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Migration to the EU: Social and Macroeconomic Effects on Sending Countries[☆]

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Abstract

In June 2016, the European Commission issued a new EU Blue Card proposal. The new proposal is meant to make the EU more attractive for highly qualified workers from third countries. While aimed at strengthening the knowledge-based economy of the EU, the potential impacts of the new Blue Card proposal on less developed sending countries raise a number of questions. The present study attempts to shed light on potential challenges and opportunities by analysing the impacts of the new EU Blue Card proposal on the knowledge-based capital in sending countries – as one of the main drivers of the economic growth. Our results suggest that the EU Blue Card may reduce the knowledge-based capital, and hence growth and development prospects in less developed sending countries if not accompanied by appropriate policy measures. Examining a number of alternative policy measures, which could help turning the sending country challenges into opportunities, our results suggest that policies implemented on the demand side of the sending country labour market are more efficient than policies that address the supply side of the labour market, though they are less costly to implement.

Keywords: High-skill migration, EU Blue Card, knowledge-based capital, endogenous growth, developing countries.
JEL code: C68, D58, F22, J20, J61, J64, O15.

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1. Introduction

In 2009 the EU introduced a new policy instrument to manage the legal migration – the EU Blue Card – that should facilitate the entry, employment and residence of highly skilled third country nationals in the EU. The first review report of the EU Blue Card, concluded by the European Commission in May 2014 revealed a number of deficiencies, such as, a relatively low uptake level. In light of rather unsatisfactory results since its introduction, the Commission's President Jean Claude Juncker stressed the need to revise the EU Blue Card Directive to make it more effective in attracting talent to Europe:[1]

> *"I want to promote a new European policy on legal migration. Such a policy could help us to address shortages of specific skills and attract talent to better cope with the demographic challenges of the European Union. [...] As a first step, I intend to review the "Blue Card" legislation and its unsatisfactory state of implementation."*

In order to address the identified shortcomings in the EU Blue Card implementation, in June 2016 the European Commission issued a new EU Blue Card proposal, which includes, inter alia, less stringent admission criteria, such as lower salary thresholds and shorter length of work contracts, better family reunification conditions, facilitated mobility and the abolition of parallel national schemes. This new proposal, which is currently being negotiated, is meant to make the EU Blue Card more attractive for highly qualified workers from third countries and increase the inflows of skilled workers (*European Commission* 2016).

While certainly strengthening the knowledge-based economy of the EU, the potential impacts of the new Blue Card proposal on less developed sending countries raise many questions. For example, what will be the long-term impacts of the new EU Blue Card proposal on the knowledge-based capital and economic growth in sending countries? What are possible policy actions to tackle challenges and utilise opportunities associated with the revised EU Blue Card to ensure a win-win situation for both receiving and sending countries?

There is a growing body of literature studying the potential implications of the EU Blue Card scheme, most of them focusing at impacts on the labour market and economic growth (e.g. *Gumus* 2010; *Parkes* and *Angenendt* 2010; *Cerna* 2013; *Eisele* 2013). Typically, these studies find that the skilled labour attracted to the EU will boost the

[1] http://www.eesc.europa.eu/resources/docs/jean-claude-juncker-political-guidelines.pdf

global competitiveness and the economic growth in the medium- to long-run. However, Blue Card impacts on less developed sending countries have been studied much less (*Lucas* 2004, 2015), although, as noted above, the EU Blue Card may pose important challenges to less developed sending countries, if not addressed appropriately by policy makers. For example, the Blue Card may increase the brain drain from less developed sending countries and reduce the human capital, which is one of the main sources of the knowledge-based capital and hence the economic growth (*Andrews* and *Criscuolo* 2013).

The main objective of the present study is to fill this research gap by assessing the potential impacts of the new EU Blue Card proposal on the knowledge-based capital – a key source of the economic growth – in less developed sending countries and, based on gained insights, to identify and examine appropriate policy instruments for dealing with potential challenges and opportunities triggered by the EU Blue Card. Given that the knowledge-based capital is one of the main sources of the economic growth (*Andrews* and *Criscuolo* 2013), which in turn depends crucially on the size of the skilled workforce in country (*De la Fuente* and *Ciccone* 2002), in this study we analyse how the EU Blue Card might affect the key ingredients of the knowledge-based capital in sending countries. In particular, we focus on the human capital and knowledge stock, as in the previous literature they are identified as key components of the knowledge-based capital (*OECD* 2013). Whereas the former is determined by investment into the human capital e.g. through education and by the international labour migration, the latter depends on the investment into the R&D and innovation and on the diffusion and absorption of ideas and knowledge generated somewhere else. Both are investigated in the present study.

Our investigation is based on a conceptual analysis, which has several advantages compared to numerical simulations.[2] First, the main objective of the present study is to identify and explain the key channels of adjustment in the knowledge-based capital in an intuitive way, rather than to produce concrete numbers. Second, given that due to the short implementation period and the rather low uptake so far the available historical data for an empirical analysis are not sufficient yet, we believe that for policy makers the adopted conceptual analysis is more insightful and makes our findings more practically applicable.

The rest of the paper is structured as follows. In section 2, we analyse how the EU Blue Card and the associated skilled labour migration affects important determinants

[2]For numerical simulations of labour migration impacts in the EU see *Ciaian* and *Kancs* (2016); *Kielyte* (2016); and *Kancs* and *Lecca* (2016).

of knowledge-based capital in less developed sending countries: skilled labour force, international migration of skilled workers, domestic knowledge accumulation, and international knowledge flows. Section 3 identifies and examines policy options for less developed sending countries in order to address the potential challenges arising from the skilled labour emigration. The final Section draws concluding remarks.

2. The impact of the EU Blue Card on the knowledge-based capital in LDC[3]

According to the new EU Blue Card (BC) proposal, it will improve access to skilled jobs in the EU and reduce migration costs, which in the short-run will widen the net wage gap between EU and less developed sending countries (LDC). Increased net of migration cost wage differences will reinforce the migration of skilled workers from LDC to EU. In the long-run, in addition to these direct labour migration effects, migration will also induce adjustments in the stock and accumulation of the knowledge-based capital (knowledge stock and human capital). In this section we analyse how BC might affect the key sources of the knowledge-based capital in LDC: the human capital accumulation through the workforce education, the long-run migration and the inter-regional distribution of the skilled workforce, the domestic knowledge accumulation through R&D and international knowledge diffusion.

2.1. BC impact on the human capital accumulation in LDC

BC will affect the long-run education equilibrium, which determines the share of the educated workforce, through several channels. According to *Ciaian* and *Kancs* (2007), the four most important ones are changes in the skilled/unskilled wage ratio in LDC, the job and skill upgrading effect in EU, higher education cost per worker, and remittance-induced changes in the worker income and liquidity constraints.

First, through the skilled worker emigration, BC will induce changes in relative skilled-unskilled *wages in LDC*, which in turn will affect education incentives. Given that under BC only skilled workers will be able to migrate, the ratio of skilled/unskilled workers will decrease in LDC, at least in the short-run. Everything else equal, a declining supply of the skilled workforce will exert an upward pressure on the skilled wage. As a result, an increased skilled/unskilled wage gap will induce additional unskilled workers to obtain skills through education. Thus, through changes in the skilled /unskilled wage

[3]See Appendix for a formal analysis.

ratio in LDC, the sending country's wage effect will increase the long-run education equilibrium in LDC.

Second, through the *job and skill upgrading*, BC will increase the average earnings of skilled migrants in EU, which will affect worker education decisions in LDC. The empirical evidence from European destination countries suggests that in the absence of BC only a small part of highly skilled immigrants from LDC are employed in skilled jobs (*Salt* 1997). The majority of skilled migrants from LDC work in sectors and jobs requiring little qualification, such as agriculture, transport or construction. BC will stop the brain waste by allowing skilled migrants from LDC to work in skilled jobs in EU. This will increase their wage to the EU skilled wage, implying that the incentives for eduction and migration will be considerably higher under BC in LDC. Thus, because of higher wages that migrants from LDC will receive in EU, emigration incentives will increase. Further, the skilled wage will increase also in LDC, which in turn will increase the education equilibrium in LDC.

Third, being a skill-biased policy instrument, BC will increase the average *education cost* per worker and hence decrease the share of the educated workforce. It is well known that people are not equally talented, they are heterogeneous in their abilities. In the presence of positive education costs, only most talented individuals obtain education (*Willis* and *Rosen* 1979, *Cameron* and *Heckman* 1998). More precisely, only those workers enter education, whose post-education productivity is sufficiently high to cover the fixed cost of schooling. Hence, those workers which were unskilled before the introduction of BC, have not only less skills, but, on average, they are also less talented than those workers who have first obtained education. Education is more costly for the remaining workforce (because on average it is less talented and less productive). Given that in terms of productivity gains the education cost per one less talented worker is higher than per one more talented worker, there will be less human capital at each given skilled/unskilled wage gap.

Finally, BC will affect the education equilibrium in LDC also through *remittances*. Depending on whether remittances are invested in education and whether workers consider them as an additional stream of income, remittances may have either a positive or negative impact on the education equilibrium in LDC. In both cases, changes would be caused by rents, which emigrants receive in EU and, as other groups of migrants, remit part to their families in LDC. Both remittance effects find support in the empirical literature (*Edwards* and *Ureta* 2003; *Chami et al.* 2003). According to *World Bank* (2000),

remittances of skilled migrants are more often spent on investment goods, e.g. fixed assets and education, compared to unskilled worker remittances, which usually are spent on consumption goods.[4] Hence, BC remittances may move upward or remove completely the liquidity constraint of education in LDC. As a result, more workers, particularly those that were restrained from education by a binding liquidity constraint, may be able to acquire skills through education (*Carneiro* and *Heckman* 2000, *Cao* 2008, *Stinebrickner* and *Stinebrickner* 2008). On the other hand, remittances may also have the opposite effect - a decrease in the skill accumulation through education. Through the cash inflow via remittances, BC increases the disposable worker income in LDC. Given that the labour supply curve is U-shaped in the worker income, a higher total income may also reduce the labour supply in LDC.

In summary, two BC effects will likely have a positive impact on the worker education (increased skilled and unskilled wage ratio in LDC, and job and wage upgrading effect in EU), one negative (increased education cost per worker), and one ambiguous (remittance-induced changes in worker income and education costs), which implies that the total impact of BC on the education equilibrium in LDC may be either positive or negative.

2.2. BC impact on the international labour migration

As noted above, in the short-run, through reduced migration costs and an improved access to skilled jobs in EU, BC will increase the net of migration cost wage gap between EU and LDC, and hence affect the international labour market equilibrium. The increased wage difference will trigger the skilled worker migration – driven by higher expected earnings in EU skilled workers will migrate from LDC to EU. In the long-run, in addition to this direct short-run effect on the skilled labour force distribution between LDC and EU, migration itself will affect determinants driving the labour migration, e.g. international wage differences and migration costs. Both the direct brain drain effect and the induced second-round migration effects – changes in relative wages in LDC and EU and changes in migration costs – are examined next.[5]

[4] According to *Cox* (1987), skilled worker remittances differ from unskilled worker remittances in at least two respects: quality and quantity. On the one hand, highly-skilled migrants remit less than unskilled because skilled migrants are more likely to settle and to reunite with their family in EU. On the other hand, in contrast to unskilled worker remittances, which are mostly spent for consumption goods, remittances of skilled migrants are more often invested in production, fixed assets and education (*World Bank* 2000).

[5] In reality, there are many more forces at work. For example, the economic geography and urban systems literature stress that because of agglomeration economies, firms in the larger region will be able to pay higher wages attracting in such a way even more workers. We abstract from these effects, as they are less pronounced at the international scale.

The most direct and visible effect induced by BC will be the transfer of the human capital embodied in the migrant labour – *brain drain* – from LDC to EU.[6] Given that skilled migrants embody private productive skills, the excludability character of the human capital implies that the increase in the stock of the human capital in EU will be proportional to a decrease in LDC. Thus, because of the brain drain, BC will have a strictly negative impact on the human capital in LDC, everything else equal. On the other hand, a series of recent studies (*Mountford* 1997; *Vidal* 1998; *Beine et al.* 2001; *Beine et al.* 2008) suggest that the brain drain may ultimately contribute to the human capital formation in sending countries. The main reason is that since the return to education is higher abroad, migration prospects will raise the expected return to the human capital and induce more people to invest in education at home. Under certain conditions, the incentive effect (or brain gain) can dominate the brain drain effect, in which case there would be a net gain for the source country (i.e., a beneficial brain drain). *Sorger at al.* (2013) find that if the human capital formation is subject to a strong enough and positive intertemporal externality and migration is sufficiently restrictive, the prospect of migration may increase the human capital and hence the economic growth in sending countries in the long-run.

In the long-run, the skilled worker migration will affect *wages in LDC*. By reducing the skilled labour supply in LDC, the skilled worker emigration will exert an upward pressure on wages in LDC (assuming that the labour demand does not change). This will narrow the migration-driving wage gap between LDC and EU, implying less migration in the long-run. Thus, because of the increasing skill premium in LDC, the long-run losses of the human capital induced by BC may be lower compared to the short-run.

According to *Borjas* (1994), the international labour migration affects the wage rate not only in sending countries but also in receiving countries. Through the increased labour supply of skilled workers in EU, emigration will exert a downward pressure on skilled *wages in EU*. A lower skilled/unskilled wage ratio in EU will narrow the migration-driving wage gap between LDC and EU, which in turn will attract fewer Blue Card migrants. Thus, because of a decreasing skill premium in EU, the long-run losses of the human capital induced by BC may be lower compared to the short-run.

Both sending and receiving country wage effects will depend on the relative country size and the size of the migrating population. The larger will be LDC, the bigger will be

[6]Given that the human capital embodied in skilled workers is draining out of country, in the migration literature this effect is often referred to as a 'brain drain'.

the wage effect in EU, and the larger will be the share of the emigrating population, the larger will be the wage effect in LDC. Analogously, if LDC would be small relative to EU, then the labour migration would not affect (affects little) the skilled labour wage in EU. Thus, the long-run losses of the human capital induced by BC may be lower in the long-run compared to the short-run; and from a large LDC compared to a small LDC.

Finally, as other types of migrants, Blue Card holders will base their migration decisions on net wage differences between EU and LDC, i.e. the gross wage difference minus *migration costs* (*Sjaastad* 1962).[7] Workers will migrate if the expected benefits arising from migration are higher than migration costs. According to *Carrington at al.* (1996), migration costs are decreasing in the migrant stock in the destination country. Declining migration costs in turn will widen the net wage gap between LDC and EU, attracting more skilled migrants. Thus, in the presence of migration networks and decreasing migration costs, the impact of BC on the brain drain will be stronger than with constant migration costs.

In summary, the direct brain drain effect will be magnified by decreasing migration costs. On the other hand, adjustments in the skilled/unskilled wage ratio in LDC and EU will reduce the direct brain drain effect on the human capital in LDC. These findings are in line with the previous migration literature (*Beine et al.* 2001; *Lowell* and *Findlay* 2001; *Lucas* 2004; *Katseli et al.* 2006). Depending on the relative strength of three induced supply side effects, the size of the skilled work force migrating from LDC to EU can be either higher or lower in the long-run compared to the short-run. In either case, it is important for the migration policy planning to be aware of potentially sizeable differences between the short-run and long-run migration and hence the impact of BC on the distribution of the skilled workforce between LDC and EU. These results are supported by empirical findings of *Beine et al.* (2008), who find that developing countries combining relatively low levels of the human capital and low skilled worker emigration rates are more likely to experience a beneficial brain drain (net positive effect) than conversely.

2.3. BC impact on R&D and innovation in LDC

BC will affect both the level and productivity of the knowledge production in LDC. The two key determinants of public R&D activities is the budget size (government revenue) and the budget share spent on R&D. Directly, BC will affect the size of the

[7] Migration costs include not only the physical relocation costs but also the employment uncertainty (which is higher abroad than at home), social costs of leaving family and/or friends behind, cultural adjustment costs etc.

government budget which in turn will affect R&D investments and hence the knowledge accumulation equilibrium. Indirectly, BC will also affect the structure of the government budget. Through changes in the skilled labour force, BC may also affect the productivity of the knowledge production.

First, through the emigration of skilled workers, BC will reduce the number of taxpayers and hence the *government tax revenue* in LDC. Given that, on average, skilled workers are higher net contributors than unskilled workers, the LDC government revenue will decrease both due to fewer tax contributors and less taxpayers of high taxes.[8] A lower tax revenue will reduce the government expenditure on research and development. On the other hand, a higher skilled/unskilled wage ratio (due to an upward pressure on skilled wages) will increase the government tax revenue per skilled worker. Thus, because of a smaller government budget but a larger budget per capita, the impact of BC might be both reducing or increasing the R&D and the production of new knowledge. The total impact of the government budget effect will depend on the size of the brain drain, the spillover effect, the knowledge spillover effects, the unskilled labour productivity effect and the remittance effect.

Second, the *knowledge productivity* in LDC will decrease because, after the introduction of BC, part of the skilled labour from LDC will emigrate to EU, implying that fewer skilled workers will be able to contribute to the production/absorption of knowledge in LDC. As a result, the knowledge production & absorptive capacity in LDC will decrease (*Cohen* and *Levinthal* 1990). On the other hand, BC will increase the knowledge productivity in EU, because immigration will increase the stock of skilled labour in EU. Hence, LDC may benefit only indirectly through a potentially higher knowledge production production in EU and more intense knowledge spillovers.

In summary, both BC effects on R&D and innovation in LDC – quantity and quality of innovation – will likely affect the knowledge stock in LDC negatively. The former works through less government revenues and hence less public R&D expenditure. The latter works though a decreasing knowledge production and absorption capacity, as less skilled workers will be available in LDC.

[8] Because on average the wage rate for skilled work is higher than for unskilled and the unemployment rate among skilled workers is lower, per capita, skilled workers contribute more to tax revenue than unskilled workers.

2.4. BC impact on the knowledge diffusion

The key channel through which the skilled labour migration affects knowledge transmission barriers is the *diaspora effect*. The limiting effect of spatial barriers, such as borders, language and distance, on knowledge spillovers has been confirmed both nationally and internationally. E.g. *Jaffe et al.* (1993), *Acs et al.* (1994), and *Audretsch* and *Feldman* (1996) find that knowledge spillovers are rather localised, and the cross-border mobility of knowledge is limited. *Peri* (2003) reports that only fifteen percent of average knowledge is learned outside the region of origin and only nine percent outside the country of origin. Among others, the international trade and migration may help to reduce the border effect of knowledge diffusion. *Kapur* (2001) argues that the skilled worker migration facilitates the spillover of knowledge, and the diffusion of technology and business contacts, by interacting as a carrier between the knowledge producing country and the knowledge absorbing country. In the migration literature this effect is known as the diaspora effect. Because of the diaspora effect, likely the skilled worker migration induced by BC will reduce the barriers of EU's knowledge flows to LDC and increases the absorptive capacity. Thus, by reducing knowledge transmission barriers, BC may increase productive inward knowledge spillovers.

In summary, the diaspora effect induced by BC will likely increase the inward knowledge spillovers and reduce the cost of the foreign knowledge absorption. This result finds strong support in the empirical literature (e.g. *Kapur* 2001).

3. Migration policy options for LDC

In light of the identified potential challenges, which the EU Blue Card may trigger, in this section we review a number of migration policy options for LDC: migration tax, skill subsidy, education subsidy, public R&D and innovation policies.

3.1. Migration tax

First, in order to compensate for BC-induced losses in the knowledge-based capital and to reduce migration-driving international net wage differences between LDC and EU, LDC government could impose a migration tax (*Bhagwati tax*) to emigrating skilled workers (*Bhagwati* 1975). The migration tax would not affect non-migrating workers in LDC. Instead, the migration tax would reduce the net skilled labour wage of LDC migrant workers. Because of smaller net wage differences between LDC and EU, the

number of migrants would decreases and the mass of skilled workers in LDC would increase.[9]

Second, given that the Bhagwati tax requires an international cooperation between LDC and EU, skilled worker incentives for making the use of BC could be reduced by increasing the skilled wage in LDC, for example, by imposing a differentiated tax rate for the skilled and unskilled labour. A *skill-biased labour tax* would affect only the demand for the unskilled labour, the skilled labour demand would remain unaffected. The skill-biased labour tax would reduce the net wage of the unskilled labour, incentives for education would increase, resulting in a higher skilled worker emigration. A higher emigration, in turn, would decreases the skilled labour wage. A lower skilled wage would allow firms in LDC to hire more skilled workers. As a result, the size of the skilled labour force in LDC and emigration to EU would increase.

In the above analysis we implicitly assumed that LDC is large enough to be able to affect the international wage rate for the skilled labour. Only this indirect wage effect may increase the skilled workforce in LDC. More precisely, by introducing a skill-biased tax in LDC would depress the international skilled wage. If, however, LDC is sufficiently small, then the LDC's tax policy would not affect the international wage rate for the skilled labour. As a result, both with and without taxation of the unskilled labour, the stock of the skilled labour in small LDC would not be affected. However, in the presence of BC, a skill-biased tax would increase emigration from LDC, which is due to a reduced after-tax wage in LDC.

3.2. Skill subsidy

In order to compensate for BC-induced losses in the human capital, the LDC government could subsidise the skilled wage (*Heckman* 2000, *Carneiro* and *Heckman* 2003). First, assume that LDC would pay the subsidy directly to skilled workers. The direct skill subsidy would decrease the supply of the skilled labour. The demand for the skilled labour, however, would not be affected. As a result, the wage rate for the skilled labour would decrease. The size of the skilled work force in LDC would increase, because of the indirect wage effect – the skilled wage would decrease. As a result, firms in LDC would hire more skilled workers. However, if LDC is small enough, the international wage rate for the skilled labour would not be affected. More skilled workers would have incentives

[9] If feasible, a migration quota/restriction would have a similar effect to the Bhagwati tax on the human capital in LDC. The only difference is that the migration quota would not contribute to the government budget.

to migrate, because with the skill subsidy, it becomes easier to buy the 'migration ticket' - BC, as it is less costly to acquire education and then migrate.

The LDC government could improve the efficiency of the skill subsidy by targeting the subsidy toward those skilled workers, e.g. through employer that do not migrate. Assume that the same subsidy would be granted to companies in LDC to decrease skilled labour costs. Because of a higher labour demand, the wage rate for the skilled labour would increase. A higher domestic wage would imply that less skilled workers would have incentives to emigrate. As a result, migration would decrease, whereas the stock of the skilled labour in LDC would increase because of a higher wage.

Comparing the two types of skill subsidies (direct and indirect) suggests that the skill subsidy to firms is a more efficient policy than paying it directly to skilled workers: (i) there would more skilled workers in LDC, (ii) less skilled workers would emigrate, and (iii) budgetary costs would be lower. The indirect skill subsidy is more efficient, because it is better targeted than the direct skill subsidy. The main disadvantage of the direct skill subsidy is that it also supports those workers that would emigrate. In other words, it helps them to buy the 'migration ticket' - BC.[10] A subsidy granted to the skilled labour would increase the stock of the skilled labour only indirectly, through the international wage effect for the skilled labour. If LDC is sufficiently small, then the skill subsidy would have no effect on the stock of the skilled labour in LDC.

3.3. Education subsidy

As discussed above, the worker education decision is determined by a trade-off between the wage difference between the skilled and unskilled work (skill premium) and the cost of education. Thus, in addition to increasing the skill premium, the demand for education can be increased also by reducing the cost of education, for example, by investing in the public education, or by subsidising education through government scholarships (*Heckman* 2000; *Carneiro* and *Heckman* 2003; *Fender* and *Wang* 2003).

The effect of the *direct education subsidy* would be similar to the direct skill subsidy. As above, the stock of the skilled labour would increase only because of the indirect wage effect. A higher supply of the skilled workforce would exert a downward pressure on the skilled labour wage, which would decrease. If the skilled wage rate would not change, then the stock of the skilled labour would remain the same. Therefore, this policy would be ineffective in terms of increasing the LDC's human capital. In addition, the direct

[10]Note that high skills is a precondition for the eligibility of the EU Blue Card.

education subsidy would also increase emigration. The stock of the skilled labour in LDC would depend only on the skilled wage effect in EU, but not on the education policy directly.

The effectiveness of the education subsidy could be improved by conditioning the education subsidy on the post-education employment in LDC that provides education. The *conditional education subsidy* has been implemented in several LDC and has proven to be an efficient way of increasing the stock of the human capital (*Lowell* and *Findlay* 2001). Under the conditional education subsidy, all skilled workers would stay in LDC and there would be no migration.

Alternatively, the LDC government could implement the education subsidy through employer (similarly to skill subsidy). The support for education at the firm level (*indirect education subsidy*) would increase the demand for the skilled labour. A higher demand for the skilled labour would exert an upward pressure on the skilled labour wage. Because of a higher skill premium, the stock of the skilled labour in LDC would increase. Hence, the indirect education subsidy would be more efficient than a policy addressing education through the labour market supply side (direct education subsidy) for three reasons: (i) a higher stock of skilled labour, (ii) a lower migration, and (iii) lower budgetary costs. Thus, by supporting the education at the firm level (addressing the demand side of the labour market), policy would be better targeted and hence more efficient.

If invested in education, high-skill worker *remittances* from EU could increase the equilibrium education in LDC (see section 2.1). Hence, by increasing incentives for investing remittances into education, e.g. by introducing a tax relief for remittances or reducing remittance transfer costs, the LDC government could increase education.[11] For example, a tax relief for remittances would increase the purchasing power of remittances in LDC and hence the incentives to remit. Alternatively, the share of remittances invested in education could be increased by introducing a distortionary taxation to remittances spent on consumption goods and/or tax exemptions to remittances spent on investment goods. Because the purchasing power of remittances for consumption goods would decrease compared to investment goods, more remittances would be invested. If invested in education, the size of the skilled work force would increase in LDC in the medium- to long-run. As above, the efficiency of the education remittance tax relief could be improved by granting the tax relief only for those skilled workers that remain in LDC, because part of newly educated workers would emigrate.

[11] In most developing countries remittances are subject to income tax (*Chami et al.* 2003).

3.4. R&D and innovation policies

As explained in section 2.3, the high-skill migration would affect not only the human capital but also the knowledge production/absorption in LDC. Hence, in addition to coping with BC-caused losses in the human capital, the LDC government also needs to deal with a decreasing knowledge stock (which not only reduces growth, but also co-determines the skilled labour migration). The two main options for increasing the knowledge stock are investing in R&D for generating new ideas (subsidising the production of a new knowledge), or in the adoption of the foreign knowledge (subsidising the adoption of the foreign knowledge).

The *knowledge adoption subsidy* could be implemented in two ways: co-financing the cost of the knowledge adoption or subsidising the demand for knowledge. First, consider a policy that would co-finance the cost of the knowledge adoption. Assume that the LDC government would pay a knowledge subsidy per unit of the adopted knowledge. The knowledge adoption subsidy would reduce the marginal costs of the knowledge adoption, which would increase the LDC's equilibrium knowledge adoption.

Another option for LDC would be to subsidise the production of new knowledge. Assume that the LDC's government would pay subsidy to reduce the cost of the new knowledge creation. The *knowledge production subsidy* would reduce the marginal cost of the knowledge creation. In this case, the knowledge production subsidy would not affect the equilibrium level of knowledge in LDC, in the presence of BC the knowledge stock would stay unchanged both with and without subsidy. The knowledge production subsidy would only change the equilibrium distribution between the new knowledge and adopted knowledge: it would increase the knowledge production and decrease the knowledge adoption.

These results suggest that, as long as the international knowledge gap between LDC and EU would be positive, subsidising the creation of new knowledge would be less efficient than subsidising the adoption of already invented knowledge somewhere else. For example, for LDC it would be less expensive to adopt the EU knowledge than to produce its own knowledge. As a result, subsidising the production of new knowledge would only offset the cost disadvantage of the new knowledge production compared to the knowledge adoption and lead to a zero (or small) increase in the total knowledge stock in LDC.

On the other hand, the reallocation of subsidies between the adoption of the foreign knowledge and the production of new knowledge would also affect the skilled labour

migration, at least in the long-run. Investing in R&D would increase the productivity of both the skilled and unskilled labour. However, because the efficiency of subsidies invested in the new knowledge production would be lower than the efficiency of subsidies invested in the knowledge adoption, the increase in the labour productivity would be higher with the latter than with the former policy. Reallocating subsidies from the knowledge production to the foreign knowledge adoption would increase the knowledge capital stronger and hence the labour productivity in LDC would increase more.

In summary, the efficiency of the knowledge adoption subsidy would be higher than that of the knowledge production subsidy. The latter would increase the knowledge capital more and hence the labour productivity. A higher labour productivity would increase the skilled labour in LDC and reduce the skilled migration more effectively than the knowledge production subsidy.

4. Conclusions and policy recommendations

In May 2009 the EU adopted the Blue Card Directive, which should facilitate the entry, employment, and residence of highly skilled third country workers in EU. The first implementation report on the EU Blue Card concluded by the European Commission after the first five years revealed a number of deficiencies. In order to address the identified shortcomings of the EU Blue Card, in June 2016 the European Commission issued a new EU Blue Card proposal. This revised proposal is meant to make the EU Blue Card more attractive for highly qualified workers from third countries and increase the inflows of skilled workers.

While certainly strengthening the knowledge-based economy of the EU, the potential impacts of the new Blue Card proposal on less developed sending countries raise many questions. For example, what will be the long-term impacts of the new EU Blue Card proposal on the knowledge-based capital and economic growth in sending countries? What are possible policy actions to tackle challenges and utilise opportunities associated with the new EU Blue Card proposal to ensure a win-win situation for both receiving and sending countries?

Although, there is a growing body of literature studying the potential implications of the EU Blue Card scheme on receiving countries, Blue Card impacts on less developed sending countries have been studied much less. The main objective of the present study is to fill this research gap by assessing the potential impacts of the new EU Blue Card proposal on the knowledge-based capital – a key source of the economic growth – in

less developed sending countries and, based on gained insights, to identify and examine appropriate policy instruments for dealing with potential challenges and opportunities triggered by the EU Blue Card.

Given that the knowledge-based capital is one of the main sources of the economic growth, which in turn depends importantly on the size of the skilled workforce in country, in this study we analyse how the EU Blue Card might affect the key ingredients of the knowledge-based capital in sending countries. In particular, we focus on the human capital and knowledge stock, as in the previous literature they are identified as key components of the knowledge-based capital. Whereas the former is determined by investment into human capital e.g. through education and by the international labour migration, the latter depends on the investment into R&D and innovation and on the diffusion and absorption of ideas and knowledge generated somewhere else.

In line with previous literature on the international labour migration, our results suggest that the EU Blue Card may reduce the knowledge-based capital and hence the economic growth in LDC, if not accompanied by appropriate policy measures. The EU Blue Card may have a negative impact on both analysed components of the knowledge-based capital: the human capital and knowledge stock. In light of potential challenges for less developed countries, we identify and examine a number of alternative policy instruments for LDC.

Our findings suggest that those policies that address the *supply side* of the skilled labour market (e.g., direct education subsidy, direct skill subsidy) would be the least efficient. This is especially the case when LDC is small relative to EU, as such policies would enhance migration, but they do not have a direct impact on the skilled labour stock in LDC. Only if LDC is large enough compared to EU, supply side policies may increase the stock of the skilled labour in LDC, as the skilled migration would decrease the international wage rate for the skilled labour. This indirect wage effect would increase the stock of the skilled labour in LDC – because of a lower wage rate, less skilled workers would have incentives to migrate. If, however, LDC is small, there would be no wage effect and the stock of the skilled labour in LDC would not be affected by direct subsidies at all. The key issue of policies that address the supply side of the skilled labour market is that these policies cannot distinguish between the skilled labour that emigrates and the skilled labour that stays. Being targeted at both potential migrants and non-migrants, they would help also potential migrants to acquire the 'skill migration ticket' - the EU Blue Card.

The efficiency of labour market policies in LDC would be improved through a better targeting: (i) directly targeting the *demand side* of the skilled labour market (e.g. through a skill subsidy granted to firms, or subsidising education at the firm level); or (ii) specifically targeting *migrant workers* (e.g. through the Bhagwati tax, conditional education subsidy). Whereas the former would change incentives only of those who stay, the latter would do the reverse - it would change incentives of those that would migrate. In terms of the implementation feasibility, policies addressing the demand side of the skilled labour market appear to be less costly. The enforcement costs of policies which would address only migrants would be higher and may require an international cooperation with receiving countries.

Turning to limitations, we would like to remind that in the present study we considered only selected sources of the knowledge-based capital growth – the human capital and knowledge stock – and only selected channels through which the revised EU Blue Card may affect the less developed sending country growth in the long-run: education, migration, R&D and innovation and knowledge spillovers. Although, we hope that we have captured all main sources of growth and channels of the knowledge-based capital adjustment, in reality there are many more. Analysing all of them however is beyond the scope of the present study, but is a promising avenue for future research.

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Appendix

1. Conceptual framework

Given that the knowledge-based capital is one of the main sources of the economic growth (*Andrews* and *Criscuolo* 2013), which in turn depends importantly on the size of the skilled workforce in country (*De la Fuente* and *Ciccone* 2002), in this study we focus on the human capital and knowledge stock in less developed sending countries, as in the previous literature they are identified as key components of the knowledge-based capital (*OECD* 2013). Whereas the former is determined by investment into human capital e.g. through education and by the international labour migration, the latter depends on the investment into R&D and innovation and on the diffusion and absorption of ideas and knowledge generated somewhere else. In this Appendix we provide a diagrammatic analysis that supports the findings presented in the paper.

1.1. Human capital

Assume that the sending country, S, is endowed with $L^S \left(= \lambda_H L_H^S + \lambda_U L_U^S\right)$ units of labour, which is shown on the horizontal axis in the left panel of Figure 1.[1] The skilled labour, L_H^S, is measured from left to right, whereas the unskilled labour, L_U^S, from right to left. Curves D_H^S and D_U^S represent the demand for the skilled and unskilled labour, respectively, and S_H^S is the supply of the skilled labour in S. λ_H and λ_U are efficiency parameters measuring the relative labour productivity of skilled and unskilled workers, respectively (see Figure 1).

Abstracting from other channels of the labour market adjustment, such as employment and participation decisions, assume that workers decide on two issues: education and migration. First, consider the education decision, where workers have to choose between offering an unskilled labour versus investing into education and offering a skilled labour. According to *Averett* and *Burton* (1996), the education decision is determined by a trade-off between the skill premium (difference between the skilled wage, w_H^S, and the unskilled wage, w_U^S), the cost of education, EC^S, and the stock of knowledge, K^S. These costs capture both the direct costs of education, such as tuition fees, as well as indirect costs, such as worker opportunity costs and the education effort (which is different across individuals).

[1] For the sake of graphical tractability of the diagrammatic analysis, we make several simplifying assumptions. First, we assume that there are only two countries (one less developed country (LDC) and one more developed (EU)), and two types of skills (low-skill and high-skill). Second, we consider only two channels of labour market adjustment (education and migration), whereas we abstract from two other important channels (participation and employment). Third, we assume that the demand of low-skill labour is infinitely elastic. If the elasticity of low-skill labour demand would be partially elastic, then there would be additional low-skill wage effect, which would affect the ratio of high-skill/low-skill workers in LDR. However, this is for illustrative purposes only to more transparently show the main drivers of high-skill labour adjustments. Moreover, it can be easily verified that, as long as the condition $L_H^{LDR}/L_L^{LDR} \leq L_H^m/L_L^m$ holds, the results with low-skill labour migration would be qualitatively equal to those presented here.

Given that education is costly, workers invest into education only when education would increase their net income.[2] Thus, net of education costs, workers must earn at least the unskilled wage, which is equal to w_U^{S*}. The vertical difference between the skilled labour supply, S_H^S, and the unskilled wage rate, w_U^{S*}, represents the cost of education (Figure 1, left panel). It's slope is increasing, because workers are not equally talented, they are heterogeneous in their ability to acquire skills through education (*Cameron* and *Heckman* 1998). In line with *Willis* and *Rosen* (1979), the last skilled worker, who enters education at L_H^{S*} is just able to compensate education costs, his skill premium is equal to zero. Assuming a full employment, the rest of workers, $L^S - L_H^S$, are unskilled. The equilibrium wage of unskilled workers without migration, w_U^{S*}, is at the point where the demand for the unskilled labour, D_U^S, intersects the vertical line at L_H^{S*}. The equilibrium stock of the skilled labour is L_H^{S*} and the skilled labour wage rate is w_H^{S*}. In equilibrium, the education cost of the marginal worker who enters education is equal to EC^*. The equilibrium for the receiving country, R, is analogous. In the absence of migration, the equilibrium skilled wage, the unskilled wage and the stock of the skilled labour are w_H^{R*}, w_U^{R*}, and L_H^{R*}, respectively (Figure 1, right panel).

Second, lets consider the skilled worker decision where to offer their work, at home or abroad, which determines the short-run equilibrium with migration. According to *Sjaastad* (1962), the trade-off which workers face here is given by the expected income increase through migration versus migration costs, MC. These costs include not only the direct transportation costs to the destination country, but also the employment uncertainty (which is higher abroad than at home), social costs of leaving family and/or friends behind, cultural adjustment costs, language barriers etc. (*Straubhaar* 1986). Workers migrate, L_H^m, if the expected net benefits arising from migration are higher than migration costs, MC.[3]

Assume that, due to cross-country differences in the knowledge stock, $K^R > K^S$, the receiving country, R, is more developed than the sending country, S. Differences in country development and hence wage levels trigger migration from S to R. In the presence of positive migration costs, $MC > 0$, the net wage which migrant workers earn is lower than the skilled incumbent wage in R, because the net wage of migrants is the skilled wage in destination country, w_H^R, minus migration costs, MC.

According to the migration network theory and the empirical evidence (*Carrington*, *Detriagiache* and *Vishwanath* 1996), migration costs are not constant, they decrease in the number of migrants from S residing in R. In Figure 1 (middle panel) these network effects are captured by a decreasing distance between curves S_{MC}^m and S^m. Curve S^m is the migrant work supply on the international labour market, which is derived by

[2] We implicitly assume that all workers, for whom it pays off to become skilled, invest in education.

[3] We recognise that in reality the migration decision of workers is driven not only by wage differences but also by non-economic considerations. However, in the present study we abstract from all other determinants of migration and consider cross-country wages differences as the only force driving labour migration.

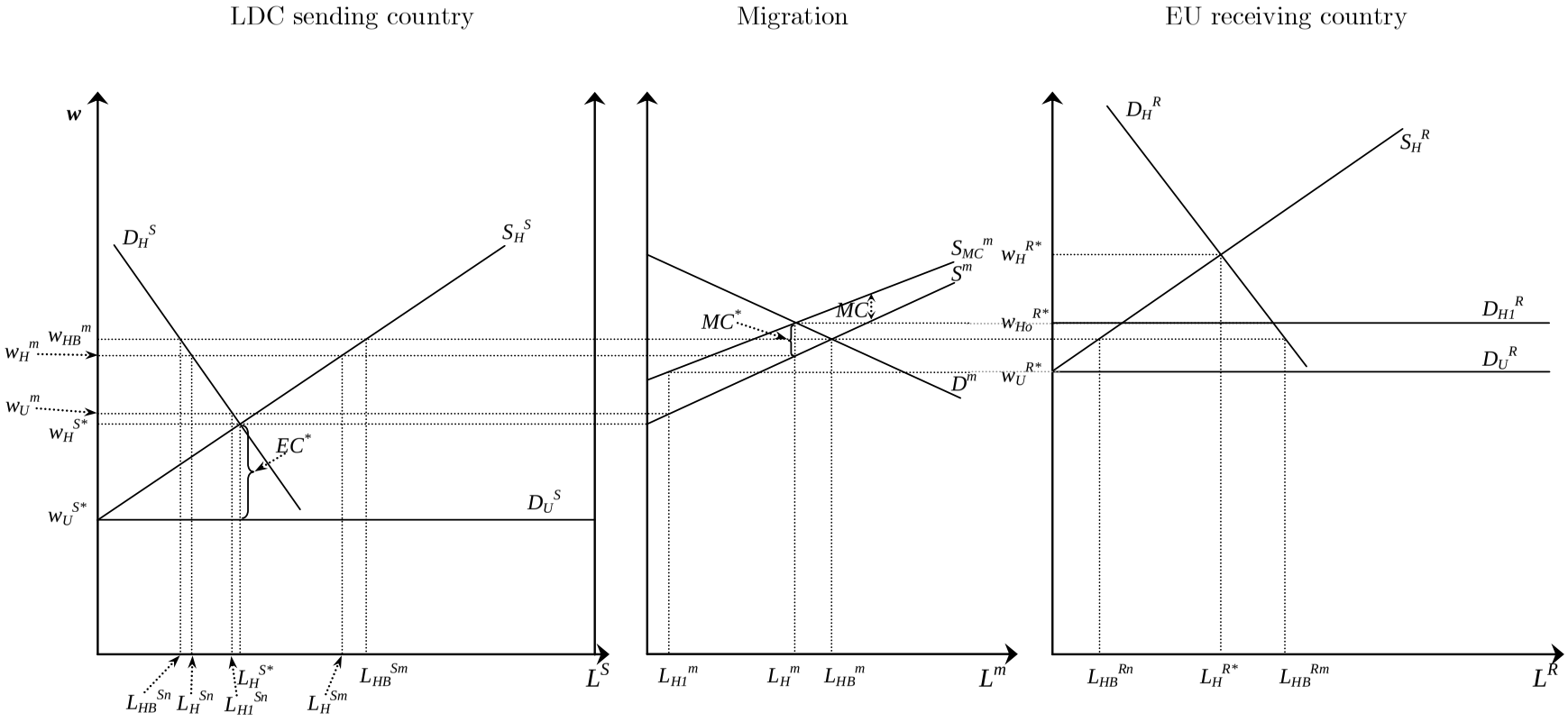

Figure 1: Human capital

subtracting the skilled labour supply, S_H^S, from the skilled labour demand, D_H^S, in S. Curve S_{MC}^m represents the migrant supply adjusted by migration costs, MC.

In equilibrium, L_H^m skilled workers migrate from S to R incurring migration cost, MC^*, and receive the net wage, $w_H^m \left(= w_{Ho}^{R*} - MC^*\right)$. The equilibrium wage rate of the skilled labour, w_{Ho}^{R*}, is determined by the intersection of the migration supply, S_{MC}^m, and the migration demand, D^m (Figure 1, middle panel). The migration demand, D^m, is derived by subtracting the skilled labour demand, D_H^R, from supply, S_H^R (right panel in Figure 1). Immigration reduces the skilled wage in R from w_H^{R*} (skilled equilibrium wage without migration) to w_{Ho}^{R*} (skilled equilibrium wage with migration). The magnitude of the wage effect depends on the sending country S's relative size - the larger is S relative to R, the bigger is the wage effect in R. In contrast, if S is sufficiently small, then migration does not affect the wage rate in R at all. This would be the case if S faces a perfectly elastic skilled labour demand in R, such as D_{H1}^R (Figure 1, right panel). In this case, the skilled labour wage in R is equal to w_{Ho}^{R*} both with and without migration, and migration is equal to L_H^m.

Workers from S migrate to R as long as $w_H^{R*} - MC^* > w_H^{S*}$. The mass of skilled workers that emigrate, $L_H^{Sm} - L_H^{Sn}$, is determined by the slope of the migrant work supply curve, S_{MC}^m. Due to emigration, the stock of the skilled and unskilled work force in S decreases from L_H^{S*} to L_{Ho}^{Sn}, and from $L^S - L_H^{S*}$ to $L^S - L_H^{Sm}$, respectively. Given that the stock of skilled workers decreases relatively more than that of unskilled, the return to education increases. As a result, the equilibrium mass of workers who acquire education increases from L_H^{S*} to L_{Ho}^{Sm}, with $L_H^{S*} < L_{Ho}^{Sm}$.[4]

1.2. Knowledge stock

According to *OECD* (2013), the knowledge available in the sending country, S, is determined by the domestic knowledge production and foreign knowledge spillovers. The knowledge creation involves the production of new knowledge, whereas the knowledge adoption is an uptake of the knowledge developed in other countries (though both are costly). In order to increase the stock of knowledge, the sending country, S, can invest in the knowledge production (new knowledge) or in the adoption of knowledge available though spillovers from R (adopted knowledge).

The level of knowledge available in S is determined by the total (private and public) expenditure on knowledge, TR^S, and the skilled workforce, L_H^S. Knowledge, K^S, increases in both the R&D expenditure, TR^S, and the human capital, L_H^S, which increases the productivity of knowledge.

In the absence of knowledge flows between countries, the only source of country S's knowledge improvement is innovation through investment into R&D. The autarky

[4]Note that in Figure 1 we assumed that only skilled workers have the migration option. Abstracting from unskilled worker migration is motivated by the focus of our study – the EU Blue Card, which targets solely high-skill workers. Moreover, it can be easily verified that, as long as the condition $L_H^S/L_U^S \leq L_H^m/L_U^m$ holds, the results with unskilled labour migration would be qualitatively equal to those presented here.

equilibrium knowledge in S is shown in the upper panel of Figure 2, where the horizontal axis measures the level of knowledge, K^S, and the vertical axes measures units of the expenditure spent on the knowledge accumulation, $tr^S (= TR^S/K^S)$. We assume that the marginal cost of the knowledge creation, MC_C^S, is increasing in the technological development, whereas the marginal productivity (benefit) of the knowledge demand, MB^S, is decreasing in the technological development (both new and adopted knowledge). This is represented by upward and downward sloping marginal cost and productivity curves, MC^S, and MB^S, respectively (upper panel in Figure 2). In the absence of international knowledge flows, the equilibrium domestic innovation, K_C^{S*}, is at the point where marginal costs of the knowledge creation, MC_C^S, equal the marginal productivity of knowledge, MB^S. The equilibrium innovation, K_C^{S*}, implies tr^{S*} units of R&D expenditure.

Analogously, the knowledge equilibrium for the receiving country, R, is shown in the bottom panel of Figure 2. The intersection between the receiving country, R's, marginal cost of the knowledge creation, MC_C^R, and the marginal productivity of knowledge, MB^R, yields the equilibrium domestic innovation and per one unit of expenditure, K_C^{R*} and tr^{R*}, respectively.

Next, consider integration between S and R, which triggers international knowledge flows. Assuming higher skilled/unskilled labour force ratio in R than in S implies a higher equilibrium knowledge in R, ($K_C^{R*} > K_C^{S*}$). As shown in Figure 2, in an open economy equilibrium, more knowledge available in R allows S to adopt inward knowledge spillovers from the more developed country, R. The maximum level of the knowledge spillover that can be adopted in S is equal to the R's equilibrium knowledge production, K_C^{R*}. On the other hand, in a two country world, R cannot benefit from knowledge spillovers from S, because the technological development in S is lower than in R.

We assume that S's marginal costs of the knowledge adoption are constant, given along the horizontal line MC_A^S, which implies that in the absence of knowledge flows between countries, the equilibrium expenditure of the knowledge creation, tr^{R*}, is higher than the marginal cost of the knowledge adoption, $MC_A^S < tr^{R*}$ in equilibrium.[5,6] This assures that, in the presence of knowledge flows between countries, the knowledge adoption may yield positive profits. The total equilibrium knowledge in S is K_T^m, which is a sum of the domestically created knowledge, K_C^m, and the adopted foreign knowledge,

[5]Note that we assume differences in marginal costs between knowledge creation and knowledge adoption. This is consistent with previous findings in the literature. According to *Mansfield* (1981), on average, imitation costs are about 65 percent of the original innovation costs. Further, we assume that both new and adopted knowledge are homogenous in production, i.e. they do not differ with respect to marginal productivities.

[6]In reality, the marginal costs of knowledge adoption may increase with additional knowledge adopted. However the slope of the marginal costs of knowledge adoption should be lower than the marginal costs of knowledge creation (*Mansfield* 1981). To simply the figures, we assume constant marginal costs of knowledge adoption, but the results hold in general.

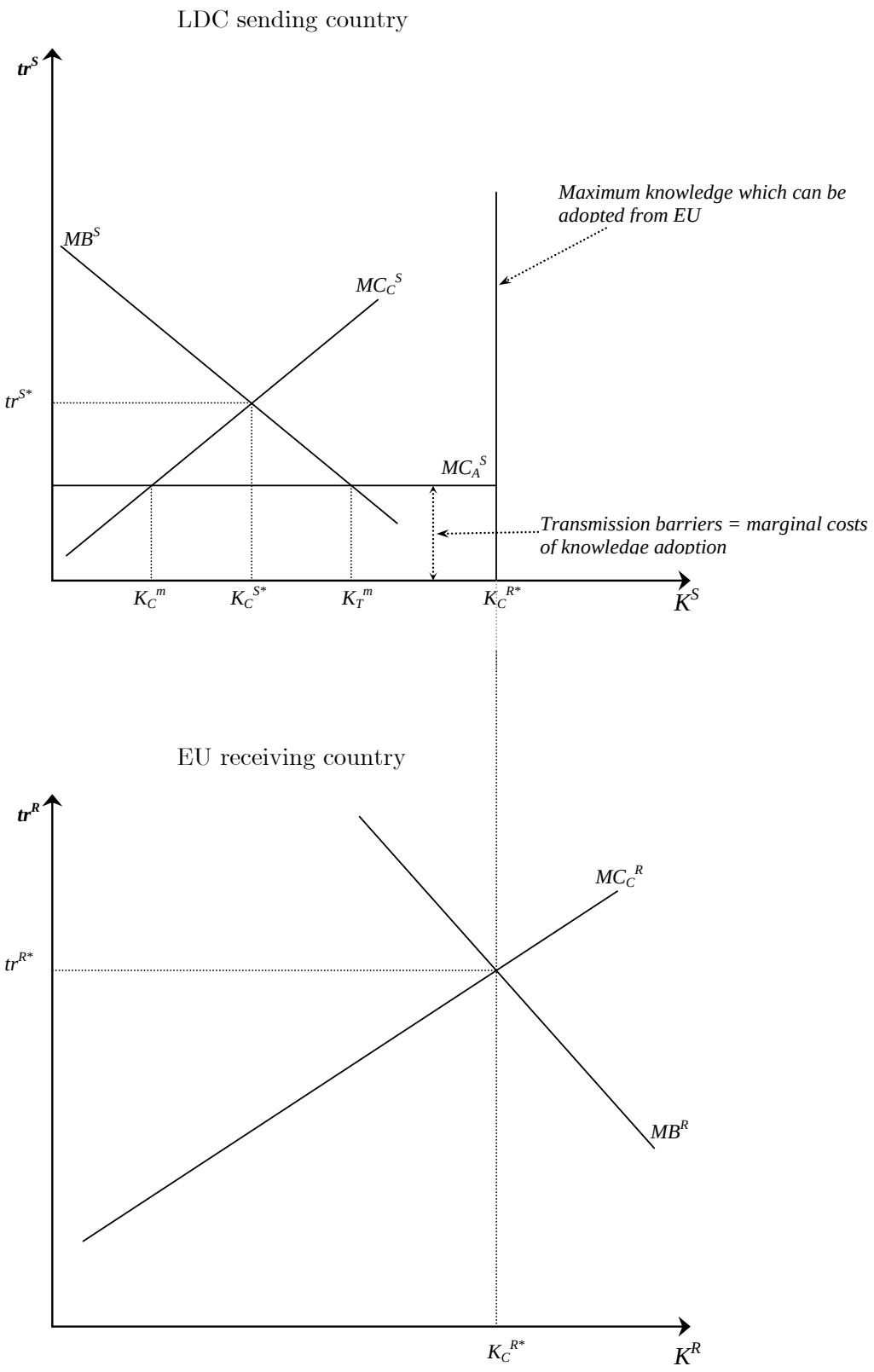

Figure 2: Knowledge capital

$K_A^m (= K_T^m - K_C^m)$. Hence, In the presence of international knowledge spillovers, the equilibrium knowledge production is lower in S, $K_C^m < K_C^{S*}$ (though the total knowledge in S is higher, $K_T^m > K_C^{S*}$). Note that the knowledge equilibrium in R is not affected by international knowledge spillovers because, due to a country development gap, knowledge spillovers are one-directional: from the more developed country, R, to the less developed country, S.

2. The impact of the EU Blue Card on the innovative capital in LDC

2.1. BC impact on the human capital accumulation in LDC

LDC wage effect. The effect of changes in the skilled/unskilled wage ratio on education is shown in Figure 1. In the absence of BC, the equilibrium wage of the skilled labour is w_H^m and the equilibrium wage of the unskilled labour is w_U^{S*} in LDC (Figure 1, left panel). BC reduces migration costs. To simplify the graphical exposition, we assume that BC reduces migration costs, MC, to zero. As a result, the excess supply of the skilled labour increases from S_{MC}^m to S^m and the equilibrium skilled labour wage in LDC increases to w_{HB}^m, implying that the wedge between the skilled and unskilled labour wage in LDC increases.[7] The mass of LDC workers who acquire education increases from L_H^{Sm} to L_{HB}^{Sm}.

Job and skill upgrading effect. The downgrading of migrant skills in EU affects the education decision of unskilled workers in LDC. With an upward sloping labour supply and a downward sloping labour demand, as in Figure 1, the international labour migration equalises the skilled wage in LDC with the unskilled wage in EU (net of migration costs), as migrant skills are downgraded in EU in the absence of BC. The equilibrium wage, w_U^m, is determined by the intersection of the unskilled wage in EU, w_U^{R*}, and the skilled migrant supply, S_{MC}^m, net of migration costs vertically along S^m, yielding an equilibrium net wage of the skilled labour in LDC, w_U^m. The equilibrium migration is L_{H1}^m.[8] BC shifts the equilibrium skilled wage to w_{HB}^m. Under BC, there is more migration, $L_{H1}^m < L_{HB}^m$, and less skilled workers stay in LDC, $L_{H1}^{Sn} > L_{HB}^{Sn}$. On the other hand, the incentives for acquiring education in LDC also increase, because under BC the wage rate of the skilled labour is higher in LDC, $w_U^m < w_{HB}^m$, resulting in a higher share of the skilled labour force, $L_{H1}^{Sn} + L_{H1}^m < L_{HB}^{Sm}$.

Education cost effect. In Figure 1 the worker heterogeneity in terms of ability is represented by an upward sloping skilled labour supply curve, S_H^S. In the absence of BC, the share of the skilled workforce in LDC is L_H^{Sm}. The upward sloping education cost curve, S_H^S, in Figure 1 implies that the average cost of education under BC is higher, $w_H^m - w_U^{S^*} = EC^m < EC_B^m = w_{HB}^m - w_U^{S^*}$, and the average net gain from schooling is lower.

[7] The exact magnitude of this wage ratio effect depends on the elasticity of the unskilled labour demand. In Figure 1 the elasticity of the unskilled labour demand is assumed to be infinitely elastic implying no unskilled wage effect.

[8] Note that in presence of migrant skill downgrading the stock of the skilled labour in EU is not affected by migration from LDC.

Remittance effect. The effect of remittances is shown in Figure 3. Similar to Figure 1, the equilibrium skilled wage in LDC without BC is w_H^m and with BC - w_{HB}^m. Through migration, BC increases the worker welfare by area ab. The worker welfare increases because of remittances (area b) and because of a higher skilled labour wage in LDC (area a). Remittances invested in education shift the skilled labour supply from S_H^S to S_{H1}^S and migration from L_H^m to L_{H1}^m, with $L_H^m < L_{H1}^m$. In the same time, because of a lower skilled labour wage, the stock of the skilled labour in LDC increases from L_{HB}^{Sn} to L_{H1}^{Sn}, with $L_{HB}^{Sn} < L_{H1}^{Sn}$. The other possible remittance effect – a reduced labour supply is represented by a decreasing supply of the skilled labour from S_H^S to S_{H2}^S and migration from L_{HB}^m to L_{H2}^m. As a result, the LDC's human capital stock decreases from L_{HB}^{Sn} to L_{H2}^{Sn}, with $L_{HB}^{Sn} > L_{H2}^{Sn}$.

2.2. BC impact on the international labour migration

Brain drain effect. In Figure 3 BC increases the skilled labour migration from L_H^m to L_{HB}^m (middle panel). In BC equilibrium, LDC has less skilled workers L_{HB}^{Sn}, with $L_{HB}^{Sn} < L_H^{Sn}$ (left panel). Thus, because of the brain drain, BC has a strictly negative impact on the human capital in LDC.

Wage effects. Both sending and receiving country wage effects on the international distribution of the labour force are shown in Figure 3, where in the long-run migration equalises the wage rate between LDC and EU. Through the skilled worker migration, BC reduces the skilled wage in EU from w_{Ho}^{R*} to w_H^m. In contrast, in LDC the skilled wage increases from w_H^m to w_{HB}^m (Figure 3). In the long-run, the equilibrium wage rate for the skilled labour, w_{HB}^m, is equalised across countries and migration equals to L_{HB}^m. Hence, because of LDC and EU wage effects, the long-run losses of the human capital induced by BC are lower compared to the short-run. Both wage effects depend on the relative country size and the size of the migrating population. In Figure 3 the small LDC case implies a perfectly elastic skilled labour demand in the EU given by D_{H1}^R. In this case, the skilled labour wage in EU is equal to w_{Ho}^{R*}, both with BC and without BC. The skilled labour migration equals to L_H^m without BC and L_{Ho}^m with BC. Compared to migration from a large LDC, more skilled workers emigrate, $L_{Ho}^m > L_H^m$, implying less human capital in LDC.

Migrant network effect. The migration decision in the presence of the migrant network effect is shown in Figure 4, where the starting point is the equilibrium migration with endogenous migration costs, MC, and the migrant supply curve S_{MC}^m. With constant migration costs, MC_1, skilled labour migration supply is S_{MC1}^m. For both types of migration costs the equilibrium skilled labour wage in LDC and the skilled migration without BC is w_H^m and L_H^m, respectively. Assume that BC reduces migration costs by c. This implies that the skilled migrant labour supply with constant migration costs shifts to S_{MCB1}^m and the skilled migrant labour supply with endogenous migration costs shifts to S_{MCB}^m. The skilled wage rate in LDC decreases to w_{HB1}^m and w_{HB}^m, respectively. This implies that with constant migration costs, MC_1, the effect is weaker both on the

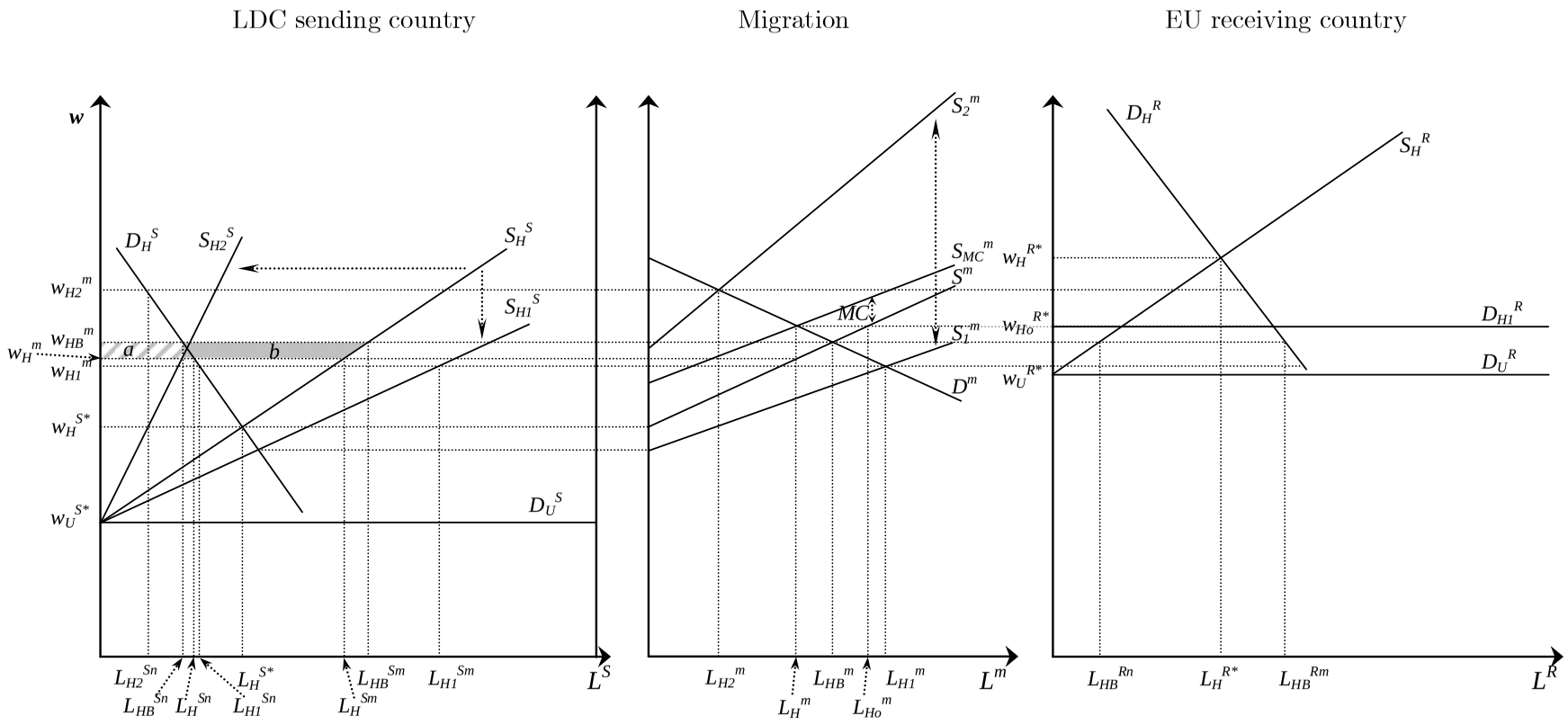

Figure 3: The impact of migration on education equilibrium in LDC

skilled migration and wage than if migrant networks reduce migration costs, MC, with $L_H^m < L_{HB1}^m < L_{HB}^m$ and $w_H^m < w_{HB1}^m < w_{HB}^m$, respectively. With constant migration costs BC leads to a smaller decline of the skilled labour force in LDC than with decreasing migration costs, $L_H^{Sn} > L_{HB1}^{Sn} > L_{HB}^{Sn}$.

2.3. BC impact on R&D and innovation in LDC

Fiscal effect. The fiscal impact of BC is shown in Figure 5. Income taxes paid by skilled and unskilled workers are t_H and t_U, respectively, where $t_H > t_U$. If taxes are paid as a fixed rate of gross wages, then the absolute value of taxes paid by the skilled labour increases under BC, t_{H1}, because of a higher wage, $t_H < t_{H1}$. The total tax revenue without BC is equal to area *abcd*, and to area *ade* with BC. Under BC, the number of individuals who pay taxes declines by $L_H^{Sn} - L_{HB}^{Sn}$ for the skilled labour and by $L_{HB}^{Sm} - L_H^{Sm}$ for the unskilled labour, which reduces tax revenues by area *bc*. Because the skilled labour wage increases with migration, the tax revenue increases by area *e*. If area *bc* is larger than area *e*, then the tax revenue declines, otherwise it increases with the introduction of BC. Thus, the total fiscal impact of BC depends on the relative size of these areas, which in turn depends on the size of the brain drain, the spillover effect, the public technical knowledge transfer effect, the unskilled labour productivity effect and the remittance effect.

Knowledge productivity effect. The knowledge productivity effect is shown in Figure 6 (upper panel), where a smaller skilled workforce implies a downward shift of the marginal productivity curve from MB^S to MB_B^S and the equilibrium knowledge decreases from K_T^m to K_{TB1}^m. An increase in the skilled workforce in EU increases the knowledge productivity. In Figure 6 (lower panel) a higher stock of the skilled labour increases the EU's marginal productivity of knowledge from MB^R to MB_B^R and the equilibrium knowledge increases from K_C^{R*} to K_{CB}^{R*}. More knowledge in EU does not affect the knowledge level in LDC, because the LDC's absorptive capacity is constraining the absorption of more foreign knowledge – both with and without BC only part of the knowledge produced in EU can be absorbed by LDC, $K_T^m < K_C^{R*}$ and $K_{TB1}^m < K_{CB}^{R*}$, respectively.

2.4. BC impact on the knowledge diffusion

Diaspora effect. The skilled worker migration facilitates the spillover of knowledge, technology and business contacts from destination countries. In Figure 6 (upper panel) the marginal cost of the knowledge adoption decreases from MC_A^S to MC_{AB}^S and the equilibrium knowledge stock shifts from K_{TB1}^m to K_{TB}^m.

3. Migration policy options for LDC

3.1. Migration tax

Bhagwati tax. The impact of the Bhagwati tax on the human capital in LDC is shown in Figure 1. Presume that tax, t_H^m, is imposed on emigrating skilled workers (for the sake

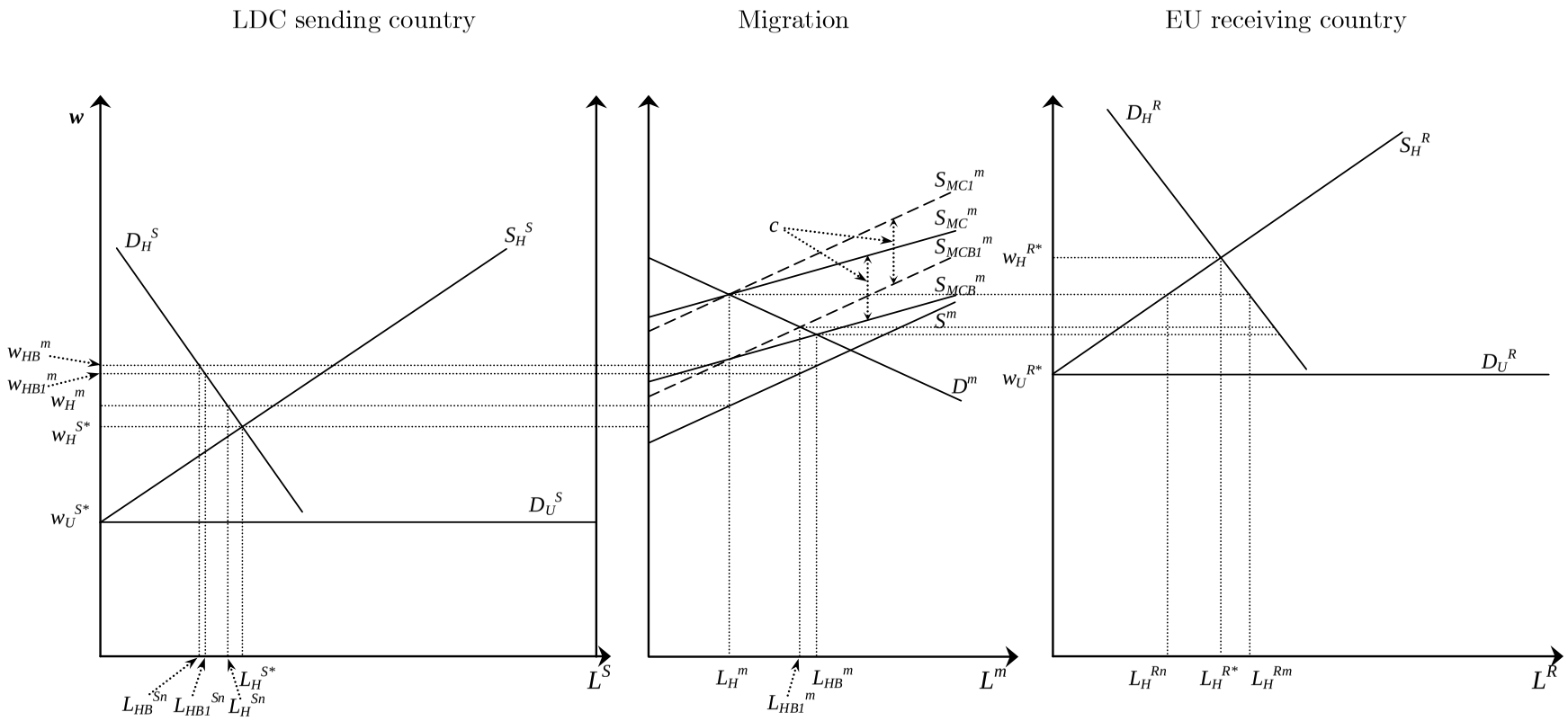

Figure 4: The impact on international distribution of labour force with constant and endogenous migration costs

of simplicity we assume that $t_H^m = MC^*$). The migration tax does not affect domestic workers in LDC and EU. Instead, migration tax reduces the net skilled labour wage of migrant workers from w_{HB}^m to w_H^m. Because of smaller net wage differences between LDC and EU, the number of migrants decreases from L_{HB}^m to L_H^m, with $L_{HB}^m > L_H^m$ and the mass of skilled workers in LDC increases from L_H^{Sn} to L_{Ho}^{Sn}, with $L_H^{Sn} < L_{Ho}^{Sn}$.[9] Note that the skilled worker emigration and the size of the skilled labour force are reduced to their pre-BC levels, because for the sake of simplicity we assumed that the migration tax rate is equal to the migration cost, $t_H^m = MC^*$.

Skill-biased labour tax. In order to simplify the diagrammatic analysis, assume that only the unskilled labour is taxed with a tax rate equal to t_U.[10] A *skill-biased labour tax* affects only the demand for the unskilled labour, which in Figure 7 shifts from D_U^S to D_{Ut}^S. The corresponding shift in the skilled labour supply is from S_H^S to S_{Ht}^S. The skilled labour demand remains unaffected at D_H^S. The skill-biased labour tax reduces the net wage of the unskilled labour. The incentives for education increases, resulting in a higher skilled worker emigration. A higher emigration, in turn, decreases the skilled labour wage. In equilibrium the wage rate for the skilled labour decreases from w_{HB}^m with BC to w_{Ht}^m under the skill-biased tax. A lower wage allows firms in LDC to hire more skilled workers. As a result, the size of the skilled labour force in LDC increases from L_{HB}^{Sn} to L_{Ht}^{Sn}, with $L_{HB}^{Sn} < L_{Ht}^{Sn}$ and emigration increases to L_{Ht}^m, with $L_{Ht}^m > L_{HB}^m$.

Next, assume that LDC is sufficiently small, such that LDC's tax policy does not affect the international wage rate for the skilled labour. This would be the case, for example, if the EU's skilled labour demand is perfectly elastic, such as D_{H1}^R in Figure 7. The skilled wage with BC is w_{Ho}^{R*}, both with and without the skill-biased tax, and will not be affected by the LDC's tax policy. As a result, in both cases with and without taxation of the unskilled labour, the stock of the skilled labour in small LDC will stay unchanged at L_{Ho}^{Sn}. However, in the presence of BC, a skill-biased tax will increase migration from L_{Ho}^m to L_{H2}^m, which is due to a reduced after-tax wage in LDC.

3.2. Skill subsidy

Direct skill subsidy. The impact of a skill subsidy is shown in Figure 8. The initial equilibrium emigration with BC (share of workers which emigrates without the skill subsidy) is given by $L_{HB}^m \left(= L_{HB}^{Sm} - L_{HB}^{Sn}\right)$, the initial stock of the skilled labour by L_{HB}^{Sn}, and the initial wage rate by w_{HB}^m. In order to reduce the cross-country wage gap, which drives migration, LDC grants the skill subsidy, s_H. The effect of the direct skill subsidy is shown in Figure 8, where the skill subsidy shifts the supply of the skilled labour down from S_H^S to S_{HS}^S. The demand for the skilled labour is, however, not affected at

[9] If feasible, migration quota/restriction would have a similar effect to Bhagwati tax on human capital in LDC. The only difference is that migration quota would not contribute to government budget.

[10] If both types of labour were taxed, then t_U would represent the tax difference between skilled and unskilled work.

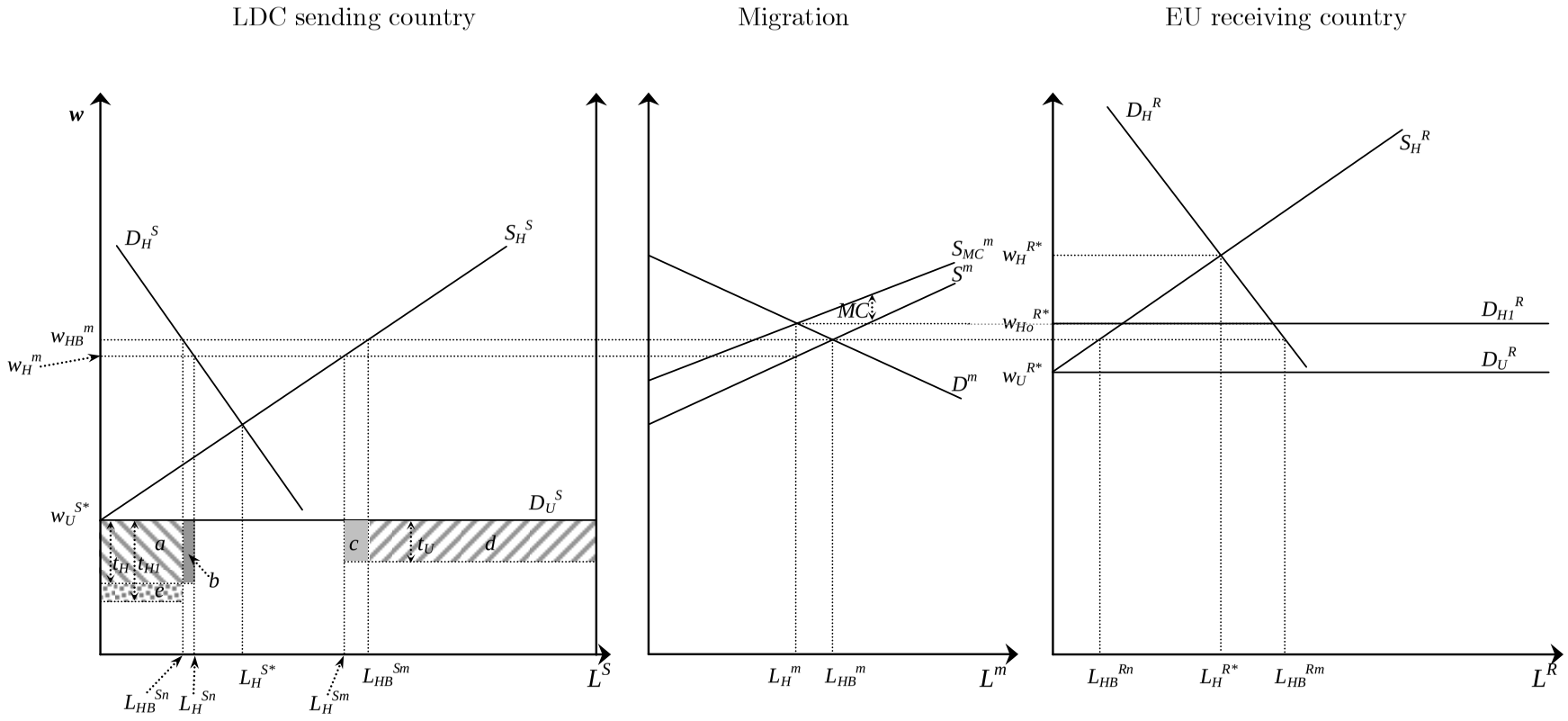

Figure 5: The fiscal effect of the EU Blue Card

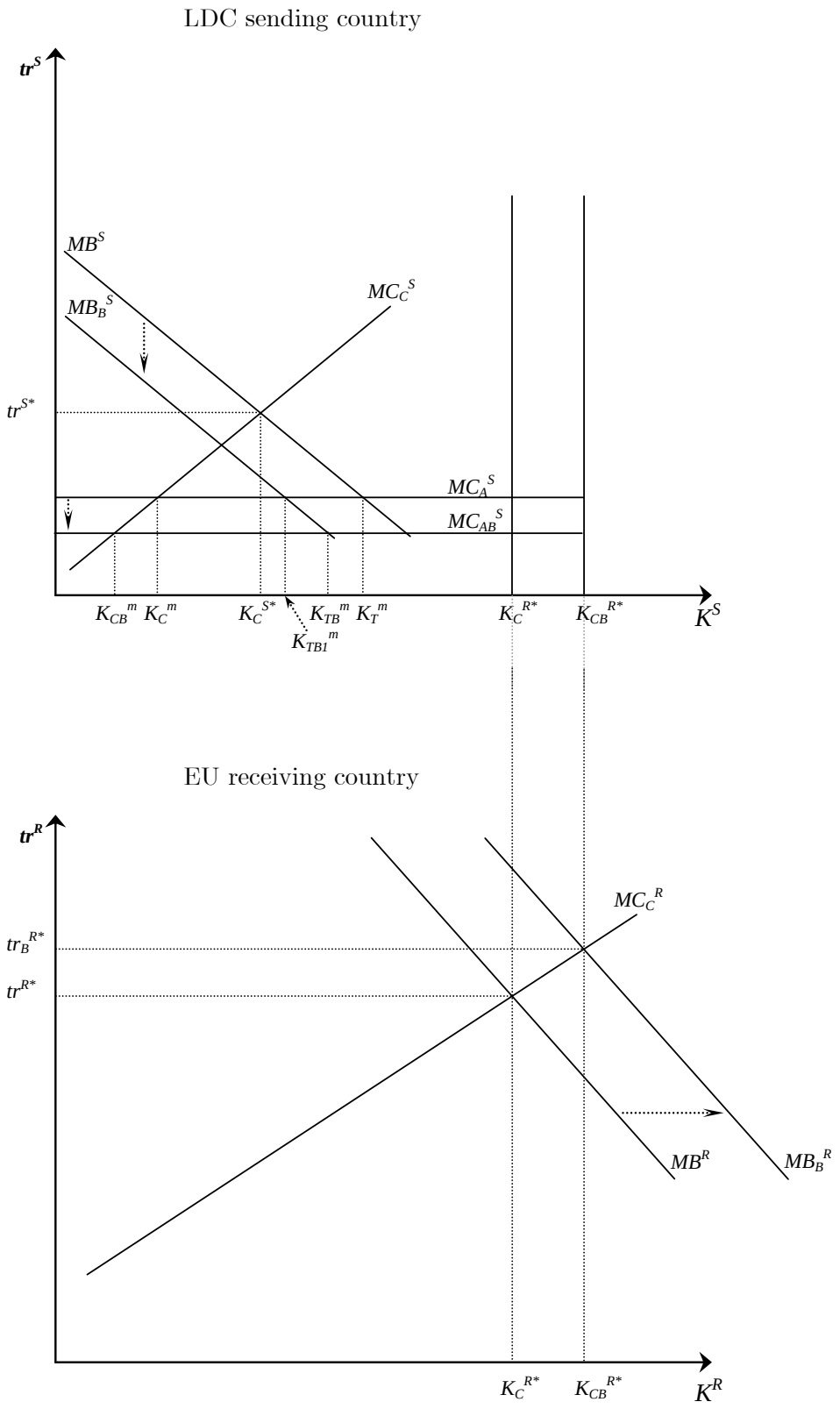

Figure 6: The impact on knowledge capital

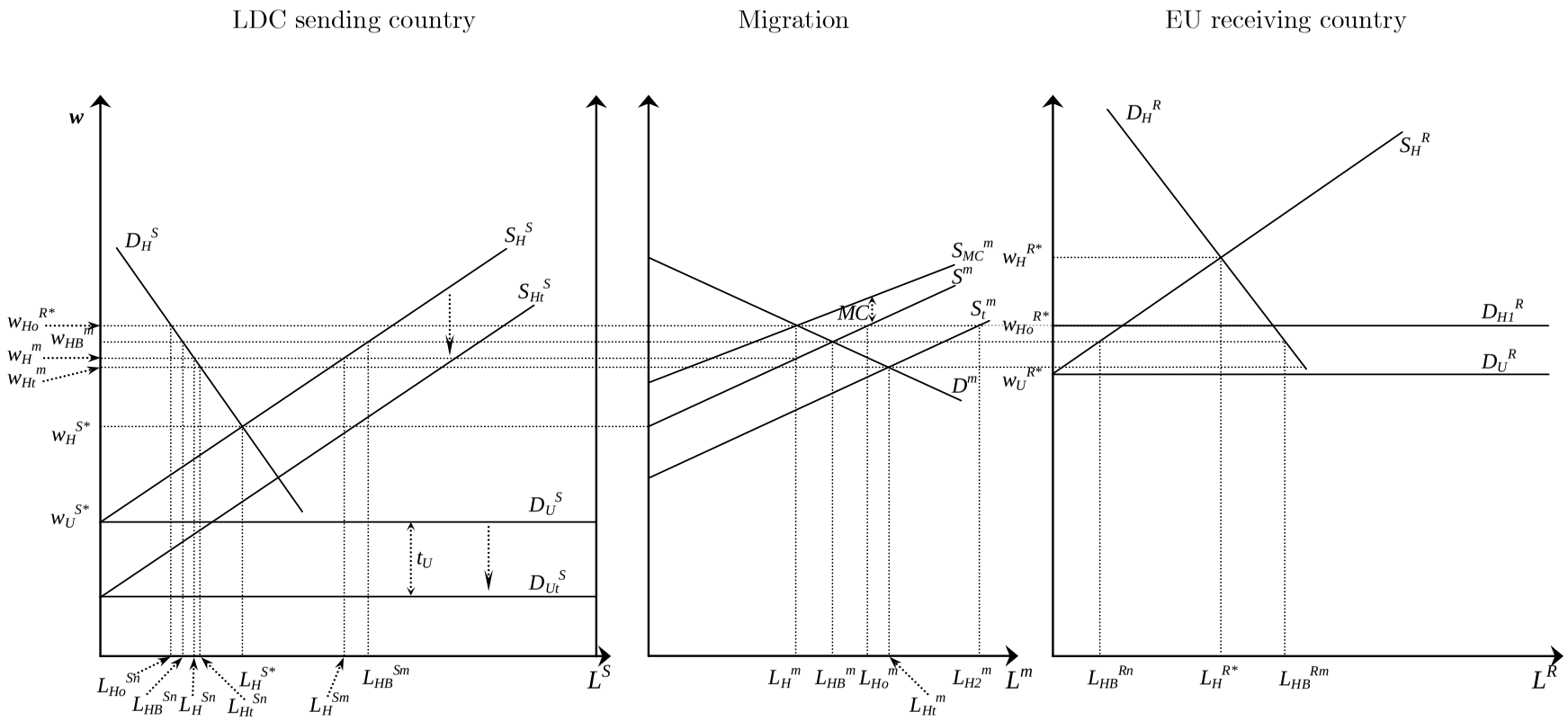

Figure 7: The impact of a skilled biased tax

D_H^S. As a result, the wage rate for the skilled labour decreases from w_H^m to w_{Hs}^m. The total income of the skilled labour is equal to wage plus subsidy, $w_{Hs}^m + s_H$. The size of the skilled work force in LDC increases from L_{HB}^{Sn} to L_{Hs}^{Sn}, with $L_{HB}^{Sn} < L_{Hs}^{Sn}$. Note that the stock of the skilled labour increases only because of the indirect wage effect - the skilled wage decreases from w_{HB}^m to w_{Hs}^m. As a result, firms in LDC hire more skilled workers. However, if LDC is small enough, i.e. with a perfectly elastic skilled labour demand, D_{H1}^R, the wage rate and LDC's skilled labour stock stays at w_{Ho}^{R*} and L_{Ho}^{Sn}, respectively, both with and without the skill subsidy. The skilled labour migration increases from L_{HB}^m to L_{Hs}^m, with $L_{HB}^m < L_{Hs}^m$ (and from L_{Ho}^m to L_{H2}^m, with $L_{Ho}^m < L_{H2}^m$ in the case of a small LDC).

Indirect skill subsidy. The effect of the indirect skill subsidy is shown in Figure 8, where the subsidy does not affect the supply of the skilled labour, S_H^S, but instead shifts to the demand for the skilled labour from D_H^S to D_{Hd}^S. Because of a higher labour demand, the wage rate for the skilled labour increases from w_{HB}^m to w_{Hd}^m. A higher domestic wage implies that less skilled workers have incentives to emigrate. As a result, migration decreases from L_{HB}^m to L_{Hd}^m, with $L_{Hd}^m < L_{HB}^m$. In the same time, because of a higher wage, the stock of the skilled labour in LDC increases from L_{HB}^{Sn} to L_{Hd}^{Sn}, with $L_{HB}^{Sn} < L_{Hd}^{Sn}$. Comparing the two types of skill subsidies (direct and indirect) suggests that the skill subsidy to firms is a more efficient policy than paying it directly to skilled workers: (i) there are more skilled workers in LDC, $L_{Hs}^{Sn} < L_{Hd}^{Sn}$, (ii) less skilled workers emigrate, $L_{Hs}^m > L_{Hd}^m$, and (iii) budgetary costs are lower, $s_H L_{Hs}^{Sm} > s_H L_{Hd}^{Sn}$.

3.3. Education subsidy

Direct education subsidy. The effect of the direct education subsidy is similar to the direct skill subsidy. As above, the stock of the skilled labour increases only because of the indirect wage effect. A higher supply of the skilled workforce exerts a downward pressure on the skilled labour wage, which decreases. If the skilled wage rate would not change, then the stock of the skilled labour would remain the same. Therefore, this policy is ineffective in terms of increasing the LDC's human capital. In addition, the direct education subsidy also increases migration. The stock of the skilled labour in LDC depends only on the skilled wage effect in EU, but not on the education policy directly. The effect of the conditional education subsidy is shown in Figure 8, where the stock of skilled workforce increases from L_{HB}^{Sn} with BC to $L_H^{S^*}$ with the conditional education subsidy. As a result, all skilled workers stay in LDC and there is no migration.

Indirect education subsidy. In Figure 8, the support for education at the firm level (indirect education subsidy) will shift the demand for the skilled labour up. A higher demand for the skilled labour exerts an upward pressure on the skilled labour wage. Because of a higher skill premium, the stock of the skilled labour in LDC increases. Hence, the indirect education subsidy is more efficient than a policy addressing education through the labour market supply side (direct education subsidy) for three reasons: (i) a higher stock of skilled labour, (ii) a lower migration, and (iii) lower budgetary costs.

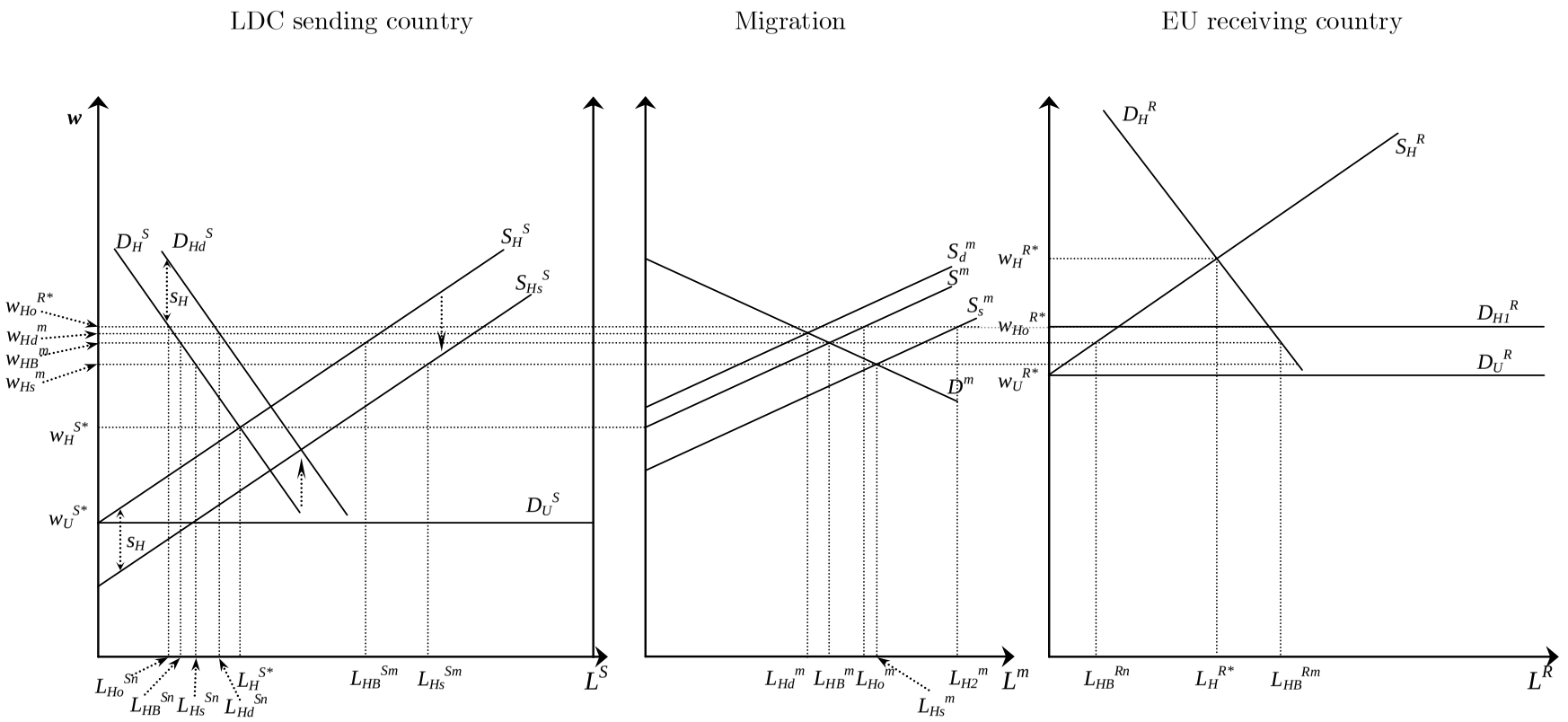

Figure 8: The impact of a skill subsidy

Remittance effect. By increasing incentives for investing remittances into education, the stock of skilled workers increases in LDC. This can be seen in Figure 9. Increase in the remittance tax rate for consumption goods changes the relative price of remittances spent on consumption and investment,[11] which in turn shifts the skilled labour supply from S_H^S to S_{Hr}^S. As a result, the stock of the skilled labour in LDC increases from L_{HB}^{Sn} to L_{Hr}^{Sn}.[12] As above, the efficiency of the education remittance tax relief can be improved by granting the tax relief only for those skilled workers that remain in LDC, because part of newly educated workers emigrates (in Figure 9 the skilled labour migration increases from L_{HB}^m to L_{Hr}^m).

3.4. R&D and innovation policies

Knowledge adoption subsidy. The knowledge adoption subsidy can be implemented in two ways: co-financing the cost of the knowledge adoption or subsidising the demand for knowledge, MB_B^S. Figure 10 (upper panel) shows the effect of a policy, which co-finances the cost of the knowledge adoption. We assume that the LDC government pays a knowledge subsidy, s_K, per unit of the adopted knowledge. The knowledge adoption subsidy reduces the marginal costs of the knowledge adoption from MC_{AB}^S to MC_{As}^S, which increases the LDC's equilibrium knowledge from K_{TB}^m with BC to K_{Ts}^m with s_K.

Knowledge production subsidy. Another option for LDC is to subsidise the creation of a new knowledge. Assume that the LDC's government pays the same subsidy, s_K, to reduce the cost of the new knowledge creation. In Figure 10 (upper panel) this implies that the marginal cost curve of the knowledge creation shifts from MC_C^S to MC_{Cs}^S. In this case the *knowledge production subsidy*, s_K, does not affect the equilibrium level of knowledge in LDC. Hence, in the presence of BC, the knowledge stock stays unchanged at K_{TB}^m both with and without s_K. The knowledge production subsidy, s_K, only changes the equilibrium distribution between the new knowledge and adopted knowledge: it increases the knowledge innovation from K_{CB}^m to K_{Cs}^m, and decreases the adopted knowledge from $K_{TB}^m - K_{CB}^m$ to $K_{TB}^m - K_{Cs}^m$. Subsidising the production of new knowledge only offsets the cost disadvantage of the new knowledge production compared to the knowledge adoption and leads to a zero (or small) increase in the total knowledge capital in LDC.[13]

Investing in the R&D increases the productivity of both the skilled and the unskilled labour. Because the efficiency of subsidies invested in the new knowledge creation is

[11] In most developing countries remittances are subject to income tax (*Chami*, *Fullenkamp* and *Jahjah* 2003).

[12] Note that the stock of skilled labour increases only because of the indirect wage effect. In the case of a small LDC country, the tax relief for remittances invested in education will not affect the LDC skilled labour. With perfectly elastic skilled labour demand D_{H1}^R the wage rate and LDC skilled labour stock stays at w_{Ho}^{R*} and L_{Ho}^{Sn}, respectively, both with and without the tax relief for remittances.

[13] Note that if marginal costs of knowledge adoption, MC_{AB}^S, is not constant but increasing in knowledge adoption, then subsidising the creation of new knowledge will result in higher knowledge stock in equilibrium. However, because creation of knowledge is more expensive than adoption of foreign knowledge (i.e. in terms of Figure 2 the slope of MC_C^S is higher than the slope of MC_{AB}^S), the result that subsidising the creation of new knowledge is less efficient than subsidising the adoption of knowledge holds in general.

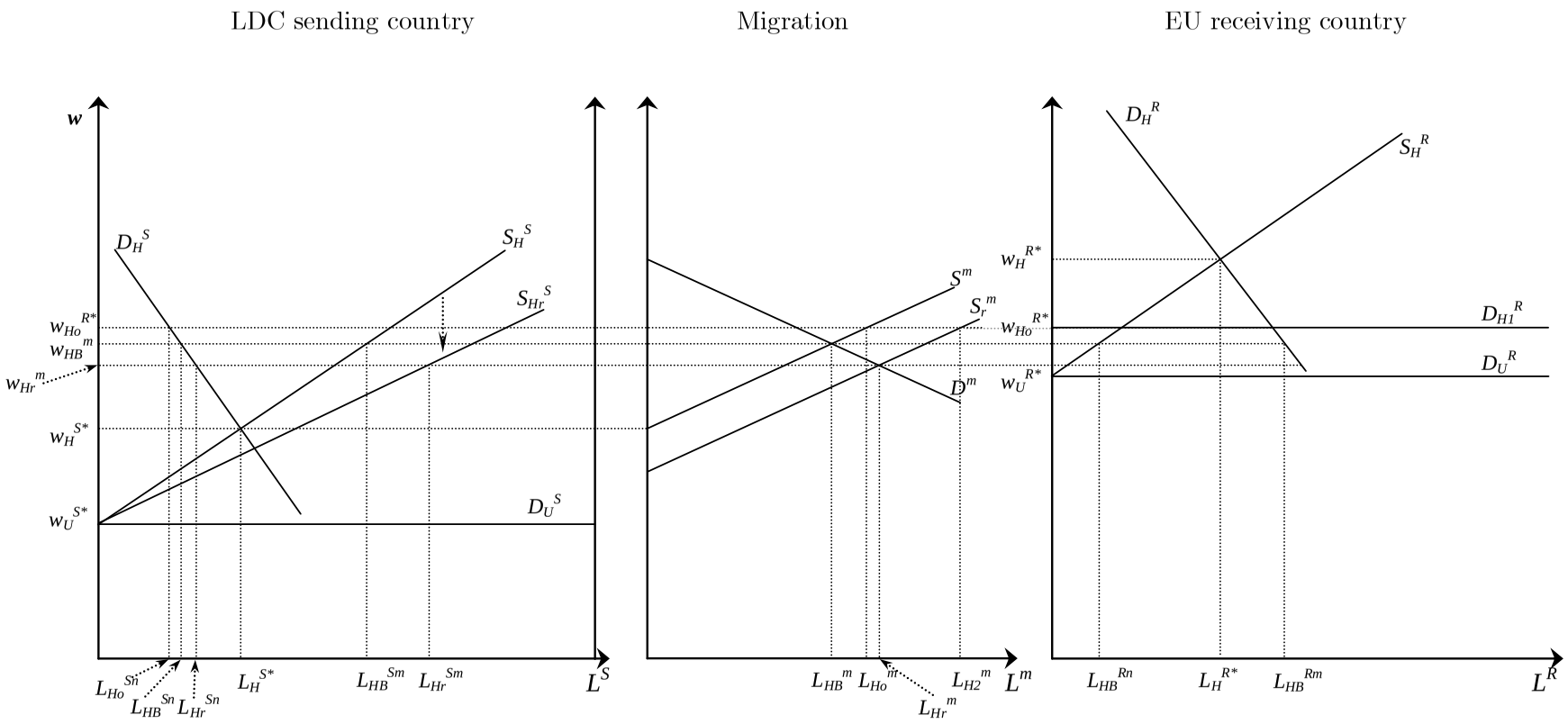

Figure 9: The impact of remittances

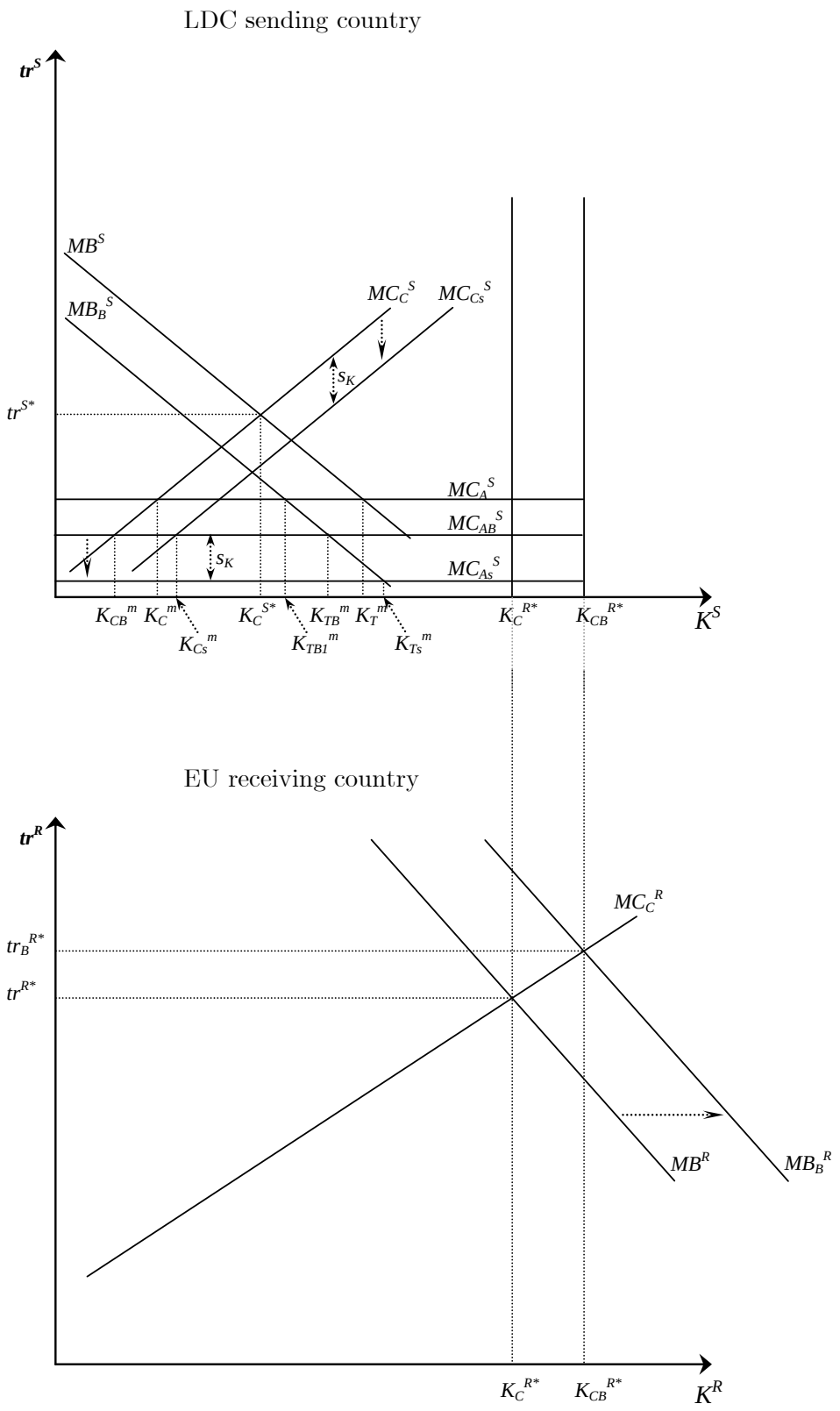

Figure 10: The impact of the knowledge creation and knowledge adoption subsidies

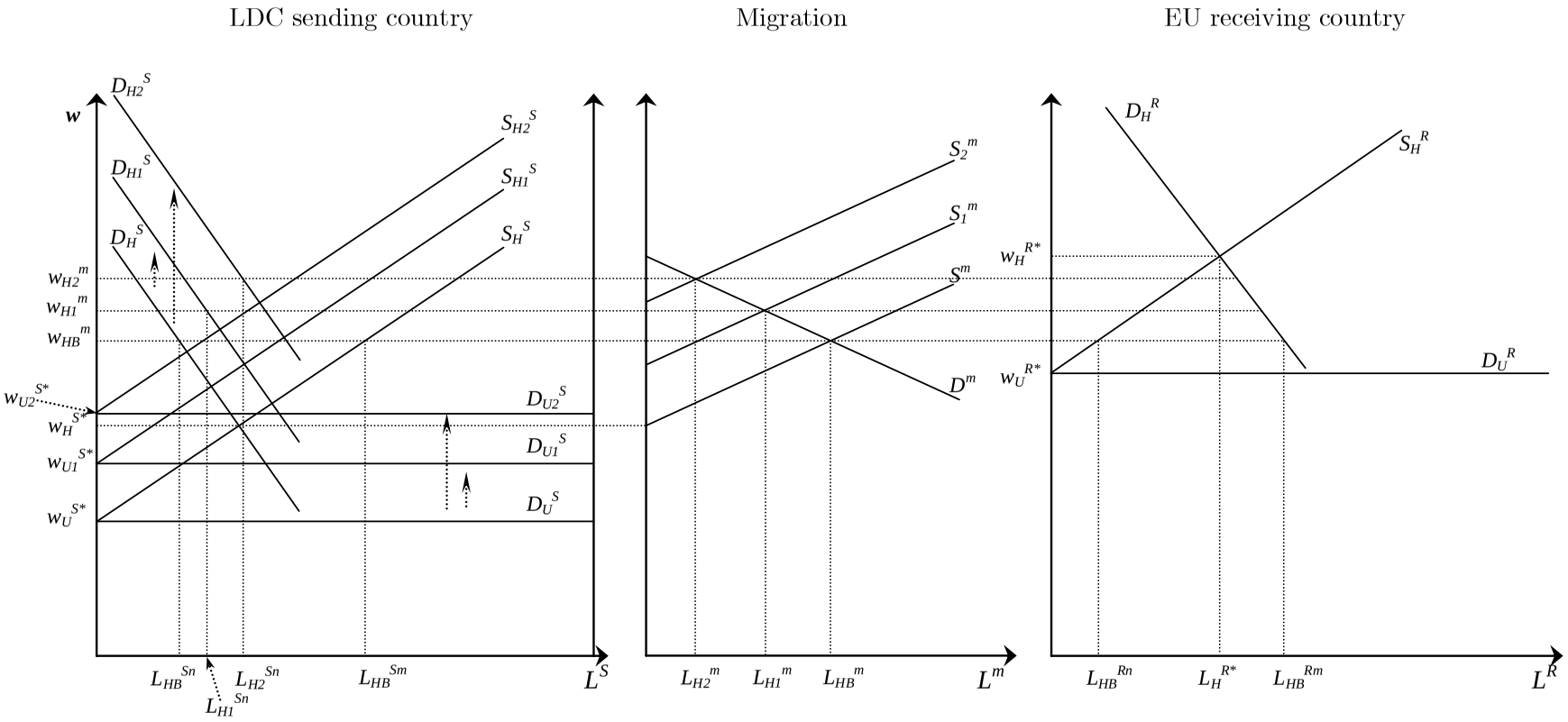

Figure 11: The impact of public R&D

lower than the efficiency of subsidies invested in the knowledge adoption, the increase in labour productivity is higher with the latter than with the former policy. These effects are shown in Figure 11. Investing in the production of new knowledge increases the skilled labour demand from D_H^S to D_{H1}^S and the unskilled labour demand from D_U^S to D_{U1}^S (Figure 11, left panel).[14] Due to the increase in the unskilled labour wage, the skilled labour supply increases from S_H^S to S_{H1}^S. Because of a smaller wage gap between EU and LDC, the stock of the skilled labour in LDC increases from L_{HB}^{Sn} to L_{H1}^{Sn} , with $L_{HB}^{Sn} < L_{H1}^{Sn}$, and the migration of skilled workers decreases to L_{H1}^m , with $L_{HB}^m > L_{H1}^m$. As shown in Figure 10, reallocating subsidies from the knowledge production to the foreign knowledge adoption, the knowledge capital increases stronger and hence the labour productivity in LDC increases more. In Figure 11, a higher productivity shifts the labour demand upwards from D_H^S to D_{H2}^S for the skilled labour and from D_U^S to D_{U2}^S for the unskilled labour, respectively. The skilled labour supply shifts up from S_H^S to S_{H2}^S, whereas migration decreases to L_{H2}^m , with $L_{HB}^m > L_{H1}^m > L_{H2}^m$. The stock of the skilled labour in LDC increases to L_{H2}^{Sn} , with $L_{H2}^{Sn} > L_{H1}^{Sn} > L_{HB}^{Sn}$.

4. Limitations

Turning to the limitations, we recognise that a number of assumptions, that were necessary for the conceptual analysis, may prevent from the generalisation of our results. For example, for the sake of the graphical tractability, we had to assume that there are only two countries (one less developed country (LDC) and one more developed (EU)), and only two types of skills (unskilled and skilled). Introducing more countries & skill levels could add the intensive margin to the analysis. In addition to deciding whether to invest into education and become skilled and whether to migrate, workers could also decide about how much to invest into education and to which country to migrate. The underlying intuition, however, would not change.

Second, the labour economics theory (see for example *Agenor* 1996) suggests that labour markets can adjust in response to macro-economic and policy shocks through many different channels: changes in unemployment; changes in the labour force participation; changes in the worker remuneration; the labour migration; and others. In the present study we consider only three channels of labour market adjustments (wage, education and migration), whereas we abstract from other important channels, such as the labour demand, participation and employment, which are captured in general equilibrium models.

Third, in the diagrammatic analysis, we assume that the demand for the unskilled labour is infinitely elastic. If the elasticity of the unskilled labour demand would be partially elastic, then there would be an additional unskilled wage effect, which would

[14] Here we assume that subsidies invested in new knowledge creation increase knowledge stock in LDC. This holds when marginal costs of knowledge adoption, MC_{AB}^S, are increasing in knowledge adoption.

affect the ratio of skilled/unskilled workers in LDR. However, the presented diagrammatic analysis serves for illustrative purposes only, to more transparently show the main drivers of skilled labour adjustments. Moreover, it can be easily verified that, as long as the skilled/inskilled ratio in higher in EU than in LDC, the results with the unskilled labour migration would be qualitatively equal to those presented in this study.

Fourth, we recognise that in reality the migration decision of workers is driven not only by wage and employment probability differences, but also by many different non-economic considerations, such as social ties, location preferences, etc. In addition, migration costs include not only direct transportation costs to the destination country, but also the employment uncertainty (which is higher abroad than at home), social costs of leaving family and/or friends behind, cultural adjustment costs, language barriers etc (*Straubhaar* 1986). For the sake of the graphical tractability, in the present study we abstract from all other determinants of migration and consider only cross-country wages differences as the sole force driving the labour migration.

Fifth, for the sake of the graphical tractability of the diagrammatic analysis, additional simplifying assumptions are introduced regarding the public costs of education, the temporary migration of skilled workers, which may facilitate the diffusion of knowledge between more developed and less developed countries, adjustments in the labour demand to changes in the labour supply and wages – they all are neglected in the present study (see e.g. *Jonkers* and *Cruz-Castro* (2013), for benefits from return migration). In order to consider all key determinants of labour market outcomes, the use of general equilibrium models is required.

Sixth, in the present study we assume differences in marginal costs between the knowledge creation and the knowledge adoption. This is consistent with previous findings in the literature. According to *Mansfield* (1981), on average, imitation costs are about 65 percent of the original innovation costs. Further, we assume that both the new and adopted knowledge are homogenous in production, i.e. they do not differ with respect to marginal productivities. In reality, however, the marginal costs of the knowledge adoption may increase with the additional knowledge adopted. Hence, the slope of the marginal costs of the knowledge adoption should be lower than the marginal costs of the knowledge creation (*Mansfield* 1981). For the sake of the graphical tractability of the diagrammatic analysis, we assume constant marginal costs of the knowledge adoption, though the results hold in general.

Further, we acknowledge that the human capital accumulation does not stop at the formal education, nor does the knowledge accumulation stop at R&D activities. For example, the knowledge-based capital can increase, if migrants are employed in conducive environments. Analogously, the social capital dimension of the knowledge production is not considered in the present analysis, as it would be rather difficult to incorporate it into a diagrammatic framework.

Finally, in the context of international labour migration policies, there are important policy implementation constraints: (i) government budget, (ii) political support, and (iii)

country openness, and others. First, if there would be no restrictions to the government expenditure, then through wage subsidies the LDC's government could straightforwardly increase the wage rate up to the EU level, and there would be no economically-driven migration either with or without BC. Second, if staying at power would not be a government objective, then it could infinitely increase the tax rate for the unskilled labour, decrease for the skilled labour and achieve similar results. Third, if restricting the outward migration would be a feasible policy option for LDC, then government could isolate LDC from the rest of the world, and there would be no international labour migration in autarky. Although, all three policy scenarios are unrealistic and hence infeasible, in the diagrammatic analysis presented in this study we are not able to account for these issues.

To summarise, although accounting for selected key aspects of the knowledge-based capital in LDC– the human capital and knowledge stock – the presented diagrammatic analysis cannot provide policy makers with a definite answer of potential impacts of the revised EU Blue Card proposal on growth prospects in LDC. For such questions the use of general equilibrium models with endogenous labour adjustments through education, migration, participation and employment is required. Nevertheless, by identifying and examining the key challenges of adjustments in the knowledge-based capital, our study contributes to a better understanding of challenges potentially arising from the EU Blue Card in LDC and available policy opportunities.

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