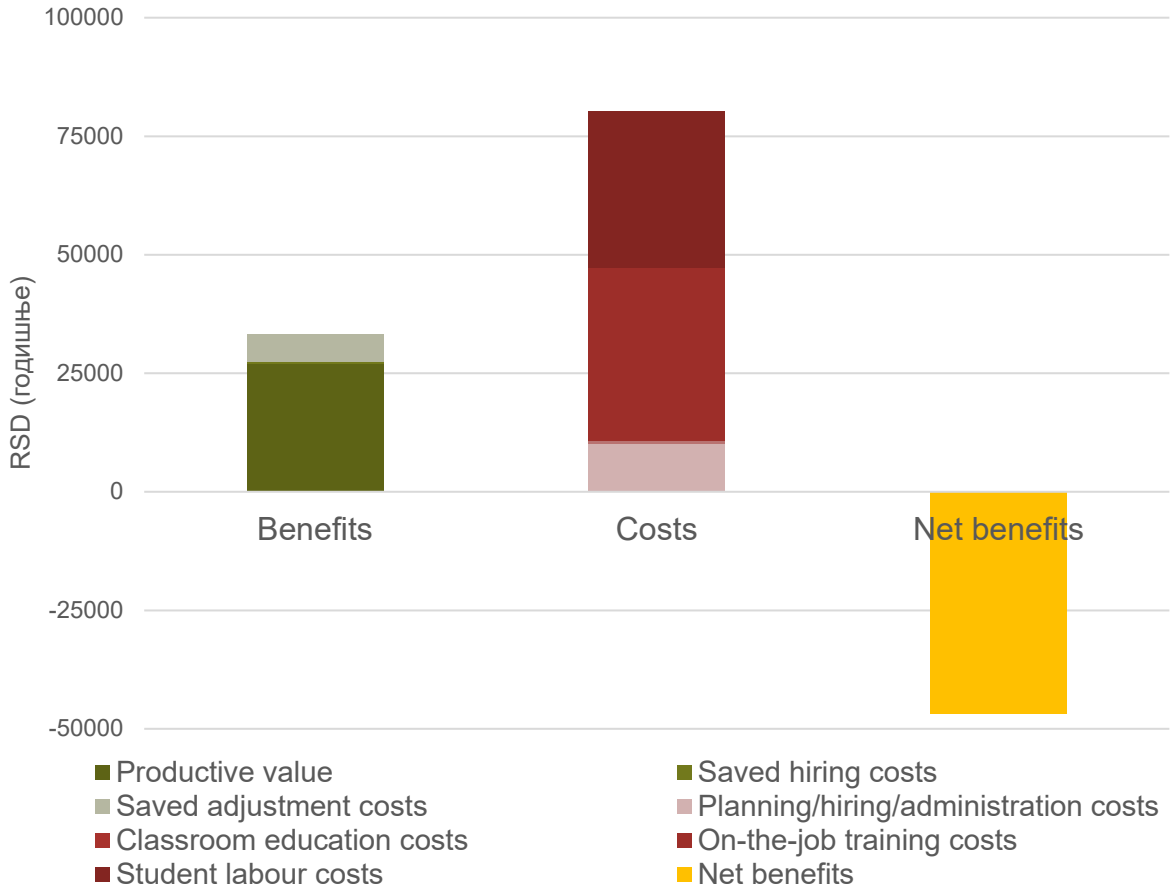
Резултати

Слика бр. 1 сумира резултате анализе трошкова и користи. Прва линија показује да компаније годишње троше око 80.000 динара. Трошкови "учења кроз рад" по ученику (тј. накнаде уз припадајуће доприносе, трошкови превоза, исхране, осигурања, као и средстава и опреме за личну заштиту на раду) су најважнија врста трошкова. Друга линија приказује корист послодавца, која износи око 33.000 динара годишње. Производна вредност је најважнија компонента користи. Како укупни трошкови премашују укупну добит, тренутно дуално образовање доноси компанијама

укупне нето трошкове. Трећа линија приказује нето трошкове, који износе око 47.000 динара годишње.

Даље анализе сугеришу да се нето трошкови значајно разликују по компанијама зависно од величине. Мале и средње компаније имају знатно веће трошкове, углавном због чињенице да је у тим компанијама време надзора над учеником дуже. Поред тога, мале и средње компаније имају мање користи због чињенице да је стопа задржавања запослених у тим компанијама изузетно ниска, тако да оне не остварују никакве користи у погледу уштеде у трошковима због лакше селекције кадрова и лакшег увођења у посао. Велике компаније су, насупрот томе, способније или вољније да задрже ученике након завршетка програма и тако остварују већу укупну корист. Штавише, велике компаније имају релативно ниже трошкове. Као последица тога, нето трошкови су много мањи за велика предузећа (око 30.000 динара годишње) него за мале и средње компаније (око 88.000 динара годишње).

Слика бр. 1: Нето користи од реализације дуалног образовања



Напомене: Н ~ 30. Слика приказује годишње вредности компонената за процењену корист, трошкове и нето корист компаније која реализују учење кроз рад.

На слици је приказано, на пример, да корист износи око 37.000 динара годишње од којих је производна вредност најважнија компонента. Годишњим трошковима од око 80.000 динара доприносе нето трошкови од око 42.000 динара годишње.

Препоруке

Наши главни резултати сугеришу да се просечна компанија која реализује учење кроз рад суочава са нето трошковима у износу од око 47.000 динара годишње по ученику, што је износ који је у многим компанијама приближно једнак једномесечној бруто плати за квалификованог запосленог. Стога се карактеристике постојећег система дуалног образовања морају пажљиво анализирати како би се идентификовале неопходне промене у осмишљавању образовног процеса и курикулума. Да би подстакао дискусију међу лидерима реформских процеса у Србији у области стручног образовања, тим ЦЕС-а спровео је анализу осетљивости која показује у ком правцу би се могао побољшати ЗоДО тако да се у средњем року може постићи мала нето корист.

Анализе осетљивости које смо извршили показују да промене неких параметара могу снажно утицати на однос трошкова и користи. Конкретно, указујемо на то да би оријентација на "продуктивнији рад" знатно побољшала резултате. Ове промене би биле нарочито ефикасне ако би се комбиновале са већим уделом времена проведеног у компанијама, тј. већим бројем часова учења кроз рад у односу на остале часове, јер би то допринело нето користима. Такође би повећање стопе задржавања ученика у компанији након школовања повећало корист и тако побољшало однос трошкова и користи. Ипак, резултате ових анализа не треба узимати "здраво за готово", јер они пружају само назнаке како би се однос трошкова и користи могао променити, а не и одређена предвиђања. Неопходна је дискусија међу лидерима реформских процеса и укљученим заинтересованим странама, како би се постигао консензус потребан за унапређење ЗоДО.

Поред разматрања који параметри би могли да побољшају однос трошкова и користи из перспективе компанија, препоручујемо и разматрање импликација које би било које мере имале на обуку из перспективе ученика. На пример, повећавање времена које ученици проводе у компанијама би их уско оспособљавало, што би имало негативне последице на мобилност ученика након завршетка школовања. С друге стране, у зависности од компетенција, ученици могу научити више из учења кроз рад у реалном радном окружењу него из образовања у учионици. Велико задовољство ученика учењем кроз рад сугерише да би то могао бити случај (Ренолд и сарадници 2020).

Друга важна препорука је даље праћење реализације дуалног образовања у наредним годинама. Топло препоручујемо да оваква анализа буде спроведена и у будућности, али да обухвати већи број компанија и то оних које су искусиле примену иновираног ЗоДО. Редовна процена трошкова и користи из перспективе компанија омогућила би прилагођавање или даљи развој дуалног образовања. Коначно, једно од питања покренутих овим истраживањем односи се на стопу задржавања ученика у компанијама, која се креће око 10%. Боље разумевање разлога овог резултата могло би да помогне доносиоцима одлука у Србији да осмисле политике на начин који ће повећати стопе задржавања ученика у компанијама након завршеног школовања.

1 Introduction

The Serbian government promulgated the Law on Dual Education (LDE) in 2017[1] in order to regulate and improve workplace training in upper-secondary vocational education and training (VET). The LDE specifies key elements of dual VET including workplace learning time, requirements for training companies, enrolment policies, instructor licensing, contracts, and career guidance provision. Crucially for companies' incentives to participate, the LDE also requires that students be remunerated for their workplace learning time and that they be given non-monetary compensation like meals, safety clothing, and transportation when necessary. These changes—many of which were piloted between 2013 and 2019 through various projects—were fully implemented in specific occupational profiles starting from the 2019-2020 school year. As of the 2020-2021 school year, most requirements apply to all workplace learning in VET over a certain threshold. Table 1 shows the number of students, companies, profiles, and school taking affected by the new regulation.

Table 1: Key figures of workplace learning participation

School year	Students	Companies	Profiles	Schools
2013-2016	400	40	3	16
2016/2017	1000	60	5	19
2017/2018	3000	200	19	60
2018/2019	4500	600	33	80
2019/2020	6100	800	35	72
2020/2021	6900	900	47	74

Source: Chamber of Commerce and Industry Serbia in Belgrade

This study examines companies' costs and benefits of participating in training under the new requirements. International evidence demonstrates that companies participate in training when they earn returns by doing so[2]. Therefore, evaluating the net costs or benefits of a program that relies on workplace learning is a crucial policy question. The LDE includes a transitional article stipulating that the law shall be revised after three years of initial implementation. This study supports evidence-based policymaking in that revision by providing initial evidence of companies' costs and benefits under the new model and identifying key recommendations.

[1] http://www.mpn.gov.rs/wp-content/uploads/2015/08/STRATEGIJA-OBRAZOVANJA.pdf

2 Theoretical Foundations

Who should pay for the investment?

Investments in human capital not only increase individuals' wages and firms' profits, but also the competitiveness and the growth of nations (Hanushek and Woessmann 2012) and thereby the well-being of societies. Although many parties benefit from investments in human capital in the optimal situation, the answer to who should pay for the investment it is not always straightforward. The economically efficient answer to this question is that those who benefit from the investment should pay the costs of education and training. However, it is not always clear who will benefit from investments in human capital as such investments can create positive externalities (benefits to those who did not invest) or help to prevent negative externalities (costs of non-education that are shifted to others).

Becker's theory adapted

In the context of firm-provided training, classical human capital theory (Becker 1962) stipulates that—in competitive labor markets—employees should cover all costs of investments in general human capital. For firm-specific human capital, employers and employees should share the investment costs. General human capital is defined as all skills and knowledge that an employee can use across many firms, whereas firm-specific human capital describes knowledge and skills that are not transferable from the current employer to other firms.

However, empirical observations show that firms invest quite frequently in general human capital. Since this contradicts the theory, adaptations of the theory are necessary to better fit reality.[2] Since the 1970s there have been many such extensions of the original theory. Most, but not all, have in some way or another loosened the assumption that labor markets are competitive. If labor markets have frictions, then these frictions allow firms to invest in their employees' general human capital without risking loss of the investment. They can recoup the investment later by paying wages below employees' marginal productivity. Aside from that, employers that invest in training can save money even in competitive labor markets by reducing turnover or by signaling better working conditions and thereby attracting more talented and motivated applicants.

Very often, however, labor market frictions come with a cost, for example higher levels of unemployment, and not all the firms can enjoy the same amount of training-investment protection from labor market frictions (e.g. Muehlemann et al. 2013). Therefore, in order to explain differences in the incidence of training provision between countries, economic sectors or individual firms, the focus has recently re-shifted to the question of the conditions under which and extent to which firms can provide general human capital by generating a net benefit.

These questions are of particular relevance in labor markets that come close to a competitive labor market[3] or for SMEs. Small firms are more likely to lose their students after training than big employers who can offer internal labor markets. Therefore, SMEs have to rely on the productive contributions of students during the training period to cover their training costs.

[2] See Wolter and Ryan (2011) for an extensive overview of theories explaining the provision and the financing of firm based training.

[3] Comparative analyses of the financing of apprenticeship training countries that run very similar apprenticeship programs, Austria, Germany and Switzerland, show remarkable differences in the net-costs for firms depending on the labour market frictions and regulations (see Muehlemann et al. 2010 and Moretti et al. 2017).

Net benefits of training are important

Most firms are not able to rely completely on labor market frictions to cover their training investments. Hence, firms' expected net benefits of training by the end of a training program is one of the most important indicators in firms' decision process of whether or not to provide training places for a given program. When firms expect to have uncovered net costs at the end of training, this does not automatically exclude the provision of training. Instead, expected net costs tell the firm how much benefit it will need to extract from students either during or after the training program.[4]

In the context of the present study, we employ a calculation method (see Section 3 for more details) that has been extensively used to measure the costs and benefits of apprenticeship training in German-speaking countries over the last three decades (see Muehlemann und Wolter 2014 for an overview). Although the new dual education program in Serbia is not directly comparable as a training scheme with the aforementioned apprenticeship programs, the method of calculating its costs and benefits from the perspective of the training firm are the same.

The cost-benefit calculation framework we use covers all costs and expenditures for training as well as the productive contribution of students during the training period. This yields the net-costs at the end of the training period. Additionally, we estimate post-training benefits that firms can accrue in the period after training through saved hiring and adjustment costs. This part of the calculation stems from the aforementioned cost-benefit surveys in German-speaking countries. Recent empirical research has shown that this part of the model is necessary to give a complete picture of the training decisions of firms (see Blatter et al. 2016), since firms may accept net costs at the end of the training period if they know they will have significant benefits afterwards.

Although the participation of firms in any firm-based training model is the *conditio sine qua non* for the functioning of such a system (without firms there is no firm-based training), such a training scheme cannot work properly if it does not generate a positive rate of return for its potential students as well. If a firm were to try to maximize its return on a training program at the expense of students, it might not find sufficient or sufficiently talented applicants for its further programs.

However, net benefits during the program are crucial for firms to avoid possible poaching. Indeed, if other firms poach trained workers, then firms might no longer able to have net benefit at the end of the training period. Such situation would occur if, for instance, costs of training arise in early phase of the training, whereas the benefits come after the training. The uncertainty about the possibility to have benefit after the end of the training might be a critical point in a firm's decision to train. For this reason, being able to have net benefit during the program might reduce the risk of poaching. Being able to have net benefit during the program is thus especially important in a country that starts to develop a dual education system.

It is easily understandable that most of the parameters in the cost-benefit model for firms have a direct link to the individual rate of return for students, although we cannot calculate these individual rates of return to training for the students with the data we collected (discussed in section 3.3). If, for example, firms reduce student wages in order to cut the costs of the training, it increases the net-benefit or decreases the net-costs of firms. At the same time, however, the wage cut also decreases the net-benefit for students. Similarly, if the program increases the time students spend in off-site schooling, it reduces the productive contribution of students to the firms and thereby increases the net-costs for firms, but might increase students' later earnings because such programs might develop higher-productivity graduates.

[4] E.g. in the case of reputation effects, the benefit is not linked to the training of an individual student but rather to the fact that the firm provides training at all.

One has to bear in mind that, although some linkages are straightforward in their consequences, some interventions or program features may affect many parameters in the model simultaneously and it is therefore not always clear *ex ante* whether changes increase or decrease net benefits for firms and the rates of return for students.

Potential benefits for the state

The third partner to consider in our model is the state. The state potentially benefits in several ways from training investments by firms and individuals. Firms become more profitable, individuals earn more, and consequently both pay more taxes. Additionally, investments in training and education help to reduce social transfers paid by the government. In the absence of externalities to training investments, the government could tax the benefits of these investments without having to make investments on its own.

However, investments in education and training produce externalities that may lead to an underinvestment by firms and individuals. As a result, most governments try to incentivize firms and individuals to invest more in training and education by subsidizing these activities. The government can do this in different ways, for example by paying for educational services or directly paying subsidies to firms that are active in education. By thus reducing the costs of training and education for firms and individuals, the government increases the net benefit of training for firms and increases the rate of return to education for individuals, at the price of lowering the fiscal rate of return to education. As long as cost- and benefit-sharing between the three parties is such that all get a positive return to training and education, this sharing can lead to a win-win-win situation and stimulates the dual education by setting effective incentives.

State investment should have causal impact on the behavior of firms and individuals

From the perspective of the government it is important to recognize that an investment like a subsidy only generates more wealth if the investment has a causal impact on the behavior of the other two actors—firms and individuals. If a firm would offer the same number of training places with or without subsidies, then government intervention would just change the cost-sharing but not produce a different outcome in terms of wealth created.

Although we cannot calculate the fiscal return to training in this analysis, the cost-benefit outcome for training firms helps the government decide whether additional public funds are needed to produce a better outcome. If that were the case, we would show that subsidies cause higher incidence of training. If a sufficiently high number of firms can offer training places with net benefits at the end of the program and training generates a positive rate of return to education for the students, a government intervention might only produce a deadweight loss.

In Serbia we are at the beginning of the systematic assessment of costs and benefits for training companies. This first study was conducted shortly after the start of the implementation of the new law. However, it was also possible to include the several years of experience of the companies that had already participated in the pilot projects for dual education.

This early measurement is important because during the three-year implementation phase, experience and empirical evidence will be gathered as to whether the dual education and training system as it was based on the first law can actually be sustainable. Although the results should be interpreted with caution due to the small number of participating companies, they nevertheless allow for an in-depth discussion based on initial findings on the costs and benefits of dual education and can help to improve the LDE in the near future.

3 Methodology and Data

In order to analyze the costs and benefits of participating in the dual education program, this study uses a simple accountancy framework based on the theoretical foundations described in the previous chapter. The data-gathering process consists of a combination of structured surveys that are conducted online and microdata of labor force surveys. This section discusses the empirical framework, followed by a description of the sample and the data-gathering process.

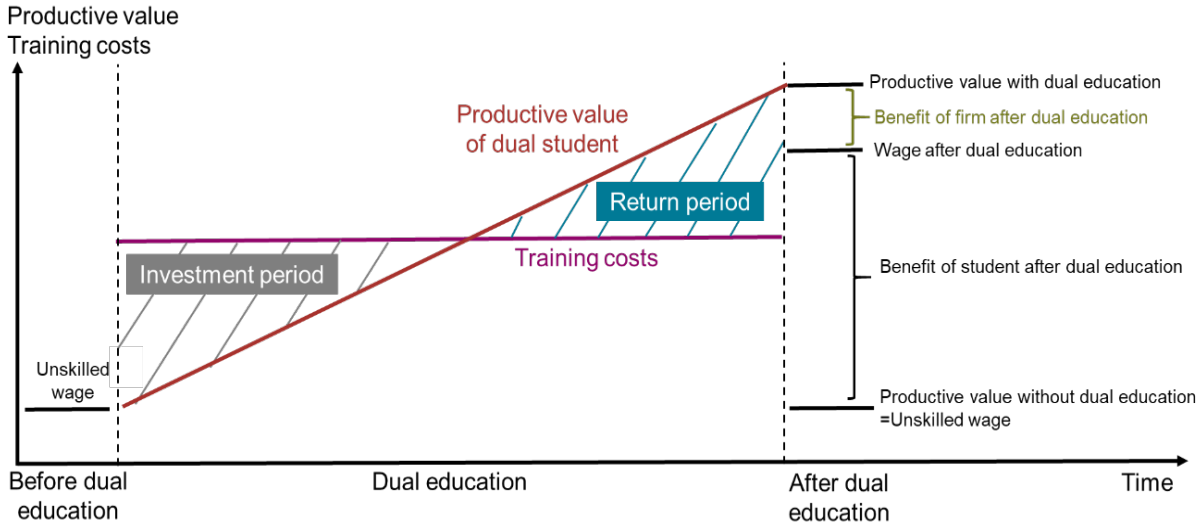
3.1 Stylized Illustration of Costs and Benefits

Before describing the accountancy framework employed in this study, the following paragraphs discuss a stylized illustration shown in Figure 1. The simplification allows us to highlight the various levers that can be used to change the costs and benefits of the dual education program, thereby preparing the ground for our later holistic policy analysis.

Productive value and training costs over time

The horizontal dimension of Figure 1 represents time, while the vertical dimension captures firms' returns to training in terms of the development of the productive value and training costs. Starting on the left shows the time before the start of the dual education program. Assuming perfect labor markets, individuals' productive value in this time is equal to wages they could earn before participating in the dual education program. We label this the unskilled wage as opposed to a skilled wage though it refers to individuals with postsecondary education. During the dual education program itself, the productive value of the student increases as they become more and more skilled at the tasks of a skilled job. After the dual education program, the student receives the post-training wage assuming they continue to work in that company. As discussed in Section **Fehler! Verweisquelle konnte nicht gefunden werden.**, this post-training wage can be equal to the individual's productive value under the assumption of perfect labor markets, but can also be lower if labor market imperfections exist.

Figure 1: Stylized illustration of costs and benefits of the dual education program



Notes: Own depiction based on Schweri et al. (2003, p. 29)

During the dual education program, wages of students are not market-based but are largely defined by the dual education program regulations. As students' wage are defined relative to the national hourly minimum wage, the figure assumes constant wages for simplicity. Hence, the pink line showing training costs, of which student wages are the most important part, remains constant.

Since the productive contribution of dual education program students is low at the beginning of the dual education program, the wages of students are often higher than their productive value. Hence, the space marked in grey space is an investment period during which training costs exceed the student's productive value. During the investment period, firms face net costs due to providing the dual education program place. At some point, when the students become more productive and are entrusted with tasks that create a higher value-added for the firm, their productive contributions should exceed the firms' costs for training and the student wage. In this period, the students create a net benefit to the firm.

If overall the net costs in the first period are lower than the net benefit in the second period, the program already creates a net benefit to the firm by the end of the program. If, however, the net costs in the first period are higher than the net benefits in the second, the program ends with a net investment on the part of the firm – an investment that has to be recouped after the program has ended if the model is to work without modification.

Potential levers to stimulate net-cost changes

This illustration also helps us consider potential levers affecting the net benefits of the dual education program. The most obvious lever is training costs; reducing student wages would increases net benefits. Furthermore, other measures that reduce training costs—such as a reduction in the administrative burden on companies—also help balance the costs and benefits of the dual education program.

Conversely, there are many opportunities to increase net benefits by increasing the productive value of students. Examples include reducing the time spent on classroom education and concentrating classroom education in the beginning of the dual education program when students are less productive. Another example is to concentrate content that provides the foundation for necessary workplace skills—for example safety procedures—at the beginning of the dual education program. A less obvious determinant of students' productive value is the social status of the dual education program. Higher social status of the dual education program means better students will self-select into the program, and better students have higher productive value from the beginning without any training investment from the firm. Furthermore, the learning curve of such students is steeper. Therefore, net benefits increase.

Another important lever is the duration of the dual education program. Increasing the duration of the dual education program increases the length of the return period, thereby increasing net benefits.

This discussion has assumed that costs and benefits need to balance out during the program itself for the dual education program to attract firms. However, if we allow for imperfect labor markets, there is a further option for firms to balance out their training costs. If students remain with the firm after the end of the program, firms can accrue additional benefits by paying wages below workers' productive value.

The illustration also clarifies the differences in the perspectives of students and firms. Concretely, students' productive value in the investment period is lower than their wages, which are the most important component of training costs. Therefore, students make a profit in the investment period. Conversely, in the return period, students' productive value exceeds their wages and students take a loss. Students are willing to make this investment because they know that the increase in human capital improves their productive value in the time after the dual education program. Put more simply, students accept lower wages in the return period in order to 'pay' for their training. Hence, the future value of the gap trained and untrained wages is the payoff for students, due to which they are willing to accept a wage below their productive value during the dual education program.

3.2 Simple Accountancy Framework

The methodology used in this study follows a simple accountancy framework (see Muehlemann and Wolter 2014) that compares costs and benefits of the dual education program from the perspective of firms as summarized in Figure 2.

Four cost categories

Costs of the dual education program can be placed in four cost categories. The first category contains the **labor and material costs of planning** the dual education program. This mainly includes developing the on-the-job training blueprint. Costs in this category arise primarily from the firm's first wave of students, even though the on-the-job blueprint may be adapted slightly to each specific position or student.

This cost category also contains costs is for **management** of the dual education program. This includes time used by personnel to select students and to conduct job interviews. Material costs of the hiring process are relatively low for students since students are matched to firms by schools. Hence, firms need to pay less for advertisements than in a system in which they compete for students in a marketplace, though some firms make substantial efforts to court potential students, for example by presenting the dual education program in schools classes and going to roadshows. These firms aim to attract the best students, which goes on to affect their returns to training. Aside from the hiring process, this cost category also entails the personnel and material costs arising from administration during the dual education program.

The second category is for **costs for classroom education**. This entails the total cost of courses provided by either companies or other providers. These costs for in-house and external courses include course fees, course organization costs, teaching materials and other course costs.

The third category is for **costs for on-the-job training**. The main component of these category is the time students' co-workers are unable to do their usual tasks. Similar to these opportunity costs of personnel, the dual education program might induce opportunity costs of capital. Concretely, training might require students to use a machine for training that could not be used for production during the time of training. Alternatively, the firm might buy equipment that is used only for training but not for the production of goods and services. In addition, on-the-job training costs include costs of training materials that are consumed during training.

Finally, costs of dual education program also contain the **labor costs of the students**. Labor costs include four components. In addition to gross wages, they entail irregular payments such as annual bonuses, overtime pay, irregular bonuses and commissions. Labor costs further include allowances such as transportation costs, meal allowances and other allowances. Since labor costs evaluate costs of labor from the perspective of firms, they further entail employer contributions for pension and disability insurance as well as health insurance contributions.

Benefits of the dual education program

Summing up planning, hiring/administration, classroom education, on-the-job training and student labor costs yields the costs of the dual education program. Net benefits during the program duration are calculated as the benefits the firm receives during the duration of the dual education program minus the costs.

The main benefit for firms stems from the **productive value** of students. This productive value arises when the student is neither attending courses nor doing exercises that produce no value. In that time, the student is working—either doing tasks that could be performed equally well by an unskilled employee

or doing tasks for which training is necessary. Comparing the activities in the beginning and end of the dual education program suggests that the share of skilled work remains relatively constant over time, while t the productivity of the skilled work clearly goes up over time.

Net benefits during and after the dual education program

Knowing the costs and benefits during the program duration allows us to calculate the net benefits of the dual education program during the program's duration. However, in order to calculate the total net benefits, we also need to take into account the benefits of the dual education program after the program's duration. These benefits arise if the student remains in the firm after the end of the dual education program. Therefore, the ratio of students a firm can expect to retain is a key element of the firm's benefits (see Blatter et al. 2016).

If a student remains in the firm, the firm saves the material and personnel costs of hiring a new employee. Similarly, students are familiar with firm specificities since they have been working in the firm for 3 to 4 years. Therefore, retaining a student further creates benefits in terms of saved adjustment costs. These adjustment costs include the initial reduced productivity of a newly hired employee, costs of any courses the newly hired employee takes, and the opportunity costs of co-workers who cannot work because they need to show and explain the workflow to the newly hired employee (disruption costs).

Figure 2: Simple Accountancy Framework

Benefits during program duration

Productive value

-Costs of dual education program

Costs for hiring the student and planning/administering the new dual education program

Costs for classroom education

Costs for on-the-job training

Labor costs of students

= Net benefits during program duration

+ Benefits after program duration

Saved hiring costs

Saved adjustment costs

= Net benefits after program duration

3.3 Limitations of the Methodology

The applied methodology has three limitations. The first limitation arises because the data stems from a survey of firms rather than access to detailed accounting data. As with all surveys, the reliability of the data depends largely on the sample size. Survey data is prone to measurement errors and might not to capture all cost categories in the necessary level of detail. However, it should be noted that no

accounting scheme shave been created to measure the costs and benefits of the dual education program at this point, so any measurement of the dual education program's costs and benefits has to rely to a certain extend on qualitative survey data.

The second limitation arises because the study focuses only on the costs and benefits of the dual education program for firms. Hence, the study fails to capture returns to individuals and furthermore does not account for the costs of teaching and administration at Polytechnics or administrative costs for the government. Additionally, wider individual, institutional and social benefits are not covered.

The third limitation of the study is its focus on the short-run effects of the dual education program for individual employers only. In the long run, the dual education program might increase the overall supply of skilled employees for the labor market, thereby alleviating negative effects arising from skill shortage. This type of general equilibrium effect is particularly important in a small country such as Serbia that relies substantially on human capital for economic growth (Quah and Toh, 2012). Hence, it is important to note that firms that train students might create positive external effects for other firms. If the participating firms encounter net costs for training, this could lead to an underinvestment in training from a societal point of view (Quah and Toh, 2012). Hence, subsidies might be necessary to prevent underinvestment. However, analyzing these externalities remains beyond the scope of this project, which focuses on the private costs and returns to firms in the short run.

3.4 Data

The data used in the project can be separated into two components. The first component is an extended survey among firms that have participated in the dual education program. The second component consists of wages from microdata of labor force surveys.

Quantitative survey

The survey contains the detailed questions necessary to calculate the dual education program's costs and benefits based on the accounting framework discussed in detail below. Furthermore, the survey concludes with a few general firm characteristics such as firm size.

In order to ease filling out the survey, the questions refer to different periods, for example to hours per week or to total hours per year. Hence, the study needs to make additional assumptions regarding the average working days per month and average paid working hours per week. Concretely, we assume that employees are entitled to 11 public holidays (Official Gazette of the Republic of Serbia", Nos. 43/2001, 101/2007 and 92/2011) and have the annual leave entitlement of at least 20 days per year (Labor Law, Article 69). Furthermore, we assume that normal working hours of employees is 40 hours each week (Labor Law, Art 50) divided across 5 working days, the most common working arrangement in 2016 (Ministry of Manpower, 2016b).

Sample, trimming, and imputation

The online survey was sent to about 400 training firms, which represent approximately all firms who had started to train students between 2013 and 2019. This restriction ensures that participating firms are able to respond to the survey, which was sent out in the mid of May 2020. The first email invitation was followed by an email reminder after two weeks. Importantly, the Chamber of Commerce and Industry Serbia (CCIS) phoned firms during the second half of June 2020 to convince them to participate in the survey.

This procedure led to about 30 firms responding to the whole survey. The sample mainly consists of firms operating in the manufacturing sector, which almost equally represent small and medium sized

firms (<250 employees) and large firms (250+). Among those companies, the most diffused occupations are locksmith-welder, industrial mechanic, fashion tailor, and operator of mechanical processing. The vast majority of the occupations represented in the sample yield to a qualification at NQF level 4. However, these observations further have missing values in some questions. In order to correct for statistical outliers, we replaced in all variables the lowest/highest values as well as the second-lowest/highest values with the third-lowest/highest value. Given the small sample, we choose to impute missing values using the median of the dual education program sector. For the subsample analysis of small and medium sized firms and large firms, we use subsample-specific median values instead. **Fehler! Verweisquelle konnte nicht gefunden werden.** in the Appendix reports the summary statistics of the variables used in the cost-benefit calculation.

Wage Information

Information about wages plays an important role in the estimation of both costs and benefits, because wages are used as proxies for productivity and for the calculation the value of time. Therefore, we combined our survey data with data form the Serbian Labor Force Survey (LFS). This approach has been also applied in simulations studies on the training program cost-benefit where collection of data was not possible (see, e.g., Wolter & Muehlemann, 2015; Muehleman et al., 2018).

Concretely, we pooled the LFS data from 2014 to 2018 and calculate median wages for different group of workers and then use these values in our calculations. Specifically, we used median wages of ISCO-class Elementary Occupations for unskilled employees, median wages of Human Resource Managers for HR employees, and median wages of Manufacturing Managers for skilled employees in the manufacturing sector, while median wages of Supply, Distribution and Related Managers for skilled employees in the service sector. We regarding occupation-specific median gross wages of skilled workers, we map the VET occupation into ISCO 08 codes as described by **Fehler! Verweisquelle konnte nicht gefunden werden.** in the Appendix.

To get reliable values on students' wages, we rely on the regulation which determines that firms have to pay students at least 70% of minimum hourly wage. In our calculations, we apply the 70% to the national minimum hourly wage of 2020, which account 172.54 RSD. On top of that, we add contributions for pension and disability insurance and health insurance contributions which account for 4% and 2% respectively of students' wage, respectively. To get monthly gross wages, we multiply the students' gross hourly wage with the number of hours students spend per month in the firm.

4 Costs and Benefits of the Program

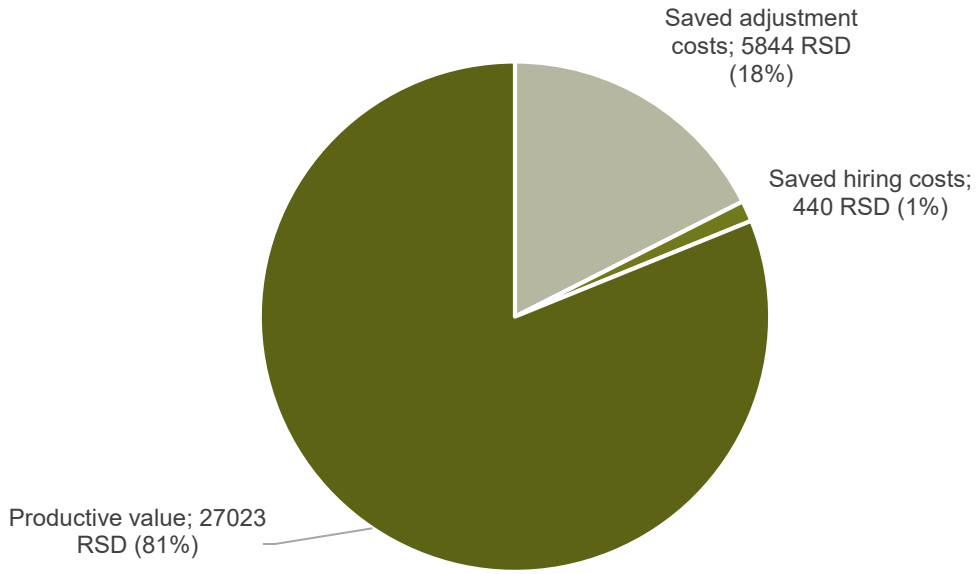
This section presents the empirical results on how much participating in the dual education program costs and benefits firms.

4.1 Benefits of the Dual Education Program

The first step towards understanding net benefits of the dual education program is to analyze the benefits of training. As mentioned above, benefits from training might arise during the program, but also after the end of the program. During the program, students provide productive value by performing either un-/semi-skilled or skilled work. After the program, they provide benefits in the form of saved hiring costs or saved adjustment costs or after the end of the program. Indeed, if students stay in the firm after the end of the program, firms can potentially save hiring costs because no new employee needs to be hired. Similarly, newly hired employee create adjustment costs that can be saved if the students stay in the firm. Adjustment costs arise for instance new employees have a lower productivity because they have to adjust to the firm-specific processes and products. They might also create expenses by taking courses. Finally, new employees create opportunity costs of co-workers who cannot work because they need to show and explain the workflow to the newly hired employee.

Figure 3 shows the yearly benefits of the dual education program for each of these categories. In total, the benefit is about 33,000 RSD per year. Of these, 81% reflects the productive value the student generates, 18% reflects the saved adjustment costs, while the saved hiring costs represent merely 1%.

Figure 3: Benefits by category



Notes: N~30. The figure shows the median yearly benefit per student in RSD.

With regard to the productive value—which is the major benefit component—the calculation has four components, namely the time students spend in firms, the share of time students use for different activities, the wage of employees with corresponding skill level, and the lower productivity of students relative to skilled employees.

The results regarding the time that students spend in the firms show that the median number of weeks per year increases from about 13 in the first year to 30 in the second and third year of the program. Also the number of hours per week that students spend in firms increases over time. The median number of hours increases from 8 in the first year, to 12 and 18 hours per week in the second and third year, respectively. The results regarding the time use of students show that the median practicing time at the workplace without producing valuable products or services is about 55%. This share decreases from 60% in the first year, to 55% in the second year, to about 50% in the third year. On average, students spend 27% of their time performing un-/semi-skilled work. Un-/semi-skilled work consists of activities that can be performed without dual education program training. This share increases over the course of the dual education program. After 15% in the first year, it increases to 25% in the second year and up to 40% in the third year. Lastly, the share of skilled work remain constant over the first and second year to about 10% of the time, while slightly increase to 15% in the third year. Hence, students spend more than half of their time in the firm unproductively and use only a small amount of time for skilled work.

When the student performs un-/semi-skilled work, the framework assumes that their productive value equals the labor costs of an unskilled employee, or 43,000 RSD per month. Similarly, the labor costs of skilled employees in the dual education program occupation serve as approximation of the productive value of time during which the student performs skilled work. These average labor costs of 57,000 RSD per month are substantially higher than those of un-/semi-skilled employees.

The calculation of productive value during the time the student performs skilled work further needs to account for the reduced productivity of students compared to a skilled employee. During the first year of the dual education program, students can complete 10% of the work that an average skilled employee perform in a given time. In the second year of the program, students complete about 30% of the work compared to a skilled employees, while in the third year this share increases to 50%. Overall, this relative productivity appears small, and can probably be explained by the considerably small time that students spend in companies.

Still, the value of goods and services produced by students increases over time, because they spend a larger share of time productively, increase the share of skilled work and become more productive. This shows empirically that increasing the intensity of the dual education program—in term of time spend in the firm—can increase net benefits of the dual education program.

After-training benefits, which occurs after the end of the program, are relatively small compared to the productive value. This is mainly due to the fact that retention rate is pretty low (10%), and therefore almost no post-training benefits occur. Still, saved adjustment costs make up 18% or about 5,800 RSD of each year's total benefits. Saved hiring costs amount to merely 1% or 440 RSD per year.

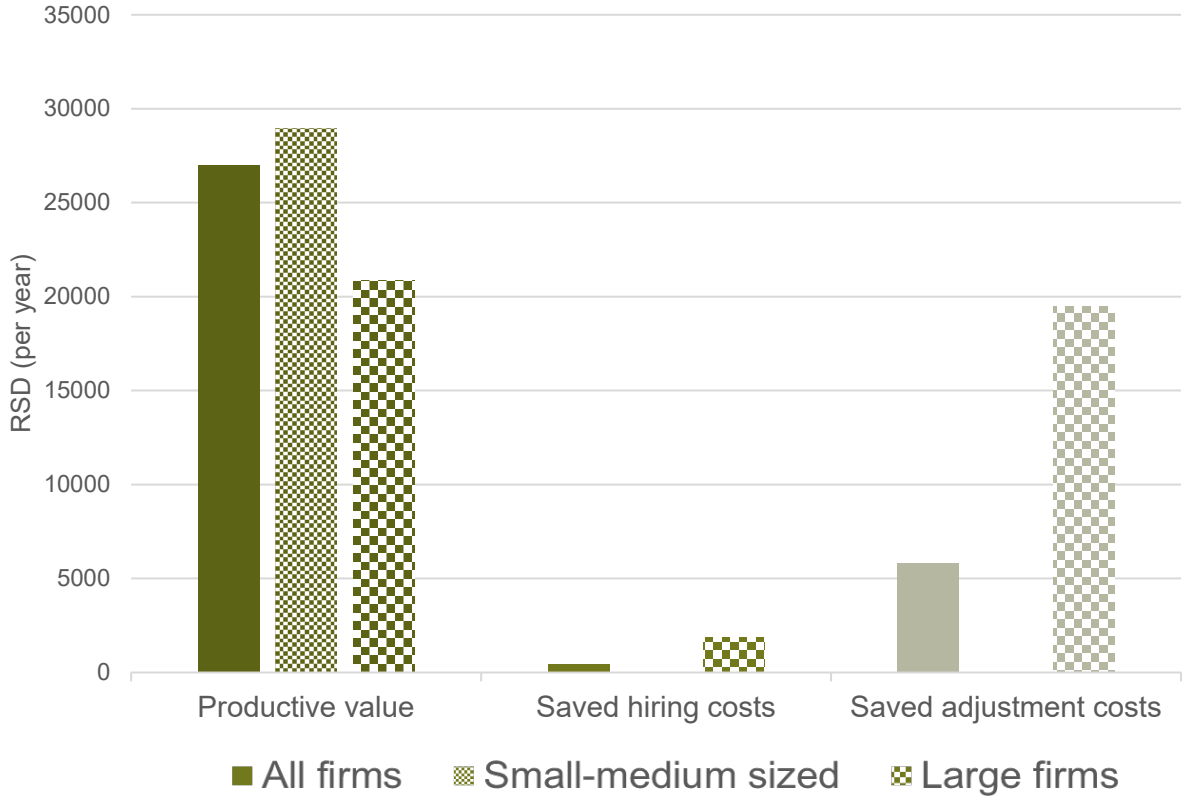
Heterogeneity of benefits

Figure 4 displays the heterogeneity of yearly dual education program benefits across firm size. We also report for reference reason the same sample average as in Figure 3. The results suggest that benefits in terms of productive value are larger in small and medium-sized firms. This results is mainly driven by the fact that students in small and medium-sized firms spend more time in conducting productive work, while students in large firms mainly spend time in doing unproductive practicing. Concretely, in small and medium-sized firms the percentage of un-/semi-skilled work is constant at about 20% over the three years, while the percentage of skilled work increases from 18.5% in the first year to about 40% in the third year. In contrast, in large firms the first year is only devoted to practicing. The percentage of un-

/semi-skilled work account to 10% in both the second and third year, while skilled work increase to about 15% in the second year and 30% in the third year.

As Figure 4 further suggests, large companies have larger saved hiring costs, and especially, larger saved adjustments costs. This is essentially due to the fact that the retention rate—the share of students remaining in the companies after the end of the program—is large, about 33%. In contrast, the median small or medium-sized firms have a retention rate of 0%—the majority of them retain no students after the end of the program—and therefore saved hiring and adjustment costs for these companies are also zero.

Figure 4: Benefits categories, by firm size



Notes: N~30. The figure shows the median yearly benefit per student in RSD.

4.2 Costs of the Dual Education Program

The second step towards understanding net benefits of the dual education program is to analyze expenditures and costs firms incur in the course of the dual education program. The median firm has costs of about 80,000 RSD per student per year. Figure 5 displays how this breaks down into cost categories. On-the-job training costs is the most important cost category, accounting for 36,000 RSD or 45% of total costs per student per year.

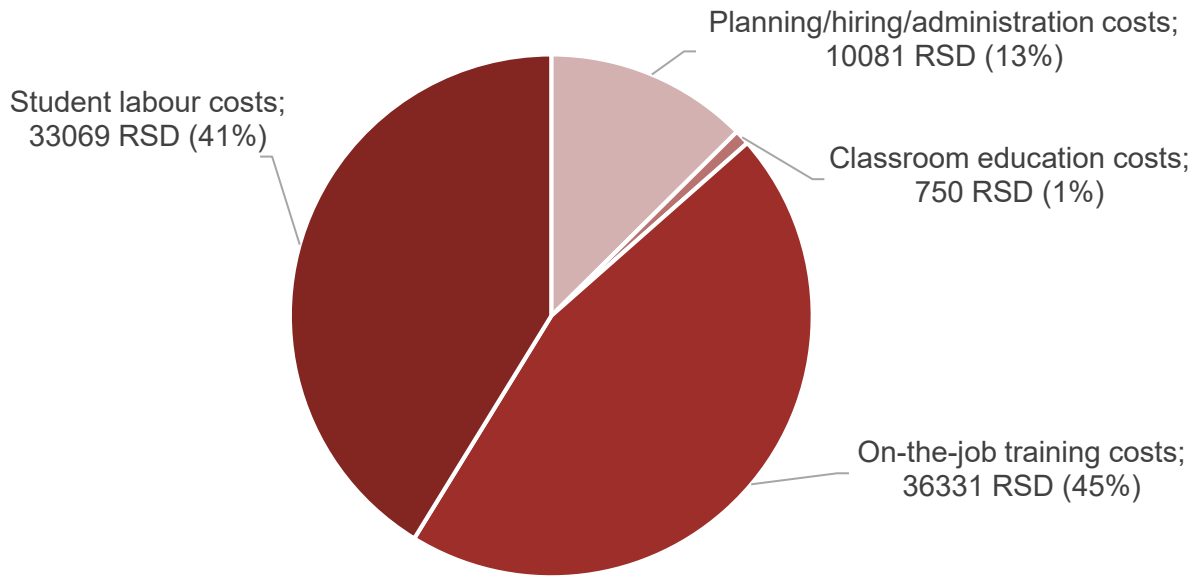
This cost category includes some costs for buying training equipment, for consuming training materials and for opportunity costs of using equipment as training equipment rather than for production. However, the brunt of on-the-job training costs arises because mentors, supervisors and co-workers have to invest time into training the student. The results regarding the time that supervisor spent with a student show that the median number of hours per week increases from about 1.5 in the first year to 2.5 in the second and 3.5 in the third year of the program. The number of hours per week that other skilled employees

spend with a student also increases over the program. The median number of hours increases from 0 in the first year, to 1.5 and 2 hours per week in the second and third year, respectively.

Another yearly 33,000 RSD or 41% of the costs stem from labor costs of students. Students' wage represent the main part of these costs. Besides that, also allowances constitute a significant cost factor. In contrast, irregular payment are small and almost irrelevant in the total student labor costs. Costs for hiring students and for administering the dual education program make up 13% or about 10,000 RSD of each year's total cost. This category contains some material costs but mainly arises from personnel time devoted to the smooth functioning of the dual education program. Concretely, HR employee, supervisor and another skilled employee spend about 2 days each fort planning the dual education, hiring a student, and administering the dual education during program.

Finally, classroom education costs amount to merely 1% or 750 RSD per year.

Figure 5: Costs by category



Notes: N~30. The figure shows the median yearly costs per student in RSD.

Heterogeneity of costs

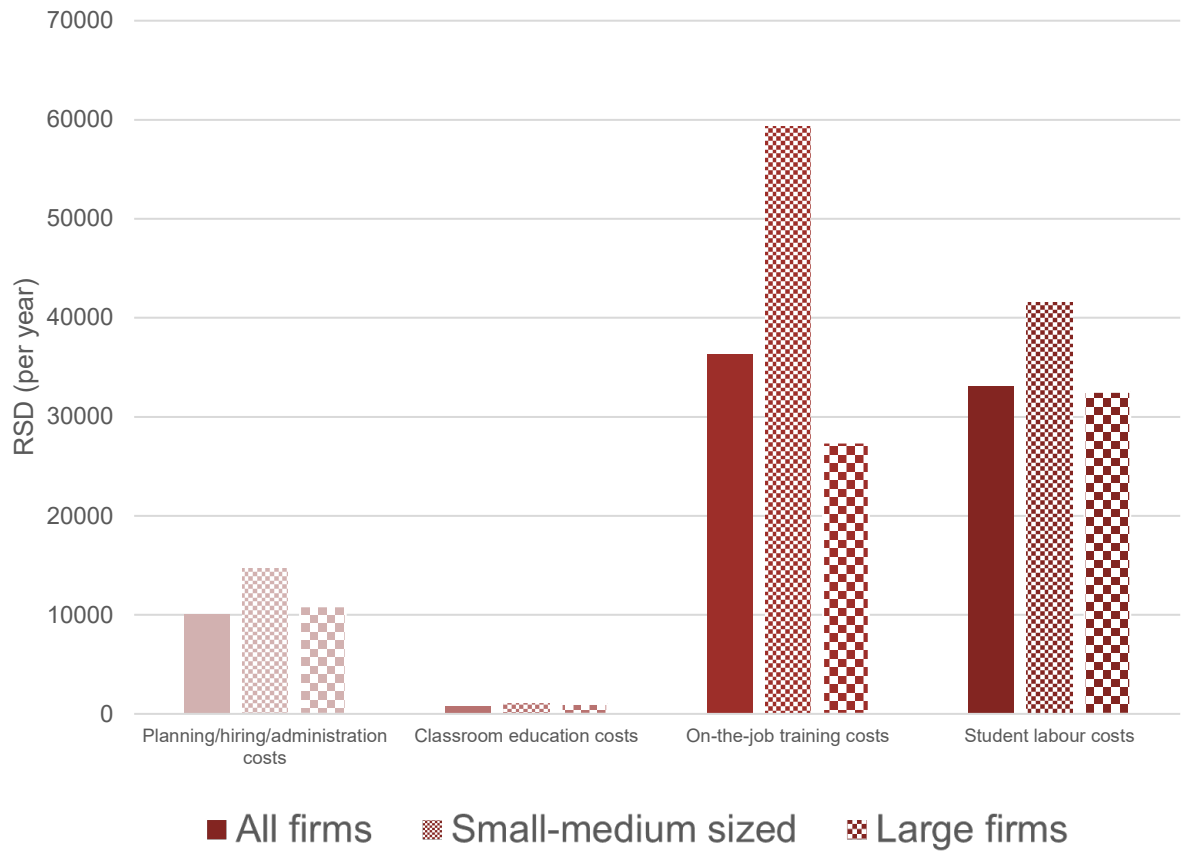
Figure 6 displays the heterogeneity of yearly dual education program costs across firm size. We also report for reference reason the same sample average as in Figure 4. The results suggest that costs are larger in small and medium-sized firms. This finding holds for all four cost categories.

Specifically, in terms of planning, hiring and administration costs, the median costs for small and medium-sized firms are about 40% higher than in large firms. This results is mainly driven by the fact that in small and medium-sized firms the employee involved in this process need more time that in large firms. Concretely, in small- and medium-sized firms the supervisor devotes 5 days in total for this activates, while HR employee and other skilled employee about 2 days each. In contrast, in large firms the supervisor devotes 3 days in total for these activities, while HR employee and skilled employee 2.5 and one day, respectively. This might be due to the fact that large firms profit from economies of scale arising from multiple apprentices. The difference in costs for material need for these processes is negligible.

As Figure 6 further shows, differences in the classroom education costs are minimal and affect total costs only marginally. In contrast, differences in on-the-job training cost are larger. Concretely, on-the-job training costs are higher in small and medium-sized firms mainly due to the fact that the number of hours that supervisors and skilled employees spend with students are larger in these firms.

Finally, student labor costs are also higher in small and medium-sized companies. This is essentially due to larger allowances paid to students by small and medium-sized firms as well as to the settlement of some irregular payment.

Figure 6: Cost categories, by firm size

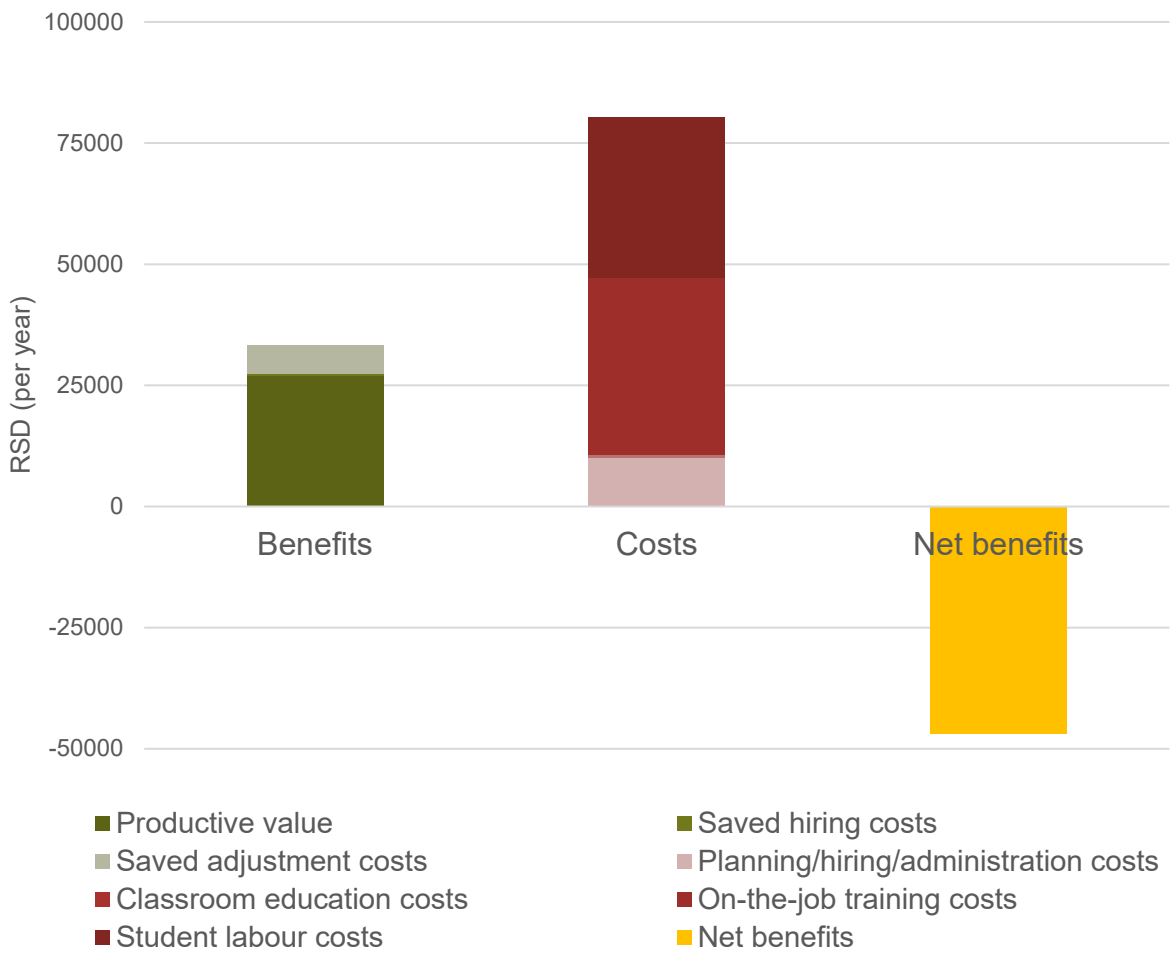


Notes: N~30. The figure shows the median yearly costs per student in RSD.

4.3 Net Benefits of the Dual Education Program

This section combines the information about costs and benefits. Figure 9 shows that the median firm receives benefits of 33,000 RSD and faces costs of 80,000 RSD per year. The median firm thus has negative net benefits of 47,000 RSD per year per student. Hence, firms mostly have an investment-oriented approach, meaning that they participate in the dual education program in order to profit from the investment into human capital at a later stage.

Figure 7: Net benefits of the dual education program



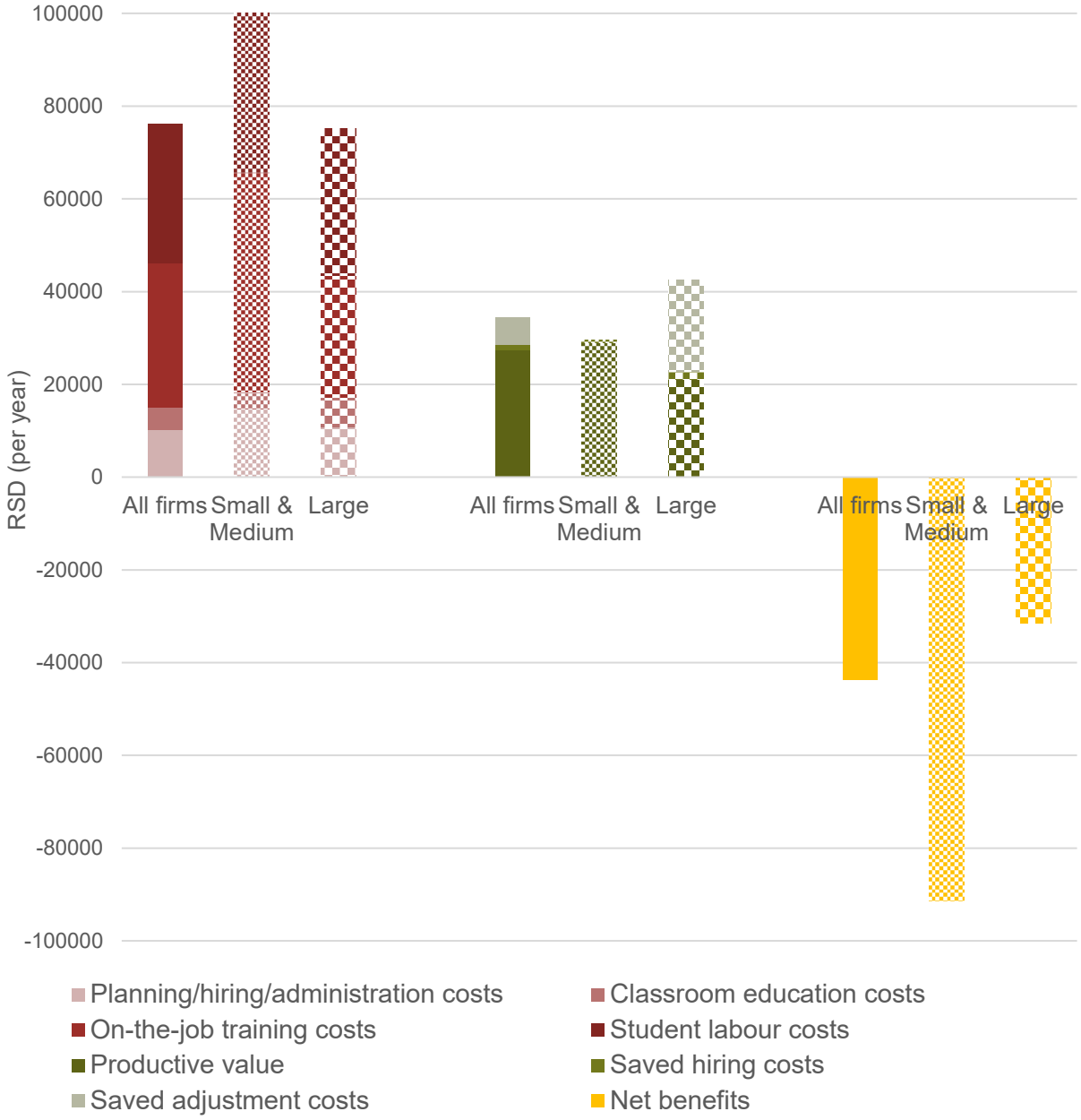
Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places.

The figure shows for example that benefits amount to about 33,000 RSD per year of which productive value is the most important component. Yearly costs of about 80,000 RSD yield net costs of about 47,000 RSD per year.

Heterogeneity of net benefits

Figure 8 displays the heterogeneity of yearly dual education program net benefit across firm size. As previously noted, small- and medium-sized firms have higher costs, mainly due to the fact that in these companies on-the-job training costs are higher than in large firms. Furthermore, small- and medium-sized companies have also smaller benefits, essentially because retention rate in these companies is extremely low, and therefore post-training benefits are inexistent. Bringing these two components together yield to negative net benefits, which are much higher for small- and medium-sized firms. Specifically, the net benefit for a small or medium sized firm are negative and reach approximately 91,000 RSD per year. Large firms also experience negative net benefits, which for the median firm are valued at 32,000 RSD per year. These negative net benefits are, however, much lower than they are for small-and medium-sized firms, suggesting thus that investing in human capital is economically more interesting for large firms than for small- and medium-sized firms.

Figure 8: Net benefits of the dual education program, by firm size



Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places.

The figure shows for example that costs amount to about 100,000 RSD per year form small- and medium-sized firms, while about 75,000 RSD per year in large firms. Benefits amount to about 29,000 RSD per year in small- and medium-sized firms, while about 41,000 RSD per year in large firms of which productive value is the most important component. Yearly net costs are about 91,000 RSD per year in small- and medium-sized firms, while about 32,000 RSD per year in large firms.

5 Sensitivity Analysis

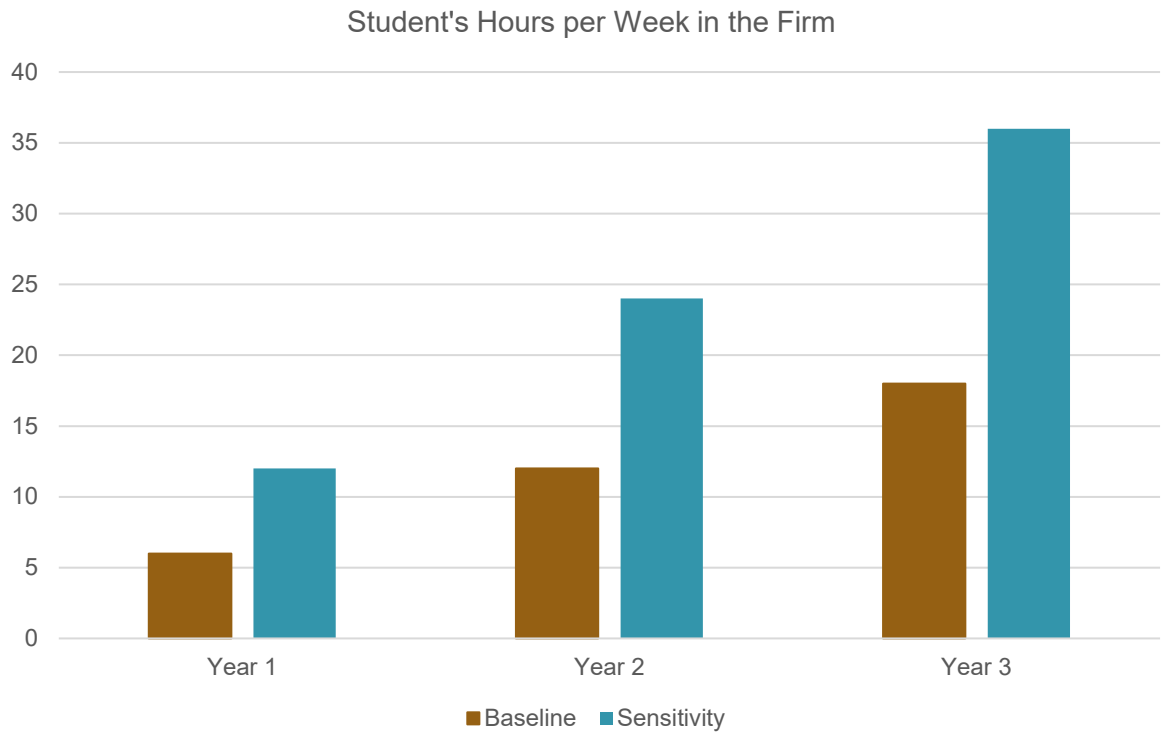
This section provides some sensitivity analyses of the results previously presented. Thereby, we show how the net benefits change when we allow some relevant parameters to change. Concretely, the sensitivity analyses provide information about how net benefits change if 1) students spend more time in the firm, if 2) the students spend less time practicing and more time with productive work and if 3) if the retention rate of students after the program increases.

It is important to note that the results of these analyses assume that, when changing certain parameters, all other cost or benefit parameters remain the same. It is therefore a *ceteris paribus* analysis. The implications of this assumption should not be taken for granted and the results should therefore be interpreted with caution.

Increase students' time in firms

The first sensitivity analysis varies the amount of time students spend in firms. Figure 9 reports the median number of hours a student spends in firm during a week in which students are in the firm. The result show that during the first year, they spend six hours per week in the firm. This value increases to 12 and 18 hours per week during which students are in the firm.

Figure 9: Student's hours per week in the firm, by training year



Notes: N~30. The figure shows the median number of hour a student spends in firm during a week in which the student is in the firm (baseline) and the hours per week in case of doubling the time in the firm (sensitivity).

The figure shows that hours per week in the firm increase from 6 hours in the first training year to 18 hours in the third year.

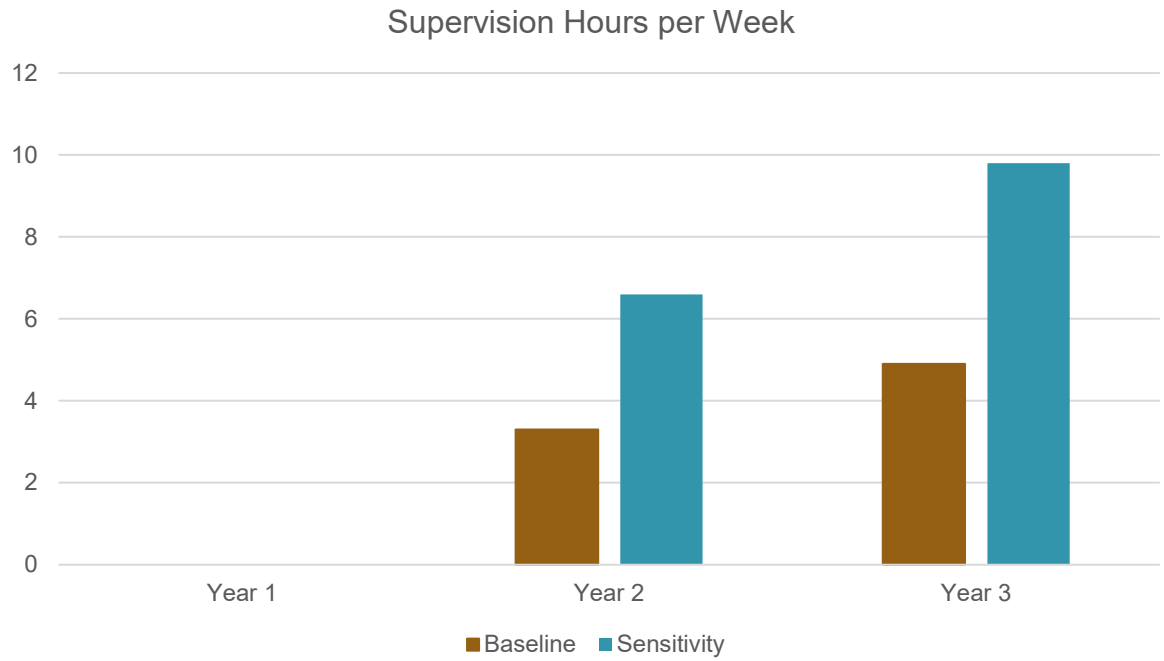
We could therefore investigate how the cost-benefit ratio would change in case of an increase in the time students spend in the firm. Assume for instance that the hours students spend in firms double in every training year. This would suggest that students spend 12, 24 and 36 hours per week in the firm. Alternatively, the amount of time students spend in the firm can also be increased by raising the number of weeks the students spend in the firm each year.

It is important to note that increasing the amount of time students spend in the company affects the net benefit calculation in several ways. First, it increases the productive value because students spend more time in the firm. Second, the student labor cost increase because students are paid on an hourly rather than on a monthly or a yearly basis.

Furthermore, in order to make the sensitivity analysis reasonable, we have to account for the fact that an increase in the amount of time students spend in the firm also increases the supervision time. Since the intensity of supervision decreases as the students become more adept, we assume that supervision time increases by 50%. Hence, supervision hours increase relatively less than the number of hours students spend in the firm, which increase by 100%.

Figure 9 reports the median number of hours per week that supervisors and other skilled employees spend training a student in each of the three years. The results show that in the first year, supervisors and skilled employers lose no time due to training students. This might be due to the fact that students spend most of their time practicing or doing un-/semi-skilled tasks. The number of hours per week increases to 3.3 and 4.9 in the second and third year, respectively. These values are relatively low compared to other dual VET programs (Moretti et al., 2017). In the sensitivity analysis, we assume an increase of weekly training hours to 0, 4.9 and 7.5 in the first, second, and third year, respectively.

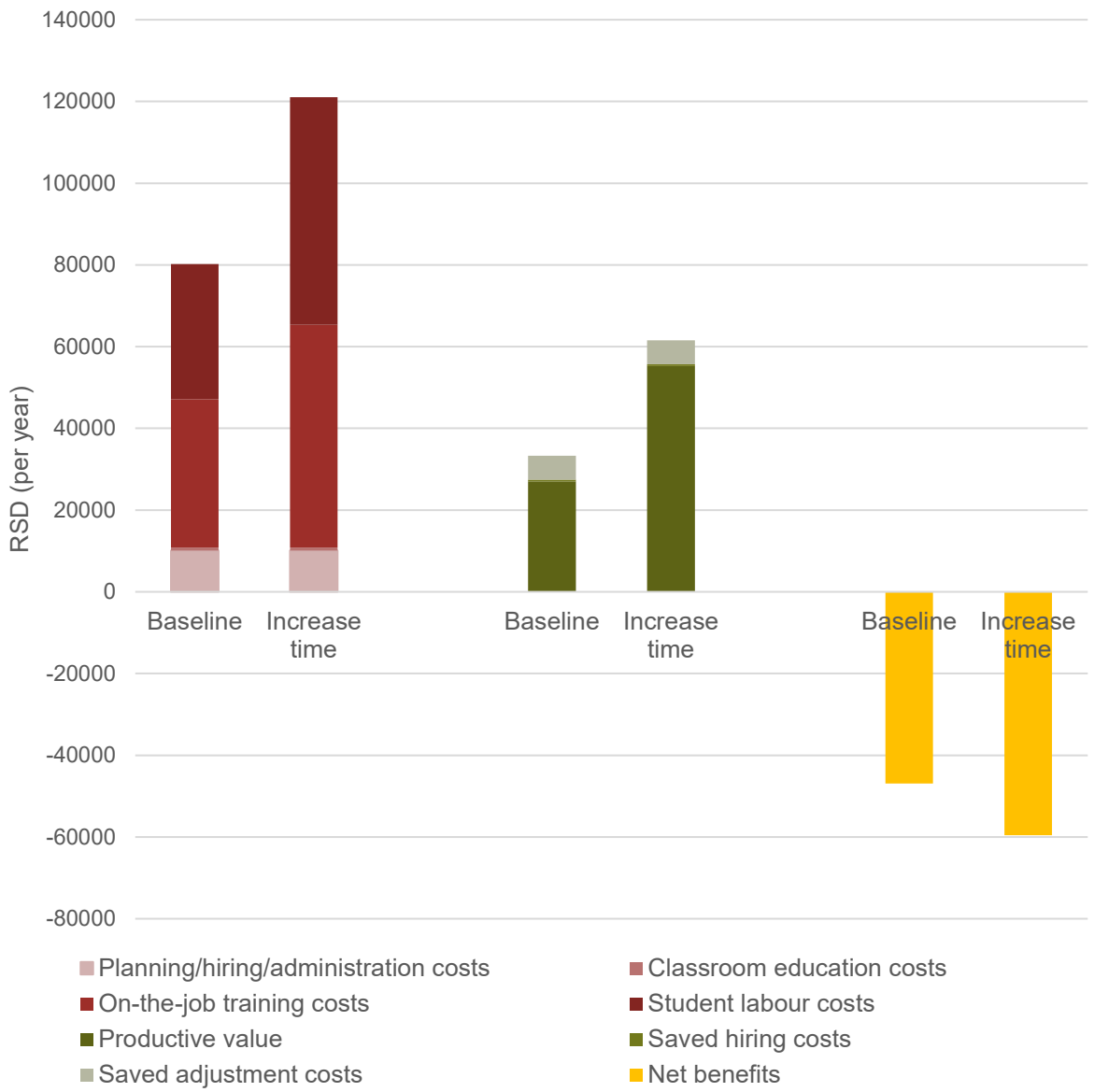
Figure 10: Supervision time per week, by training year



Notes: N~30. The figure shows the median number of hour that supervisor and other skilled employees spend with a student during a week in which student is in the firm (baseline) and the hours per week in case of a 50% increase the supervision time (sensitivity). The figure shows that supervision time increase from 0 hours per week in the first training year to 7.5 hours per week in the third year.

Figure 11 compares the costs, benefits and net benefits of the sensitivity analysis with the baseline results presented in the previous section. Compared to the baseline results, costs are clearly higher. This is due to two reasons. First, doubling students' time in firm increases student labour costs. Second, it increases the supervision time and therefore on-the-job training costs. However, increasing the hours students spend in the firm also increases the productive value and thus the benefits for firms. Nevertheless, the increase in costs (from about 80,000 RSD per year to about 120,000 RSD per year) is larger than the increase in benefits arising from the productive value (from about 35,000 RSD per year to about 60,000 RSD per year), and thus the negative net benefits are larger. In other words, the program would be even less attractive for firms from a monetary point of view.

Figure 11: Sensitivity analysis – increase students' time in firms



Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places. For each component, the first bar reports the values of the baseline estimation, while the second ones the values of the sensitivity analysis.

The figure shows that by increasing students' time in firms costs increase from 80,000 RSD to 120,000 RSD per year. Benefits increase from about 33,000 RSD to about 60,000 RSD per year. The net costs increases from about 47,000 RSD to about 60,000 RSD per year.

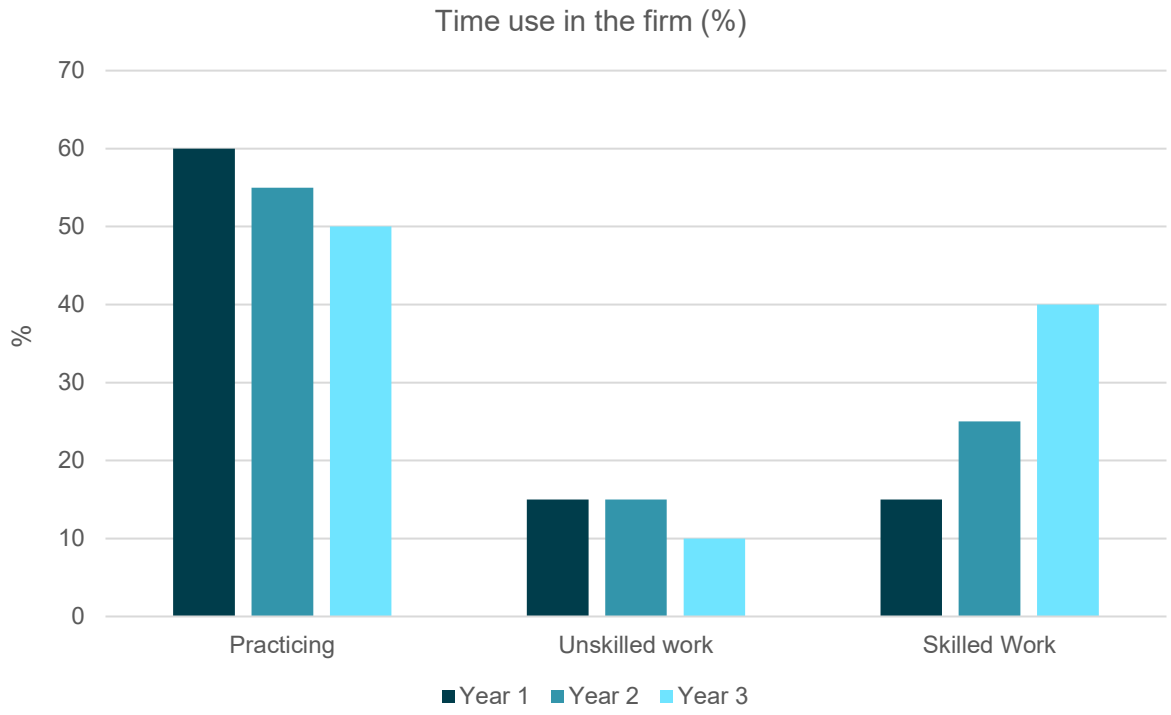
Increase the percentage of productive work

The sensitivity analysis regarding the amount of time students spend in the firm assumes that the time use of students remains unaffected. However, it appears possible that increasing students' time in the firm also changes the percentage of time students spend practicing, doing un-/semi-skilled tasks and doing skilled tasks. Therefore, this sensitivity analysis starts by analyzing how the cost-benefit ratio would change in case of a shift from practicing to un-/semi-skilled work and skilled work. Concretely, we assume that in each year the percentage of time devoted to practicing can be reduced by 20%, and instead the percentage of time doing un- /semi-skilled work and skilled work increase by 10% each.

Figure 12 reports for every training year the percentage of time that students use for practicing, conducting un-/semi-skilled work, or conducting skilled work. This figure shows that students, when they are in the firm, mainly pursue practicing activates which have no productive value for the firm. This percentage decreases slightly from 60% in the first year to 50% in the third year. However, the share of practicing remains high. Therefore, the time devoted to un-/semi-skilled or skilled work remains relatively low. The median value for the percentage of time spent in conducting un-/semi-skilled work remains almost constant around 10% over the three years. The percentage of skilled work starts at 15% and increases to about 25% and 40% in the second and third year, respectively.

Therefore, the sensitivity analysis assumes that practicing amounts to about 40%, 35% and 50% in the three training years, respectively. The percentage of unskilled work is about 20%. The skilled work percentage increases from 25% to 35% and 50% in the sensitivity analysis.

Figure 12: Percentage of time students use to do different tasks, by training year

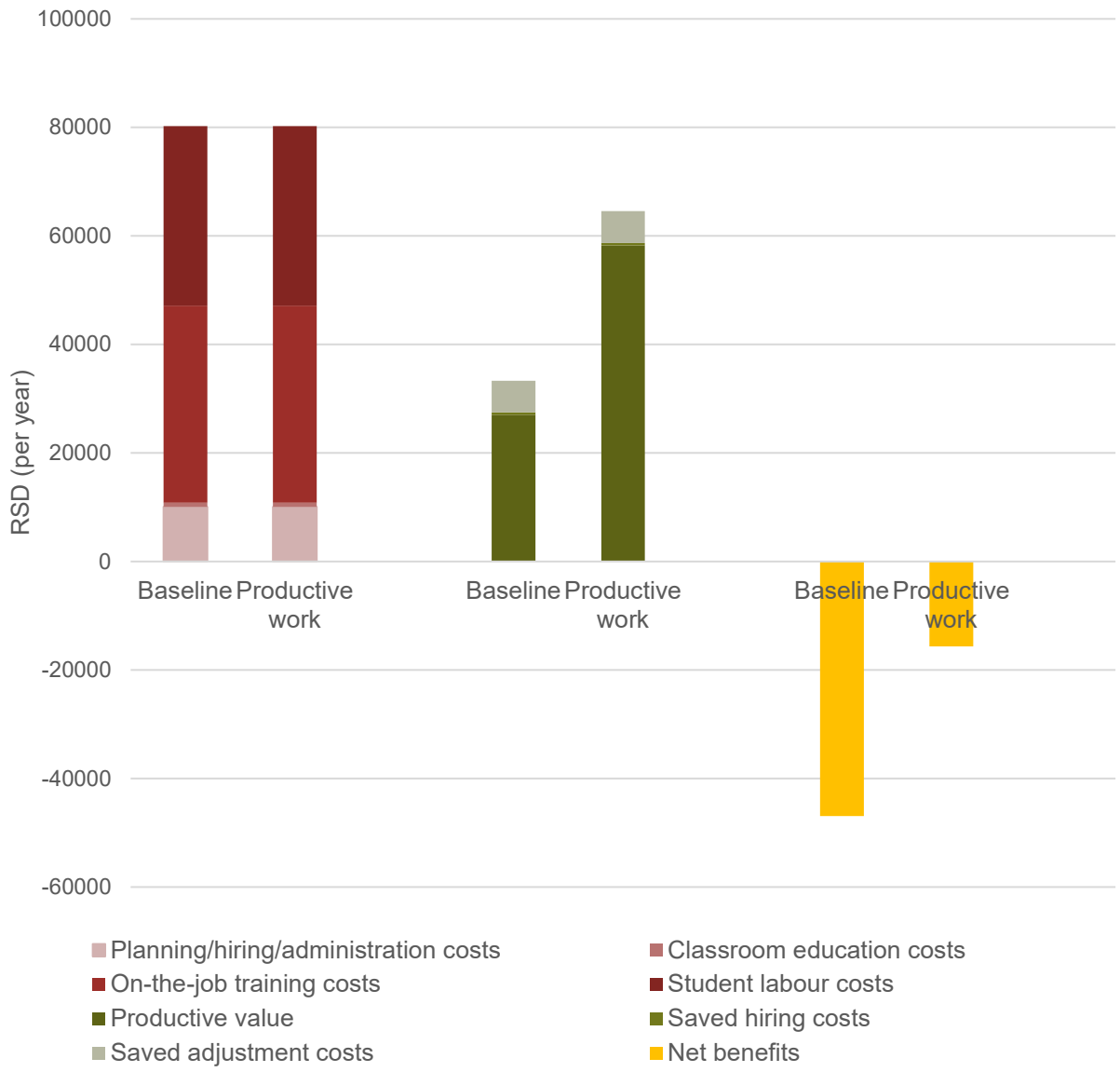


Notes: N~30. The figure shows for every training year the median percentage of time that students use for practicing, conducting un-/semi-skilled work, or conducting skilled work.

The figure shows that students, when they are in the firm, mainly pursue practicing activates. The time spent in practicing decreases from 60% in the first year to 50% in the third year. The time devoted to un-/semi-skilled remains almost constant around 10% over the three years. The percentage of skilled work increases form 15% to about 40% in the third year.

Figure 13 shows the costs, benefits and net benefits resulting from this second sensitivity analysis and compares them to the baseline. By shifting some time from practicing to un-/semi-skilled work and skilled work, the costs remains basically unaffected. In contrast, the total benefits increase due to the fact that the productive value increases. Nevertheless, the increase in benefits (from about 33,000 RSD per year to about 65,000 RSD per year) is not enough to fully balance the total costs of about 80,000 RSD per year. Thus, if the percentage of time devoted to practicing is reduced to 20%, and meanwhile the percentage of time for un-/semi-skilled work and skilled work increase each by 10%, the program would still on average generate net costs. However, the net costs become relatively small, amounting to about 16,000 RSD per year.

Figure 13: Sensitivity analysis – increase the percentage of productive work



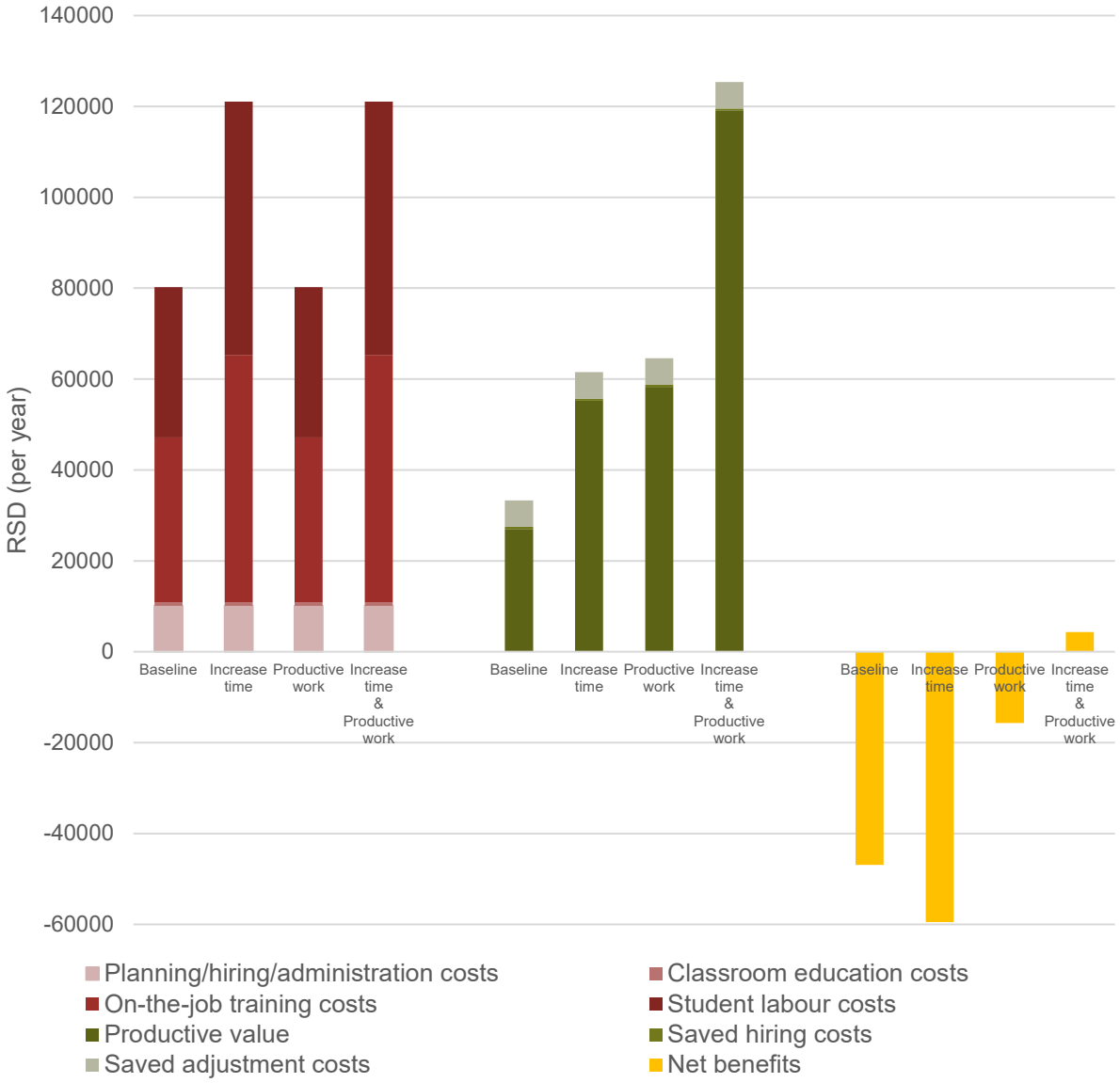
Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places. For each component, the first bar reports the values of the baseline estimation, while the second ones the values of the sensitivity analysis.

The figure shows that by increasing the percentage of productive work firms' costs remain constant, while benefits increase from about 33,000 RSD to about 65,000 RSD per year. The net costs decreases from about 47,000 RSD to about 16,000 RSD per year.

Increase students' time in firms and the percentage of productive work

How would net benefits change if we increase the time students spend in firms and, at the same time, increase also the percentage of productive work they conduct? To answer this question, we combine the two sensitivity analysis previously described. Specifically, we investigate the effect of doubling the time students spends in firms and increasing the supervision time by 50% combined with a 20% reduction in the time students practice and an increase of 10% for both un-/semi-skilled work and skilled work. Also for this third sensitivity analysis we make the strong assumption that by changing those parameters the rest remain unchanged.

Figure 14: Sensitivity analysis – increase both students' time in firms and their productive value



Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places. For each component, the first bar reports the values of the baseline estimation, while the following ones the values of the sensitivity analyses.

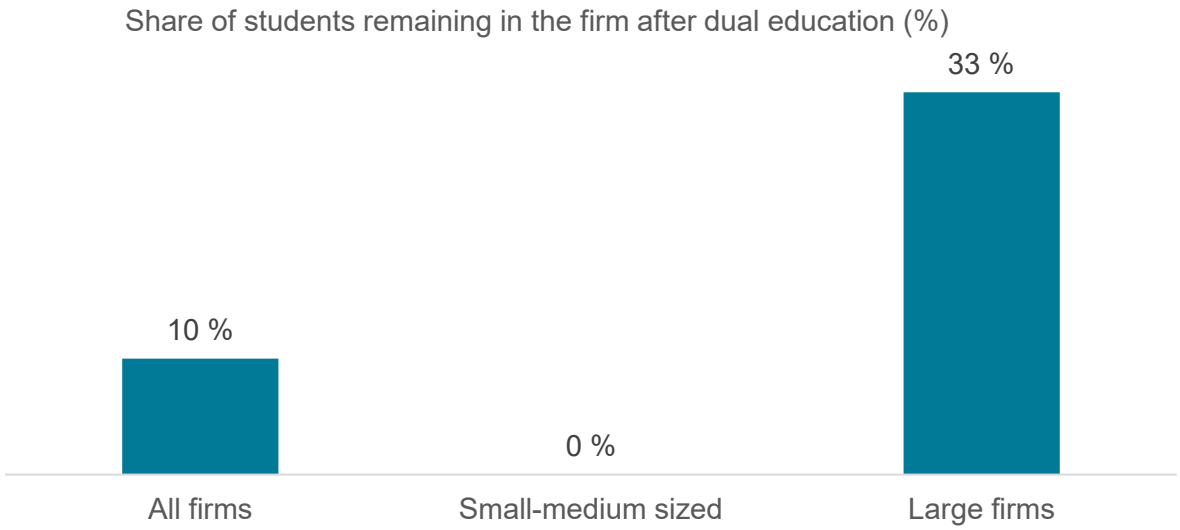
The figure shows that by increasing students' time and increasing the percentage of productive work firms' costs increase from 80,000 RSD to 120,000 RSD per year. Benefits increase from about 33,000 RSD to about 125,000 RSD per year. The net benefits increases from about -47,000 RSD to about 5,000 RSD per year.

Figure 14 presents the costs, the benefits, and the net benefits of this combined sensitivity analysis. For each component, the first bar reports the results of the baseline cost-benefit estimations. The second and third bars report the results for the previous two sensitivity analysis, namely increasing the time student spend in the firms or changing the percentage across the different activities. Finally, the fourth bar reports the results of the combined effect. Starting by looking at the costs, we can observe that the fourth bar reports costs similar than in the second bar. This is due to the fact that increasing students' time in the firms generates higher costs, while changing the percentage of activities does not affect costs. In contrast, both variations increases benefits, as also reported by the second and third bars. What is remarkable, however, is that by changing both parameters at the same time, the additional benefits are greater than the sum of the two separate changes. Indeed, by increasing students' time in firms and changing the percentage across the different activities a cross-effect arises. Students spend more time in the firms and this time is devoted to productive activities. The resulting total benefits exceed the total costs, and thus imply on average small but positive net benefits.

Increase retention rate

So far we focused on parameters affecting costs and benefits of the work-based learning during the program duration. We now investigate how the cost-benefit ratio would change if after-training benefits would change. In this regard, one key parameter is the retention rate, i.e. the percentage of students remaining in the firms after the end of the program. As reported by Figure 15, the median retention rate in the sample is 10%. This relatively low retention rate, strongly differ across firm size. For instance, in small- and medium-sized firms the median retention rate is by 0%, meaning that more than 50% of these firms do not retain apprentices after the end of the program. In contrast, the median retention rate by large firms is about 33%. We could for instance investigate how the net benefits would change in case of an increase in the median retention rate from 10% to 75%.

Figure 15: Retention rate, by firm size



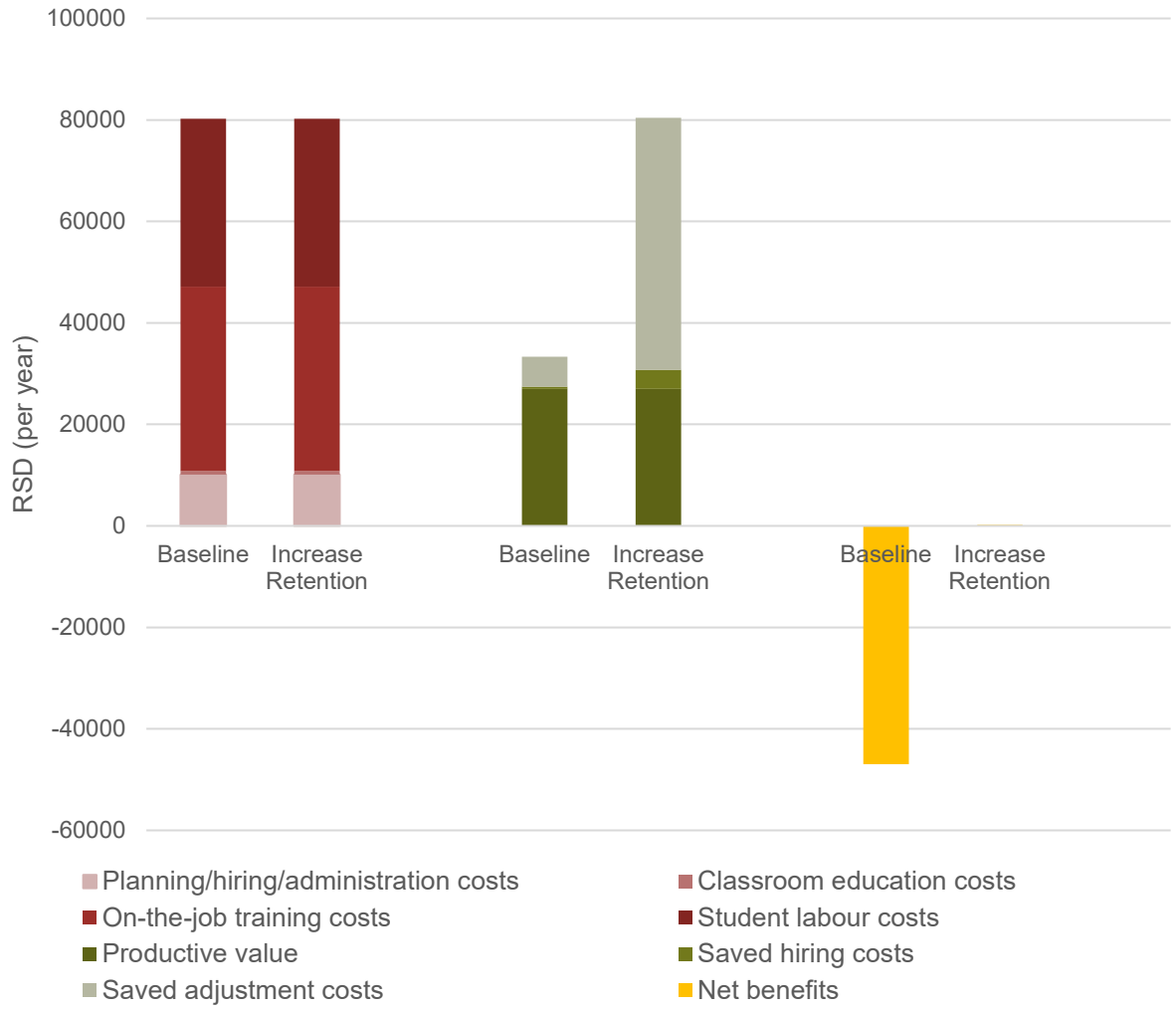
Notes: N~30. The figure shows the median retention rate in the sample and across firm size. The figure shows that the median retention rate in the sample is 10%, which however strongly differ across firm size. In small- and medium-sized firms the median retention rate is by 0%, while the median retention rate by large firms is about 33%

Figure 16 compares the resulting costs, benefits and net benefits of this last sensitivity analysis with the baseline results presented in the previous section. Changing the retention rate would leave the total costs unchanged. Similarly, the productive value remains the same. However, post-training benefits would increase due to the fact that saved hiring costs and especially saved adjustment costs would increase. The estimated total benefits would reach about the same value as the total costs, implying thus total net benefits of about zero.

Hence, it is possible that firms make a net benefit if the retention rate increases. However, the necessary increase is substantial. Therefore, policies aiming to increase the retention rate should be accompanied by policies aiming to improve the cost-benefit ratio during the program.

Furthermore, we currently have little information about why the retention rate is so low. Are the former students switching the firm? Do the former students start another education program or do the firms have no positions for the former students to offer? Therefore, improving our understanding of the process after the end of the program is key to develop measures that might increase the retention rate.

Figure 16: Sensitivity analysis – increase retention rate



Notes: N~30. The figure shows yearly values of the components for the estimated benefits, costs and net benefits of firms providing training places. For each component, the first bar reports the values of the baseline estimation, while the second ones the values of the sensitivity analysis.

The figure shows that by increasing the retention rate firms' costs remain constant, while benefits increase from about 33,000 RSD to about 65,000 RSD per year. The net costs decreases from about 47,000 RSD to about 16,000 RSD per year.

6 Conclusions, Discussion & Recommendations

Results

Firms participating in work-based learning between 2013 and 2019 incur costs of about RSD 80,000 per participant per year. Student labor costs and on-the-job training costs are the most important cost types. Firms reap benefits of about 33,000 RSD per year. Participants' productive value is the most important benefit, followed by saved adjustment costs and saved hiring costs. Combining costs and benefits yields net costs of about 47,000 RSD per student per year.

These net costs strongly differ across firm size. Small- and medium-sized firms experience clearly higher costs, mainly due to the fact that supervision time is higher in these firms. Additionally, small- and medium-sized firms have lower benefits due to the fact that the retention rate in these firms is extremely low, and therefore no post-training benefits occur. Large firms, in contrast, are more able or willing to retain students after the end of the programs and so experience larger total benefits. Furthermore, large firms, compared to small- and medium-sized ones, have lower costs. As a consequence, net costs are much lower for large firms (about 30,000 RSD per year) than in the case of small- and medium-sized firms (about 88,000 RSD per year).

As we mentioned at the beginning, the sample size is unfortunately very small. Therefore these results must be considered with caution. They allow all the partners involved in the implementation of dual education to understand the different variables that make up the cost-benefit analysis and to stimulate the discussion on possible changes in the context of the total revision of the dual education law.

Sensitivity Analyses

Sensitivity analyses of the results illustrate how the net benefits change when we allow some relevant parameters to change. We show that doubling the hours that students spend in firms and increasing the supervision time by 50% increases net costs. In contrast, an increase in the percentage of time students devote to productive tasks rather than practicing increases benefits while leaving costs unchanged. Nevertheless, only a combination of increasing the time students spend in firms and a shift towards more productive work would generate positive net benefits. Still, it is important to mention that the results of these analyses assume that, even when changing certain parameters, all other cost or benefit parameters remain the same. Finally, we also show that an increase in the retention rate could increase after-training benefits and eventually also induce positive net benefits.

Discussion of Results & Policy Options

The main results suggests that the average firm that trained students in dual education faces net costs of about 47,000 RSD per year. These net costs correspond to about a monthly gross wage of a skilled employee. This is mainly due to the fact that the productive value of students is relatively low and that the retention rate is extremely low. Student labor costs and on-the-job training costs are the most important components of costs.

It is however important to contextualize these results. These costs and these benefits have arisen in firms adopting dual education in pilot projects or at the beginning of the implementation of the LDE. We could therefore suppose that some of the costs arose due the fact that firms had relative little experience with the program. For instance, the supervision costs, which are high compared to the relatively little time students spend in firms, might be due to the fact that supervisors or other skilled employees spent

much time with students in order to be sure to correctly implement the program. One could imagine that, by acquiring more experience over time, firms might optimize supervision, for instance by adopting peer-to-peer practices in which students of the later years teach to the younger ones.

Furthermore, firms might become more adept at utilizing the students for productive work rather than practicing as firms gain experience with the program. The sensitivity analyses we performed show that changes in some parameters might strongly affect the cost-benefit ratio. In particular, we show that an increase in the time students spend in firms together with a shift towards more productive work could generate positive net benefits. Also an increase in the retention rate would increase after-training benefits and so improve the cost-benefit ratio. However, the necessary change in the retention rate to arrive at net benefits is quite substantial. Hence, it appears important that measures to increase the retention rate are accompanied by measures to improve the cost-benefit ratio during the program duration. Note that the results of these analyses should not be taken for granted as these provide only indications of how the cost-benefit ratio might change.

Further Recommendations

As already mentioned, due to the low sample size, no concrete instructions for action based on the sensitivity analysis can be given. However, the study does help to structure the discussion among stakeholders in an evidence-based way. We therefore recommend the following measures:

- We recommend to **discuss the study results** with various stakeholders. The sensitivity analysis gives first indications in which direction the program could be improved. It is important to weigh up the advantages and disadvantages of all factors and to choose a **combination of different measures**. For example, the number of hours spent in the company could be increased and at the same time the instructors and supervisors could be trained to gradually involve the LDE students more in productive work.

- Another important recommendation is to further **monitor the program** in the next years. We therefore highly recommend to conduct cost-benefit analysis again in the future (e.g. 2 years after the total revision of the LDE). This is particularly important as the sample size in this study remains relatively small.

- Furthermore, a **regular evaluation of cost and benefits** from the firms' perspective would allow to adjust or further develop the program. This should however be accompanied also by qualitative research for instance through structured surveys or focus groups by industry of firm-size.

- One question raised by this report consists of why the **retention rate** is only about 10%. Understanding more about the reasons for this finding might help to design policies in a way that retention rates increase.

We congratulate the Serbian government and the CCIS for conducting such a cost-benefit study at this early stage of the implementation of the LDE. This allows a broad discussion with the stakeholders involved about the various influencing factors. The sensitivity analysis helps the decision makers to guide possible variants of the improvement of the program on the basis of first empirical findings in Serbia.

7 References

Becker, G. (1962). Investment in human capital: a theoretical analysis. Journal of Political Economy, 70 (5), 9–49.

Blatter, M.; Muehlemann, S.; Schenker, S. & S.C. Wolter (2016). Hiring Costs for Skilled Workers and the Supply of Firm-Provided Training, Oxford Economic Papers, 68 (1), 238-257.

Hanushek, R. & L. Woessmann (2012). Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation, Journal of Economic Growth, 17:267–321

Moretti, L.; Mayerl, M.; Muehlemann, S.; Schloegl, P. & S.C. Wolter (2017). So Similar and Yet so Different: A Comparative Analysis of a Firm's Cost and Benefits of Apprenticeship Training in Austria and Switzerland, IZA DP 11081.

Muehlemann, S. & S.C. Wolter (2014). Return on investment of apprenticeship systems for enterprises: Evidence from cost-benefit analyses, IZA Journal of Labor Policy, 3:25

Muehlemann, S., Wolter, S., & Joho, E. (2018). Apprenticeship training in Italy: a cost-effective model for firms?.

Muehlemann, S.; Pfeifer, H.; Walden, G.; Wenzelmann, F. & S.C. Wolter (2010). The Financing of Apprenticeship Training in the Light of Labor Market Regulations, Labour Economics, 17(5), 799-809.

Muehlemann, S.; Ryan, P. & Wolter S.C. (2013). Monopsony Power, Pay Structure and Training, Industrial and Labor Relations Review, 66(5), 1095-1112.

Quah, E., and Toh, R. (2012). *Cost-benefit analysis: Cases and materials*. Routledge.

Renold, U., Caves, K. M., Oswald-Egg, M. E., Markovic, J., Veselinovic, Z., & Todorovic, M. (2020). Implementation of the Serbian Law on Dual Education: Third Report on Drivers and Barriers. *CES Studies*, *8*.

Schweri, J.; Muehlemann, S.; Pescio, Y.; Walther, B.; Wolter, S.C.; Zuercher, L. (2003). Kosten und Nutzen der Lehrlingsausbildung aus der Sicht der Betriebe, Chur; Zürich: Rüegger Verlag.

Wolter, S.C. & P. Ryan (2011): Apprenticeship, in: Hanushek, E.A., Machin, S. and Wössmann, L. (Eds.): Handbook of Economics of Education, Volume 3, Elsevier, S. 521-576.

Wolter, S. C., & Muehlemann, S. (2015). Apprenticeship training in Spain–a cost effective model for firms. *Bertelsmann Stiftung, Guetersloh*.

Appendix

Table A1: Summary statistics

Variable	N	Mean	Median	Min	Max
Students' time use					
Weeks per year in the company: year 1	28	14.8	13.5	0	37
Weeks per year in the company: year 2	32	24.8	30	2	40
Weeks per year in the company: year 3	33	25.5	30	3	40
Hours per week in the company: year 1	25	7.6	6	0	24
Hours per week in the company: year 2	32	12.3	12	2	24
Hours per week in the company: year 3	34	15.5	18	3	24
Hours per week of in-house courses: year 1	21	0.6	0	0	2
Hours per week of in-house courses: year 2	23	2.0	1	0	8
Hours per week of in-house courses: year 3	24	2.3	0.5	0	8
Share of time in the company used for practicing: year 1	25	60.2	60	20	100
Share of time in the company used for practicing: year 2	31	58.3	55	20	100
Share of time in the company used for practicing: year 3	33	50.1	50	10	100
Share of time in the company used for un-/semi-skilled work: year 1	25	22.0	15	0	70
Share of time in the company used for un-/semi-skilled work: year 2	31	17.3	15	0	50
Share of time in the company used for un-/semi-skilled work: year 3	33	16.1	10	0	50
Share of time in the company used for skilled work: year 1	25	15.4	15	0	40
Share of time in the company used for skilled work: year 2	31	24.1	25	0	70
Share of time in the company used for skilled work: year 3	33	32.4	40	0	70
Relative productivity					
Productivity of students relative to skilled employees: year 1	24	15.0	10	0	50
Productivity of students relative to skilled employees: year 2	29	27.4	30	5	60
Productivity of students relative to skilled employees: year 3	31	44.7	50	15	80
Students' wages					
Monthly gross wage: year 1	190	815.3	815.3	815.3	815.3
Monthly gross wage: year 2	190	3623.3	3623.3	3623.3	3623.3
Monthly gross wage: year 3	190	5435.0	5435.0	5435.0	5435.0
Monthly irregular payment: year 1	20	1.7	0	0	10
Monthly irregular payment: year 2	18	439.2	0	0	2300
Monthly irregular payment: year 3	18	850.3	0.5	0	3000
Monthly allowances: year 1	27	2252.9	1000	0	10000
Monthly allowances: year 2	22	2595.3	1550	0	8000
Monthly allowances: year 3	24	3557.3	2320	0	11000
Employees' wages					
Monthly net wage HR employee	37	55540.6	52000	0	120000
Monthly net wage supervisor	265	55807.8	50000	0	170000
Monthly net wage skilled employee	8969	30579.2	28000	0	300000

Monthly net wage unskilled employee	8940	2433.	23000	0	480000
Hiring and administrating students					
Total days that HR employee spent to hire and administrate a student	34	6.1	2	0	28
Total days that supervisor to hire and administrate a student	34	6.8	2.5	0.5	30
Total days that skilled employee to hire and administrate a student	34	3.6	2	0	15
Total material costs of hiring and administrating	28	4031.3	211	0	20000
Cost of courses, equipment and material					
Course cost	26	13388.3	2250	0	50000
Value of existing equipment used for training	34	1603.6	0	0	14100
Weeks of existing equipment used for training	36	3.5	0	0	36
Cost of new equipment used for training	38	7506.6	0	0	83000
Cost of material used for training	35	3827.0	0	0	20000
Training time of supervisor and skilled employees					
Weekly hours spent by supervisors in training: year 1	15	1.5	0	0	5
Weekly hours spent by supervisors in training: year 2	16	2.5	1.8	0	6
Weekly hours spent by supervisors in training: year 3	14	3.5	2.9	1	6
Weekly hours spent by skilled employees in training: year 1	15	2.0	0	0	6
Weekly hours spent by skilled employees in training: year 2	16	1.8	1.5	0	5
Weekly hours spent by skilled employees in training: year 3	14	2.4	2	0	5
Saved hiring costs					
Job add costs	29	11036.2	11200	0	25000
Hours of HR employee to hire new employee	31	2.9	2	0	10
Hours of supervisor to hire new employee	31	1.4	1	0	5
Hours of skilled employee to hire new employee	31	1.5	0	0	8
Saved adjustment costs					
Hours spent by newly hired employee in courses	29	5.2	0	0	30
Costs of courses	23	6652.2	0	0	36000
Weeks needed for newly hired employee to reach full productivity	33	18.5	12	3	52
Productivity of the newly hired employee compared to an average employee	31	42.9	40	30	60
Time used by HR employee to prepare the newly hired employee	25	2.9	1	1	10
Time used by supervisor employee to prepare the newly hired employee	28	9.4	8	2	20
Time used by skilled employee to prepare the newly hired employee	28	11.4	7	3	40
Retention rate					
Share of students remaining in the company after competition	69	23.6	10	0	100

Table A2: Mapping of VET occupations into ISCO 08 codes

VET Name	ISCO08 Number	ISCO 08 Name
Air traffic technician	7232	Aircraft Engine Mechanics and Repairers
Aircraft electrical equipment technician	7232	Aircraft Engine Mechanics and Repairers
Aircraft technician and engine	7232	Aircraft Engine Mechanics and Repairers
Aircraft technician for electronic equipment of aircraft	7232	Aircraft Engine Mechanics and Repairers
Aircraft technician for security	7232	Aircraft Engine Mechanics and Repairers
Aircraft technician to rescue	7232	Aircraft Engine Mechanics and Repairers
Aviation technician	7232	Aircraft Engine Mechanics and Repairers
Baker	7512	Bakers, Pastry-cooks and Confectionery Makers
Butcher	7511	Butchers, Fishmongers and Related Food Preparers
Confectioner/Pastry cook	7512	Bakers, Pastry-cooks and Confectionery Makers
Construction mechanic operator	71	Building and Related Trades Workers (excluding electricians)
Cook	5120	Cooks
Electrician	7411	Building and Related Electricians
Electro fitter of networks and plants	7413	Electrical Line Installers and Repairers
Fashion tailor	7531	Tailors, Dressmakers, Furriers and Hatter
Industrial mechanic	7412	Electrical Mechanics and Fitters
Industrial tailor	7531	Tailors, Dressmakers, Furriers and Hatter
Locksmith-welder	7221	Blacksmiths, Hammersmiths and Forging Press Workers
Logistic and freight forwarding technician	3324	Trade Brokers
Mechanic of motor vehicles	7231	Motor Vehicle Mechanics and Repairer
Mechatronic for airport transport systems	7232	Aircraft Engine Mechanics and Repairers
Mechatronic for radar systems	7232	Aircraft Engine Mechanics and Repairers
Mechatronic for rocket systems	7232	Aircraft Engine Mechanics and Repairers
Mechatronics technician	7412	Electrical Mechanics and Fitters
Operator for furniture production	7522	Cabinet-makers and Related Workers
Operator in the food industry	8160	Food and Related Products Machine Operators
Operator of basic construction works	71	Building and Related Trades Workers (excluding electricians)
Operator of mechanical processing	8122	Metal Finishing, Plating and Coating Machine Operators
Operator of metal processing	8121	Metal Processing Plant Operators
Technician for computer management od (CNC) machines	7223	Metal Working Machine Tool Setters and Operators
Technician for digital graphics and web design	2166	Graphic and Multimedia Designers
Technician for security of information and communication systems in air traffic	7232	Aircraft Engine Mechanics and Repairers
Tourist and hotels technician	4224	Hotel Receptionists
Trader	5211	Shopkeeper
Waiter	5131	Waiters

Author Information

Bolli Thomas, Dr.
Chair of Educations Systems, ETH Zurich
Leonhardstrasse 21
8092 Zurich
thomas.bolli@mtec.ethz.ch

Caves Katherine, Dr.
Chair of Educations Systems, ETH Zurich
Leonhardstrasse 21
8092 Zurich
katie.caves@mtec.ethz.ch

Pusterla Filippo
Chair of Educations Systems, ETH Zurich
Leonhardstrasse 21
8092 Zurich
filippo.pusterla@mtec.ethz.ch

Renold Ursula, Prof. Dr.
Chair of Educations Systems, ETH Zurich
Leonhardstrasse 21
8092 Zurich
ursula.renold@mtec.ethz.ch

ETH Zürich
Chair of Education Systems
Leonhardstrasse 21
8092 Zurich, Switzerland

www.ces.ethz.ch

Publisher: CES Chair of Education Systems
Editor: Authors
Layout: Authors
Photo: shutterstock