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Children from migrant backgrounds

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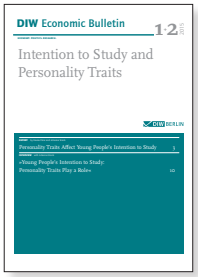

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Children from migrant backgrounds: who are their Kita peers?

By Ludovica F. Gambaro

In Germany, attendance in early childhood education and care (ECEC) centers has soared in the last twenty years, making them a key context in which children learn. For children from migrant backgrounds who speak a foreign language at home, participation in ECEC has the potential of providing them with early German language exposure. One important but often overlooked factor in this respect is the composition of a child's peer group. Do children from migrant backgrounds attend ECEC centers where the majority of their peers are also from migrant backgrounds? This report offers the first systematic evidence for Germany of how children, and children from migrant backgrounds in particular, are distributed across ECEC centers, thus assessing the level of segregation. Using administrative data from 2007 to 2016, it shows that one-third of children who mainly speak a foreign language at home attend centers where the majority of their peers have a similar background. The report argues that peer group composition is a crucial aspect affecting the quality of children's experiences in ECEC. Luckily, it is also an aspect that can be influenced by careful policy design.

Over the last two decades, early childhood education and care (ECEC) centers have been awarded increasing priority and spending in Germany. The entitlement to a *Kindergarten* place for children aged three, which came into force in 1996, led to an increase in the number of places available for this age group. Similarly, the 2013 introduction of the right to a place upon a child's first birthday further drove expansion of services for children under three. As a result, 94 percent of children aged between three and the school entry age and 34 percent of children under the age of three were attending an ECEC center in 2016.[1]

The provision of ECEC makes it possible for parents—more specifically mothers—to work in the paid labor market, which is instrumental to the policy goal of achieving a higher labor market participation rate. At the same time, as children can profit from attending an ECEC center, these services can help reduce educational inequalities. In Germany, where the gap in educational attainment between students from migrant backgrounds and students born to German families is especially large,[2] there has been a growing interest in the potential of ECEC to support early German language acquisition and foster greater social cohesion.

Attending an ECEC center, however, does not automatically lead to success in school or integration: The quality of what takes place within the center is increasingly understood to be important.[3] The evidence so far is not

1 Statistisches Bundesamt, "Betreuungsquoten der Kinder unter 6 Jahren in Kindertagesbetreuung am 01.03.2016" (2017) (in German; available online, accessed November 29, 2017; this applies to all other online sources in this report unless stated otherwise).

2 Autorengruppe Bildungsberichterstattung, "Bildung in Deutschland 2016. Ein indikatorengestützter Bericht mit einer Analyse zu Bildung und Migration" (Bielefeld: Bertelsmann Verlag, 2017) (in German); Petra Stanat and Gayle Christensen, "Where Immigrant Students Succeed – A Comparative Review of Performance and Engagement in PISA 2003" (Paris: OECD, 2006).

3 See for example Yvonne Anders et al., "Home and preschool learning environments and their relations to the development of early numeracy skills," *Early Childhood Research Quarterly* 27, no. 2 (2012): 231–244.

Box 1

Data, definitions, and measures

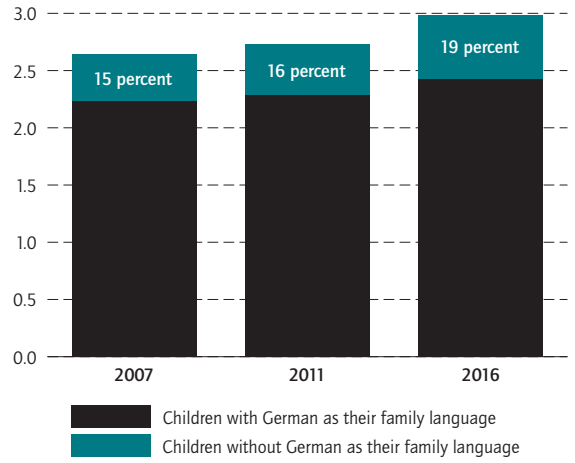
Data source: We use data from the *Kinder- und Jugendhilfestatistik*, in particular the series "*Statistik der Kinder und tätigen Personen in Tageseinrichtungen* (EVAS 22,541)," for the years from 2007 to 2016. This series is a return collected every March from all ECEC centers in Germany, including information on the center, the children enrolled, and those employed. It thus represents the entire ECEC population. For the analysis of concentration of children by migrant background, we exclude centers in East Germany and centers that have fewer than five children.

Definition of migrant background: We use an indicator based on whether German is the main language spoken at home (*deutsche Familiensprache*) or not (*nichtdeutsche Familiensprache*). An alternative indicator would have been based on whether at least one of the child's parents has a foreign background (*ein Elternteil des Kindes stammt aus einem ausländischen Herkunftsland, ist also zugewandert*). A definition based on language is more restrictive and includes approximately 63 percent of the children who are considered to be from a migrant background on the basis of having at least one parent with a foreign background.

Figure 1

Increase in the number of children attending an ECEC center in Germany

Millions, children with or without German as their family language



Note: Data include children aged from zero to six.

Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Statistik der Kinder und tätigen Personen in Tageseinrichtungen (EVAS 22541), survey years: 2007, 2011, 2016; authors' own calculations.

In 2016, close to three million children were attending an ECEC center, of which 19 percent had another family language than German.

reassuring. Researchers have shown that parents from migrant backgrounds tend to choose ECEC centers that are of slightly lesser quality, as measured by a variety of indicators.[4] The NUBBEK study on early childhood education and care reported that the pedagogical quality observed in classrooms with a higher proportion of children with a non-German background was significantly lower than in classrooms with fewer migrant children.[5] In another study, children's vocabulary was found to grow faster in classes with a lower proportion of children from migrant backgrounds than in classes with relatively higher proportions.[6] And, arguably, if children from migrant backgrounds attend highly segregated centers, integration is unlikely to materialize.

Yet we still know relatively little about the composition of children's peer groups in ECEC centers. Are most children from migrant backgrounds enrolled in centers where the majority of their peers are also from migrant backgrounds? Has the recent expansion of ECEC been accompanied by an increase or decrease in the levels of concentration of children from migrant backgrounds within centers? Is there a role for ECEC policy to influence the centers' composition? These are the questions that this report seeks to answer. By drawing on national administrative data spanning over ten years, this report is able to offer for the first time a comprehensive picture of how children are distributed in ECEC centers across Germany. It also reflects on why the composition of children's peer groups is important for their development and what future research should seek to uncover.

Before starting, however, it would be helpful to clarify how we define children from migrant backgrounds. For the purpose of this report, these are children who at home primarily speak and are exposed to a language other than German (Box 1). This definition is widely used and also particularly pertinent to this age group, as it identifies children who, on average, have a lesser ability to converse

4 Juliane Stahl, Pia Schober, and C. Katharina Spieß, "Parental Socio-Economic Status and Childcare Quality: Early Inequalities in Educational Opportunity?" (working paper, *Early Childhood Research Quarterly*).

5 Wolfgang Tietze et al., "NUBBEK. Nationale Untersuchung zur Bildung, Betreuung und Erziehung in der frühen Kindheit" (Weimar: Verlag das Netz, 2013); See also Susanne Kuger and Katharina Kluczniok, "Prozessqualität im Kindergarten – Konzept, Umsetzung und Befunde," *Zeitschrift für Erziehungswissenschaft*, Sonderheft no. 11 (2012): 159–178 (in German).

6 Susanne Ebert et al., "Internal and external influences on vocabulary development in preschool children," *School Effectiveness and School Improvement* 24, no. 2 (2013): 138–154.

in the language of instruction. This labelling has a pejorative connotation, as it implies a deficit, although we do not know how much and how well German is also spoken at home. These children could also be described as having German as an additional language.

A stable concentration of children whose main language at home is not German

Our analysis is based on data from the Kinder- und Jugendhilfestatistik (Box 1). We use information from 2007 to 2016, covering all ECEC centers in Germany and including information on all children enrolled. Crucially for our purposes, the dataset reports whether or not each child speaks German as the main language at home. This information has been collected since 2006, thus limiting how far back in time this empirical exercise can go. Given that in East Germany the presence of children from migrant backgrounds—however defined—is extremely low, our analysis focuses on West Germany, including Berlin.[7] This means that our analysis does not apply to the whole of Germany, but nonetheless covers around three quarters of all children attending ECEC centers.

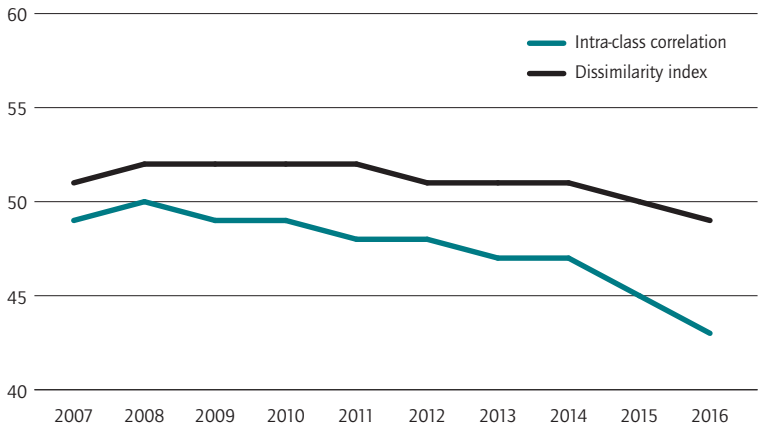
In 2007, approximately 2.6 million children were enrolled, 15 percent of whom did not speak German as the main language at home (Figure 1). By 2016, the number of children enrolled had increased to almost three million, with 19 percent of them not speaking German as the main language at home. Although we do not report it here, the data show that the expansion was driven by the opening of new centers rather than by increasing the capacity of existing ones so that the average size of centers remained constant (around 75 children per center).

The index of dissimilarity, the most commonly used measure of segregation in social science, hovers around 50 percent throughout the period from 2007 to 2016 (Figure 2), indicating that approximately half of the children without German as their main language at home would need to change ECEC centers if we wanted to achieve an even distribution. A small decline from 51 to 49 percent is noticeable. To offer an alternative measure of clustering, we also calculate the intra-class correlation coefficient, which estimates dependence within centers. In practice, the measure captures to what extent children within one center are more similar to each other than children across settings. The intra-class correlation shows, as in the case of the dissimilarity index, little change between 2007 and 2016, albeit with a slight reduction in most recent years.

Figure 2

Concentration of children with a foreign family language in German ECEC centers

Percent, as measured by two indexes



Note: Data include children aged from zero to six attending ECEC centres in Western Germany and Berlin. ECEC centers with fewer than five children enrolled are excluded.

Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Statistik der Kinder und tätigen Personen in Tageseinrichtungen (EVAS 22541), survey years: 2007–2016; authors' own calculations.

The concentration of children with a family language other than German in ECEC centers has declined slightly in recent years.

The expansion of ECEC places since 2007 has mainly affected children under three. We therefore checked whether patterns differ depending on the children's age, but the results show that they do not.

As centers are fairly large, a child's peer group at each point in time is likely to be better reflected by the group or class a child is in.[8] However, most centers do not group children according to age. Thus, a child's peer group changes from one year to the next as older children leave for school and new, younger peers enter.[9] While the data do not allow any longitudinal analysis, this means that a center's overall intake for one year contributes to a child's peer group composition over the years of attendance.

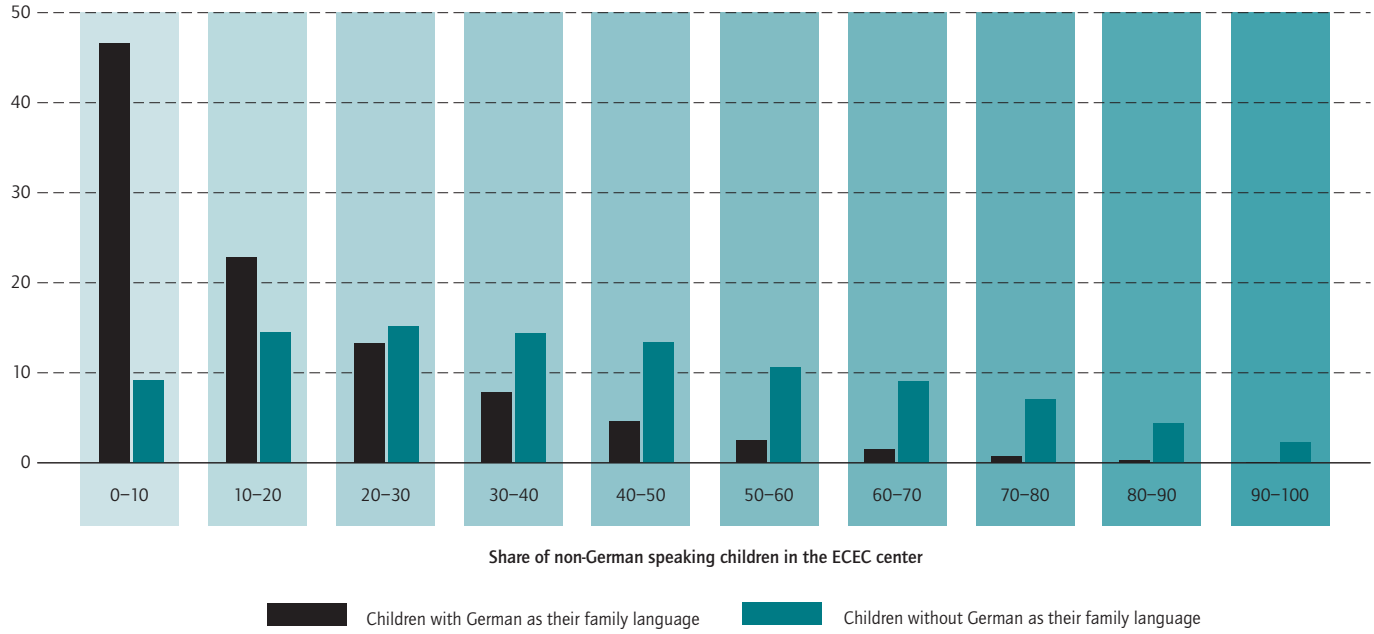
7 In East Germany (excluding Berlin), the share of children who do not have German as their main language at home is less than four percent, compared to approximately 21 percent in the rest of Germany. Analyses of clustering and segregation require groups to be fairly large, making analyses of clustering by migrant background in East Germany not viable.

8 Not all centers operate this way: approximately 15 percent of centers have an open group policy, whereby children are not assigned to a specific group.

9 A recent study of how quality in ECEC varied over a period of three years found that group composition was the factor most likely to change, with repercussion on the pedagogical quality observed. Susanne Kuger et al., "Stability and patterns of classroom quality in German early childhood education and care," *School Effectiveness and School Improvement* 27, no. 3 (2016): 418–440.

Figure 3

Percentage of peers whose family language is not German in 2016
In percent, for children with and without German as their family language



Note: Data include children aged from zero to six attending ECEC centers in Western Germany and Berlin. ECEC centers with fewer than five children enrolled are excluded.

Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Statistik der Kinder und tätigen Personen in Tageseinrichtungen (EVAS 22541), survey year: 2016; authors' own calculations.

Children for whom German is not the family language are much more likely than native speakers to have peers whose family language is also a foreign language.

One third of children who do not speak German at home primarily have peers who also do not speak German at home

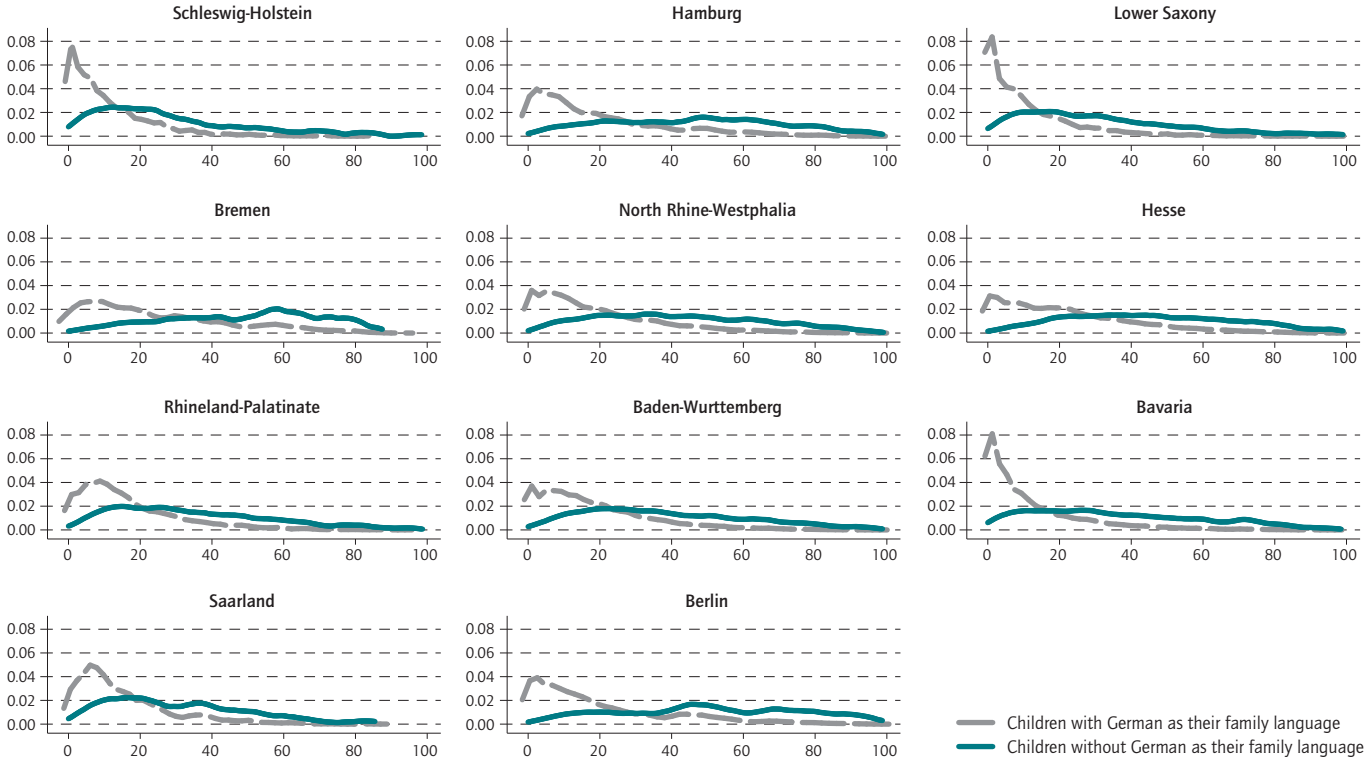
The index of dissimilarity and the intra-class correlation suggest that the overall level of concentration of children from migrant backgrounds in ECEC centers is fairly high and has been stable for a long time. A more concrete way to see what it implies for children is to break down the proportion of peers without German as their main language at home in bands of ten percentage points (Figure 3).

For each individual child, we calculate the percentage of peers in the center she attends who mainly speak another language at home, excluding the individual child herself. We do so separately for children with German and non-German language backgrounds. In 2016, most of the children speaking predominantly German at home (over 80 percent) attended centers where less than 30 percent of their peers spoke mainly another language at home. By contrast, one-third of the children for whom German is not the main language at home were in centers where the majority of their peers (50 percent and above) were also from families who did not use German as their main language. Only a minority of children from non-German-speaking families experienced a concentration of similar peers below 20 percent.

Such contrasting patterns of peer group composition emerge in all federal states, although the differences between the two groups—children from a German and those from a non-German background—is least pronounced in Baden-Württemberg and North Rhine-Westphalia (Figure 4). In these two states, the overall higher presence of children predominantly speaking another language at home makes it more likely for children from mainly German-speaking families to be in ECEC centers where 20 to 40 percent children of the children in their peer group did not speak mainly German at home.

Figure 4

Concentration of peers with family language other than German across federal states
Kernel density, for children with and without German as their family language



Note: Data include children aged from zero to six. ECEC centres with fewer than five children enrolled are excluded.

Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Statistik der Kinder und tätigen Personen in Tageseinrichtungen (EVAS 22541), survey year: 2016; authors' own calculations.

The difference between children with German as a family language and those with another language is the narrowest in Baden-Württemberg and North Rhine Westphalia, as far as the concentration of their peers is concerned.

Children's peer group composition: does it matter?

So far we have established that there is a fairly high level of concentration of children from non-German language backgrounds in ECEC centers, that is children from migrant backgrounds—as defined by language—tend to attend centers which cater to far higher proportions of children from migrant backgrounds than children with German as their main home language. We now turn to the question of whether the level of reported concentration matters. To answer, we draw on previous research with the aim of highlighting the gaps in the current evidence and new directions needed to advance our knowledge.

As attendance rates have increased, ECEC has become a key context in which young children begin to develop social skills, establish social relationships, and learn to interact with each other. Besides being an explicit policy goal,[10] promoting social competencies is a fundamental pedagogical objective of most early childhood centers, which results in a strong emphasis on providing children with ample opportunities for peer-to-peer interactions.

10 The relevant law, the Child and Youth Services Act (*Kinder- und Jugendhilfegesetz*, KJHG), states (§ 22): "Day care facilities for children and childminders should foster children's development in such a way that they grow to be independent and socially competent."

It is therefore possible that there are direct effects from peer groups on individual trajectories as children learn from and imitate each other. Previous analyses of German data suggest that these direct effects may exist. Children from families who did not mainly speak German at home were found, unsurprisingly, to have lower vocabulary achievement around age three and also slower vocabulary growth during the preschool years compared to monolingual German children. Crucially for the purpose of this report, all children, irrespective of their own language background status, made less progress in language development when they were in groups with higher proportions of children with a foreign-language background.[11]

In addition to the effects of direct peer interactions, the composition of a group may exert indirect effects on children's experience by influencing the nature of interactions between adults and children. Studies carrying out assessments of the teaching and learning interactions in German ECEC centers found a negative association between the proportion of children with non-German backgrounds and the quality of teaching and learning interactions, assessed through observational scales. In particular, the NUBBEK study defined groups with a "high proportion" of children from migrant backgrounds as those with a concentration of above 67 percent and found that pedagogical quality in such groups was lower than in those with a lower concentration.[12]

These findings raise questions about the optimal mix of peers. Most studies estimating peer effects are not able to comment on this because they lack sample size, but peer effect research in schools has uncovered "tipping points". Only two studies, both from the U.S., move early education research in this direction. However, they use low income instead of migrant background as a marker of disadvantage. In Boston, levels of concentration of low-income children above the district mean of 32 percent appeared to have a negative effect on children's language development. Similarly, another study showed that the negative association between language achievement and low-income peers' composition emerged once the threshold of 25 percent was reached.[13]

But such non-linearities could operate differently in other national contexts or in relation to other outcomes. For example, a certain density of children from migrant backgrounds, say 30 percent, may comprise a critical mass that triggers more appropriate language support or greater parental involvement. On this latter point, there is evidence from Germany that parents were more satisfied with their involvement in the ECEC center when the center was attended by a higher proportion of families with foreign-language backgrounds.[14] Future research should seek to discover what levels of concentration are more or less beneficial to children's learning and well-being.

ECEC policy can influence the composition of children's peer group

On the face of it, the level of concentration of children from migrant backgrounds in each ECEC center appears to be a reflection of residential segregation. Housing and neighborhood policies, one could argue, are better suited than interventions in early childhood services to alter the composition of centers. However, research on segregation in primary schools in Germany suggests that while residential segregation is the main factor underlying school segregation, it is by far not the only one. The precise design of admission policies contributes to the composition of primary schools.[15]

What are the forces for mixing and segregation in the case of ECEC? First of all, supply is organized in a high number of small centers, and this feature favors high segregation. For example, for every primary school there were approximately 3.6 ECEC centers in 2016. Second, parents can choose ECEC centers. They are not bound to any catchment area, although proximity is an important selection criterion. A recent survey found that 91 percent of parents reported having a choice in their selection of centers.[16] Third, centers vary in their pedagogical approach. Even within individual federal states, curricula provide guidance principles only. Parents may therefore choose a center that is convenient for them and best matches their education and care expectations. This is indeed what previous research has shown.[17]

11 Ebert et al., "Internal and external influences on vocabulary development in preschool children," 138–154.

12 Christina Weiland and Hirokazu Yoshikawa, "Does higher peer socio-economic status predict children's language and executive function skills gains in prekindergarten?" *Journal of Applied Developmental Psychology* 35, no. 5 (2014): 422–432.

13 Portia Miller et al., "Pre-K classroom-economic composition and children's early academic development," *Journal of Educational Psychology* 109, no. 2 (2017): 149–165.

14 Axinja Hachfeld et al., "Triggering parental involvement for parents of different language backgrounds: the role of types of partnership activities and preschool characteristics," *Early Child Development and Care* 186, no. 1 (2016): 190–211.

15 Gunilla Fincke and Simon Lange, Segregation an Grundschulen: Der Einfluss der elterlichen Schulwahl, Policy brief, Sachverständigenrat deutscher Stiftungen für Integration und Migration (2012) (in German; available online); Andrea Riedel et al., "School choice in German primary schools. How binding are school districts?" *Journal for Educational Research Online* 2, no. 1 (2012): 94–120.

16 Stahl, Schober, and Spieß, op. cit.

17 Pia S. Schober, C. Katharina Spieß, and Juliane F. Stahl, *Gute Gründe für gute Kitas!* (Berlin: Friedrich-Ebert-Stiftung, 2016) (available online in German).

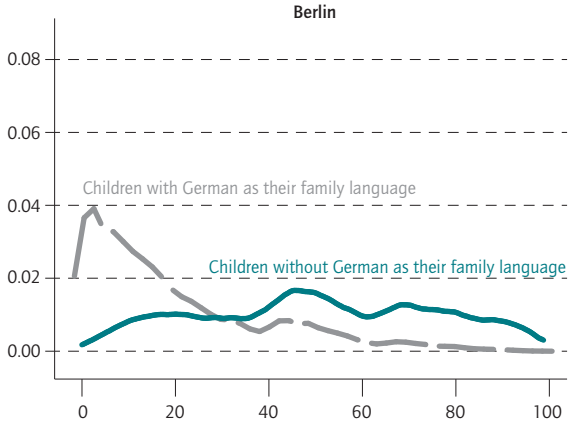
While this diversity lends itself to selection and clustering by parents, other factors seem to potentially promote consistency and uniformity, feasibly discouraging sorting and segregation. Although the actual framework is determined at regional state and municipal levels, the ECEC system in Germany is universal and almost exclusively publicly subsidized. Staff educational qualification, wages, and staff-to-children ratios are all subject to minimum requirements. These are markedly different across federal states but rather uniform at the lowest administrative level. Basic fees, which are mostly income-related, are often regulated at state or municipal level, minimizing differences between centers in the same neighborhood.[18] However, individual centers can charge for additional activities, thus creating a more diversified offer than it would appear from the formal regulatory framework alone.

While fees may be relatively uniform from the parents' perspective, from the perspective of providers there may be important differences between children. For example, in some states and municipalities, ECEC centers receive additional funding when they cater to children whose main home language is not German. The exact design of the funding scheme likely influences the overall composition of the children attending a center. In particular, the funding premium can be linked to the individual child so that a center receives more money when it caters to a child from a migrant background than to one from a German family. Bavaria, for example, operates such a scheme.[19] Alternatively, additional financial resources can be channeled to ECEC centers with high levels of concentration of children from migrant backgrounds. This is the case in Berlin[20] and Hamburg[21], for example. We looked at the case of Berlin more closely, as the city has the highest percentage of children from a non-German language background. In Berlin, additional funding is available for ECEC centers that have a share of children whose main language at home is not German above 40 percent. As a result, children both from and not from migrant backgrounds are more likely to have a share of peers from mainly non-German speaking families, which was closer to just above the 40-percent threshold than just below (Figure 5). Thus, financial incentives can help influence ECEC centers' composition, albeit only marginally.

Figure 5

Concentration of peers with family language other than German in Berlin

Kernel density, for children with and without German as their family language



Note: Data include children aged from zero to six. ECEC centres with fewer than five children enrolled are excluded.

Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Statistik der Kinder und tätigen Personen in Tageseinrichtungen (EVAS 22541), survey year: 2016; authors' own calculations.

In ECEC centers in Berlin, the share of children slightly speaking a foreign language at home is more likely to be above than slightly below 40 percent.

Conclusion

In 2016, almost one-fifth of the children attending an ECEC center in Germany came from a migrant background, defined as belonging to a family in which German is not the main language spoken at home. Up until now, little was known about the composition of the peers they interact with in their daily experiences in ECEC centers. The results presented here show that even in the context of a universal, fairly uniform ECEC system at a neighborhood level, there is a stark contrast between the peer group composition experienced by children from migrant backgrounds and by German children. Especially noteworthy is the result that, in contrast to children for whom German is the main home language, up to one-third of children who do not speak German as the main language at home are in centers where the majority of their peers also have a foreign-language background. This points to the risk of a "parallel educational track" from the very beginning.

18 Sophia Schmitz, C. Katharina Spieß, and Juliane F. Stahl, "Day Care Centers: Family Expenditures Increased Significantly at Some Points between 1996 and 2015," *DIW Economic Bulletin*, no. 42 (2017) (available online).

19 Bavarian Law on Educating, Raising and Providing Care for Children in Nurseries, other Childcare Facilities and Day Care Centers (*Bayerisches Kinderbildungs- und -betreuungsgesetz, BayKiBiG*), § 21 para. 5 (2005): 2.

20 Statutory Order about the Proceedings to Ensure a Need-Based Offer of Places in Day Care Facilities and Family Day Care and for Staffing in Day Care Facilities (*Kindertagesförderungsverordnung, VOKitaFöG*), § 17 (2017).

21 Hans-Georg Weigel et al., *Evaluation des Programms Kita-Plus der Freien Hansestadt Hamburg* (Frankfurt am Main: Institut für Sozialarbeit und Sozialpädagogik e.V., 2014) (in German).

Research into peer effects in ECEC is still in its early stages, but has the potential to understand what an "optimal peer mix" might look like. Without such knowledge, policymakers are best advised not to favor a particular concentration level but instead to design funding schemes that encourage individual centers to reach out to children from migrant backgrounds.

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JEL: J15, J13, I24, H75

Keywords: Early education and care, peer composition, segregation, migrant background

Crude oil: market trends and simulations point toward stable equilibrium

By Aleksandar Zaklan, Dawud Ansari, and Claudia Kemfert

In this study, we report on the current state of the international market for crude oil. The market data we analyzed indicate that competition has intensified as a result of the now firmly-established shale oil extraction industry in the U.S. Model-based simulations also show that supply-side shifts should only have moderate price effects. This applies to both an expansion in U.S. shale oil production and a disruption of production in OPEC countries.

Market data and simulations indicate that the crude oil market is currently in a new equilibrium that appears to be relatively robust in the short term. In the absence of further shocks, we can continue to expect a moderate price level for crude oil in the short term with corresponding implications for economic and climate policy.

In this study, we report on our analysis of the current state of the international market for crude oil.[1] Alongside a presentation of current price and quantity trends, we use a model-based analysis to show how robust the current oil market equilibrium would be in the face of supply-side changes. We closely examine two cases, the first one being increased shale oil production as a result of gains in efficiency in the U.S. shale oil sector. The second one focuses on production disruptions in OPEC (Organization of the Petroleum Exporting Countries)[2] countries as a result of increased geopolitical tension in the Middle East.

Moderate price level in today's oil market

The price of crude oil has fallen sharply since the middle of 2014. From a low of less than 30 U.S. dollars per barrel of Brent crude[3] at the beginning of 2016, prices have been fluctuating between 40 and 60 U.S. dollars per barrel ever since (Figure 1). Most recently in the wake of increased political tension in the Middle East, it exceeded the 60-dollar mark.

This price level is moderate in comparison to that of the period before mid-2014, currently favoring economic growth in oil-importing countries such as Germany.[4] At the same time, compared to the low in 2016, a recovering oil price is stabilizing the budgetary situation of oil-

1 The present study is an update of an earlier analysis. See Aleksandar Zaklan and Claudia Kemfert, "Rohölmarkt: US-amerikanisches Schieferöl schwächt Marktmacht der OPEC," *DIW Wochenbericht* no. 19 (2015): 429–433 (in German only; available online, accessed November 20, 2017. This applies to all other online sources in this report unless stated otherwise).

2 The current members of OPEC, the Organization of the Petroleum Exporting Countries, are: Algeria, Angola, Equatorial Guinea, Ecuador, Gabon, Iran, Iraq, Qatar, Kuwait, Libya, Nigeria, Saudi Arabia, Venezuela, and the United Arab Emirates.

3 Brent crude oil is produced in the North Sea and traded on the Intercontinental Exchange in London. The price of Brent is recognized as the global reference price. See Lutz Kilian, "How the Tight Oil Boom Has Changed Oil and Gasoline Markets," *CEPR Discussion Paper*, 11876 (2017) (available online).

4 See Projektgruppe Gemeinschaftsdiagnose, "Gemeinschaftsdiagnose Herbst 2017," *DIW Wochenbericht*, no. 40 (2017): 809–883 (available online).

Figure 1

Spot market prices for crude oil
In U.S. dollars per barrel Brent

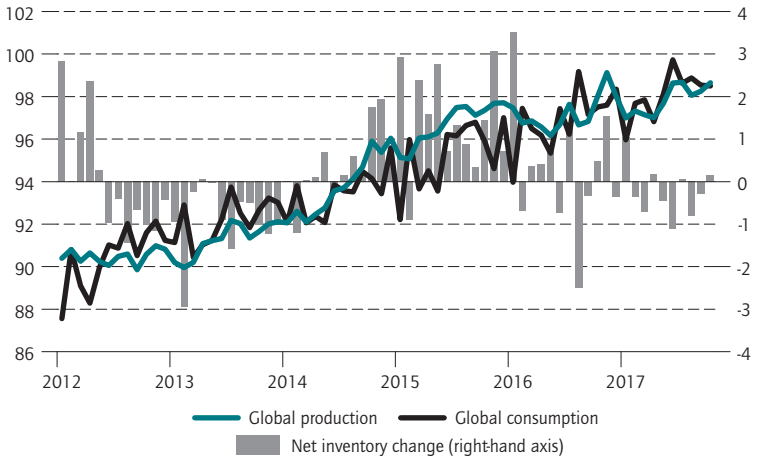
Note: In current prices.

Source: U.S. Energy Information Administration.

Since mid-2016, prices have been largely stable.

Figure 2

Global production, consumption and inventory change of crude oil
In million barrels per day



Source: U.S. Energy Information Administration.

At the moment, production and consumption are largely balanced.

exporting countries, in particular the members of OPEC and important non-OPEC exporters such as Russia.[5]

Overall, the growth of the global economy in recent years has led to rising demand for oil and, consequently, a recent draw-down in inventories (Figure 2). At the same time, oil production is expanding. U.S. shale oil production is currently at a very high level, as is the output of OPEC and other oil-producing countries. Further, inventories remain high in comparison to the long-run average despite the latest draw-down.[6] Currently, limited production slowdowns, such as the one caused by the hurricane in the Gulf of Mexico in fall 2017, can be absorbed with only minor price effects. The oil market appears to be relatively robust at present.

Continued high output in the oil market

Recently, crude oil production has expanded less rapidly than in previous years. While total global production increased by a solid six percent between the beginning of 2014 and the end of 2015, it seems to have plateaued since then (Figure 2). Nevertheless, the market continues to be well supplied.

Moderate curb on output in OPEC countries

OPEC's oil output levels have exhibited a stable to rising trend in recent years.[7] At the end of 2016, OPEC's total production exceeded 33 million barrels per day. Since the beginning of 2017, OPEC and key non-OPEC producers—Russia in particular—have almost fully implemented their joint plan to curb oil output.[8] As part of the strategy, Russia and Saudi Arabia's output quantities fell slightly in the first half of 2017 (Figure 3).[9] The agreement to curb output will apparently hold throughout 2018. Output cuts primarily refer to limits on the growth rate of crude oil production and not to an absolute drop in output.

In the process, OPEC countries find themselves in a trade-off: On the one hand, they have an incentive to drive oil prices upward by curbing output in order to reduce revenue losses. On the other, expanding pro-

5 See Projektgruppe Gemeinschaftsdiagnose, "Gemeinschaftsdiagnose Herbst 2017."

6 See U.S. Energy Information Administration, *Weekly Petroleum Status Report*, (2017) (available online).

7 This development has been obscured by the fact that individual countries have joined or quit OPEC in recent years. For example, Indonesia was temporarily an OPEC member in 2016.

8 Organization of the Petroleum Exporting Countries, "Declaration of Cooperation" (2016) (available online).

9 See International Energy Agency, "Oil Market Report," *Market Report Series_Oil and Annual Statistical Supplement* (2017) (available online).

Box 1

Shale oil

Shale oil is a type of crude oil found in fine-grained sedimentary rock. Conventional drilling techniques have proven to be uneconomical for this type of oil, which is why unconventional extraction processes are used. They include fracking, in which a pressurized liquid fractures the surrounding rock, and horizontal drilling.

Conventional oil extraction is characterized by decades-long project durations and high fixed costs. This is why conventional oil business reacts to new investments only with major lags. Investment decisions are typically based on longer-term market forecasts and subject to a great deal of uncertainty. These factors result in a low supply elasticity for conventional oil extraction: Assuming perfect competition, the quantity supplied reacts to price changes in the short term only to a very limited extent.

Shale oil, on the other hand, is characterized by lower fixed costs, higher operating costs, and shorter extraction cycles per well. From drilling to extraction, it can take less than six months to open a new well, and wells are depleted much faster. Most of the available oil is extracted within the first two to three years. Due to the shorter planning horizon, shale oil producers can fine-tune their investment behavior to react to price changes much more quickly, resulting in a more elastic global oil output.

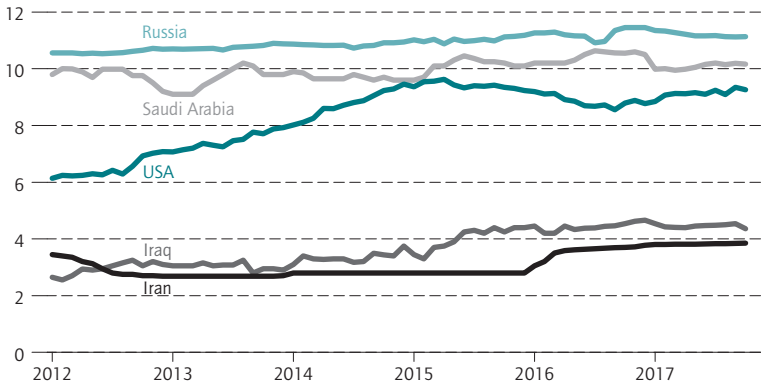
duction—a strategy that goes hand in hand with lower prices in the short term—would increase their own market share, probably reinforcing their market dominance in the long term. [10]

U.S. shale oil producers firmly established in market

U.S. crude oil production recovered from its temporary decrease in mid-2016 and currently trends toward 10 million barrels per day. Producers will probably meet this target by the end of 2018,[11] thus approaching the historical highs of the 1970s.

Figure 3

Crude oil production of major producers
In million barrels per day

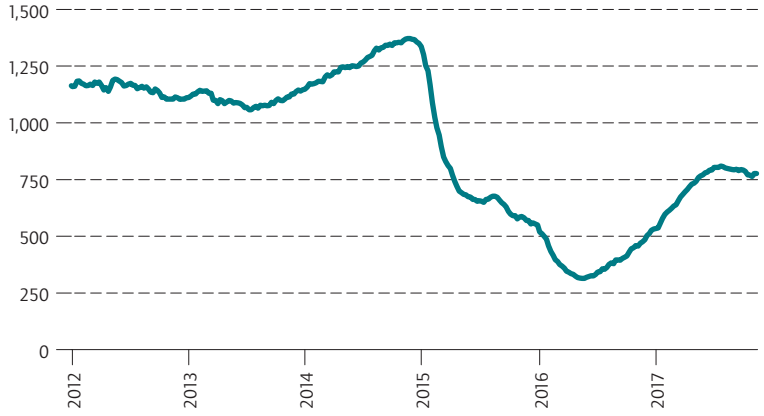


Source: U.S. Energy Information Administration.

Production in Russia and Saudi Arabia slightly decreased in the first half of 2017.

Figure 4

Number of active horizontal drilling rigs in the US



Note: Horizontal drilling rigs for shale oil and shale gas extraction.

Source: Baker Hughes.

The number of active rigs has increased significantly over the last year.

The momentum in production is primarily driven by a renewed increase in fracking activity (Box 1). Even at moderate crude oil prices, expanding shale oil production appears to be economically viable—measured by the number of active horizontal drilling rigs. This is evident in the rising number of active horizontal drilling rigs since

10 See Bassam Fattouh, Rahmat Poudineh, and Anupama Sen, "The dynamics of the revenue maximization–market share trade-off: Saudi Arabia's oil policy in the 2014–15 price fall," *Oxford Review of Economic Policy*, 32 (2) (2016): 223–240; and Dawud Ansari, "OPEC, Saudi Arabia, and the Shale Revolution: Insights from Equilibrium Modelling and Oil Politics," *Energy Policy*, 111 (2017): 166–178.

11 See U.S. Energy Information Administration, "Short-Term Energy Outlook," (2017) (available online).

Box 2

The OILMOD-E model

The price effects of the scenarios described in this study were calculated with the OILMOD-E model of the German Institute for Economic Research (DIW Berlin). OILMOD-E is a numerical partial equilibrium model used to investigate strategic interactions among profit-maximizing, oligopolistic oil producers. The model is similar to other numerical energy market models developed by DIW Berlin (e.g., GLOBAL GAS MODEL and COALMOD) to analyze trends in global natural gas or coal markets while taking imperfect competition into account.[1]

OILMOD-E determines output, consumption, and market prices based on an array of input parameters. They include: production costs, oil production capacity, a demand curve, and assumptions about the competition setup. Estimations by the International Energy Agency, *Oil & Gas Journal*, and various scientific publications serve as data sources. The actors included in the model represent over 95 percent of the global crude oil market. Due to the globalized structure of the sector, the model considers an aggregated market, but it uses sophisticated cost curves and quality parameters for different crude oils to capture technical and geophysical features of crude oil production in detail.[2]

OILMOD-E has a special feature: It can explicitly model the crude oil market's asymmetrical, imperfect competition structure. In Cournot competition, crude oil producers decide on the amount of output they will produce simultaneously and independently of each other, based on their anticipated levels of market influence and other producers' reactions. This makes it possible to account for the complex, at times sequential reality of the crude oil market. Modeled as an oligopoly of the individual member states, OPEC specifies production targets for its members strategically. Other market participants, which behave competitively, observe the OPEC targets and include them in their own production decisions. In OILMOD-E, this anticipatory process is implemented as (semi-)consistent conjectures, i.e. parameters that measure the market's anticipated reaction to the own output decision. They are selected on the basis of stylized facts, considerations of consistency, and calibration to past market results.

1 More information on the Energy, Transportation, Environment Department's energy market models can be found on the DIW website (available online).

2 Most recently, the OILMOD-E model was used to analyze the drop in prices in the global oil market between 2014 and 2016. See Dawud Ansari, "OPEC, Saudi Arabia, and the Shale Revolution."

mid-2016 (Figure 4). Made more attractive by rising efficiency in the shale oil sector, investment in new production capacity increased again after a phase of consolidation from the end of 2014 to the beginning of 2016.[12] At current prices, shale oil is firmly established in the market.

Therefore, beyond OPEC, the continuation and expansion of U.S. shale oil production represents a component of global oil supply that can react to price changes quickly. Shale oil production reduces the power that strategic producers such as OPEC have over the market.[13]

Growing political risk in the Middle East

For some years, political tension has been growing between Saudi Arabia and Iran, two of the most important members of OPEC. The two countries are competing for political influence in the Middle East, as expressed by opposing roles in a series of regional conflicts—currently in Yemen, Qatar, Lebanon, and Syria, for example. At the same time, the political reality within Saudi Arabia is being restructured.[14]

These circumstances did not prevent OPEC from enacting and implementing its latest curb on production. Yet heightened political tension does increase the risk of a partial disruption in OPEC production. This also probably contributed to the most current rise in the price of oil to more than 60 U.S. dollars per barrel.

Model-based simulation of supply-side shifts

At the German Institute for Economic Research (DIW Berlin), we conducted a model-based study of oil price reactions to possible shifts on the supply side of the oil market. The study used the OILMOD-E crude oil market model (Box 2) and a database that includes the fourth quarter of 2017. The assumption was that oil demand would continue to increase at its average rate between 2015 and 2017. The study examines the consequences of further efficiency growth in U.S. shale production as well as the price effects of OPEC production disruptions on the global crude oil price up to the first quarter of 2019. The following scenarios were analyzed:

- The **base scenario** assumes that the current expansion in production capacity will continue. It serves primarily as a means of calculating baseline values for the remaining scenarios.

12 See U.S. Energy Information Administration, "Drilling Productivity Report for Key Tight Oil and Shale Gas Regions," (2017) (available online).

13 Zaklan and Kemfert, "Rohölmarkt: US-amerikanisches Schieferöl."

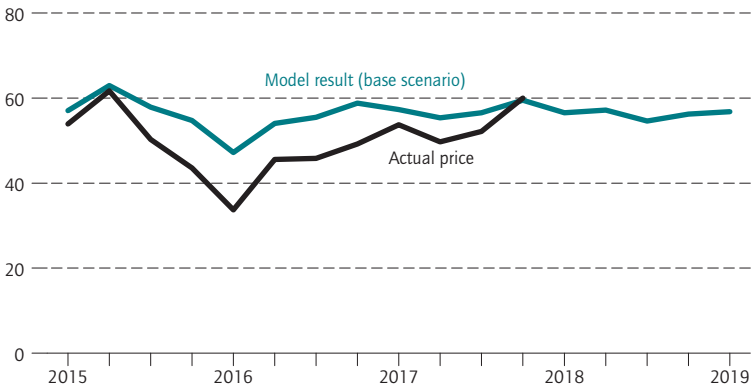
14 See David D. Kirkpatrick, "Saudi Crown Prince's Mass Purge Upends a Longstanding System," *New York Times*, November 5, 2017, (available online).

- The **U.S. shale oil expansion** scenario examines the influence of intensified shale oil production expansion in the U.S. due to reductions in production costs of up to 20 percent.[15] We assume that such reductions in production costs would go hand in hand with increases in output capacity of the same level (also up to 20 percent). Two cases are examined. The first case assumes that OPEC members would strategically react to the expansion in shale oil production by cutting their own output. The second case assumes that OPEC would not adjust its output to counteract the expansion in U.S. shale oil production. This would be similar to the situation between 2014 and 2016, when OPEC members could not agree to cut production despite a dramatic drop in the price of oil.

- The **OPEC supply disruption** scenario examines the outcome if individual OPEC members were no longer able to maintain production at previous levels as a consequence of a hypothetical conflict in the Middle East. The model presents this case as a decline in overall OPEC output capacity of up to 15 percent. As an example, this would amount approximately to Iraq's total oil output.

Figure 5

Actual and simulated crude oil prices
In U.S. dollars per barrel



Sources: U.S. Energy Administration; authors' own calculations with OILMOD-E.

The model has been calibrated to fit simulation results to the oil price in the 4th quarter of 2017.

Simulation results indicate stable market equilibrium

Initially, spot market prices for Brent crude were simulated as part of the base scenario for the period between the first quarter of 2015 and the first quarter of 2019 (Figure 5). Forecasted prices indicate only relatively minor fluctuations around the current level. A comparison of the model results with observed prices shows that the model is able to track the actual price trend quite accurately. However, results seem to underestimate the extent of price fluctuations. One reason for this is that the simulated prices only reflect the fundamental equilibrium of supply and demand, i.e. the market outcome based on regular supply behavior and a specific demand curve. The model does not take into account fluctuations in price that result from the expectation-driven behavior of market participants, such as speculation or panic buying. Yet, this type of behavior may lead to significant price volatility compared to the fundamental equilibrium modeled here.

Moderate price reduction due to ongoing U.S. shale oil expansion

The results of the scenario of U.S. shale oil expansion show that further increases in the efficiency of the shale oil sector would only have moderate price effects. In the case of a strategic adjustment in output by OPEC members, even if efficiency increased and capacity expanded in the U.S. by 20 percent, only a comparatively insignificant price effect would be discernible (Figure 6). This demonstrates that the current equilibrium is stable. If OPEC members did not agree to curb production, the price effects would be greater since OPEC could not compensate for the increase in U.S. production, and the supply of oil would increase overall.

While an expansion up to a level of around ten percent would have a significant effect on the market, further expansion would only lead to insignificant price effects as further shale oil expansion would shift the producers' position on the global output curve. However, even in the rather unlikely case of shale oil expansion by up to 20 percent, the simulated price remained above the 40-dollar level.

Moderate price increase due to OPEC supply disruption

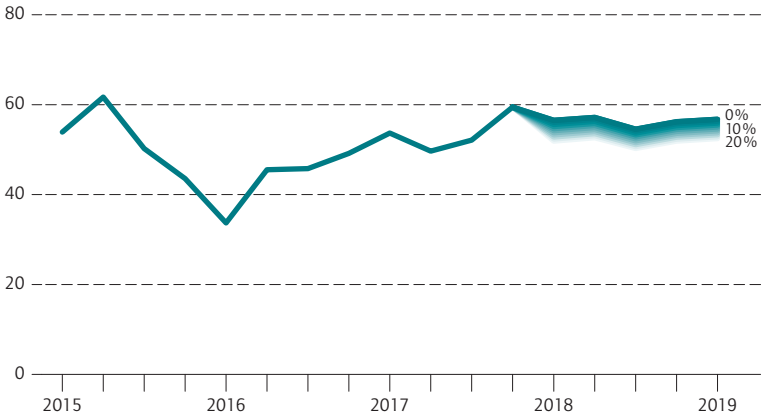
The price effect resulting from the OPEC supply disruption simulation is also comparatively moderate. Notably, the marginal price effect of supply disruptions below ten percent would still be low, since other market par-

15 All scenarios assume a change in the respective value for the total simulation period from the first quarter of 2018 until the first quarter of 2019.

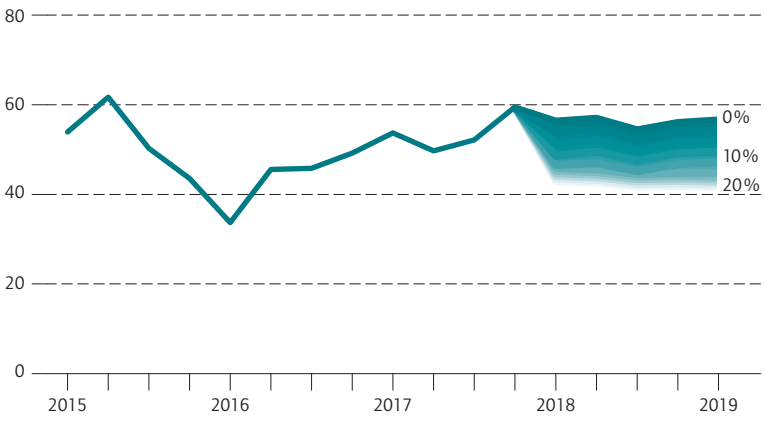
Figure 6

Oil price trajectory in the case of a U.S. shale oil expansion

With OPEC quantity adjustment, in U.S. dollars per barrel



Without OPEC quantity adjustment, in U.S. dollars per barrel



Note: Actual market prices are shown until 4th quarter 2017, followed by simulated prices starting from 1st quarter 2018. Percentage numbers show the degree of shale oil expansion. Ten percent, for instance, imply a ten percent decrease in shale oil extraction costs alongside a ten percent increase in U.S. capacity.

Sources: U.S. Energy Administration; authors' own calculations with OILMOD-E.

An expansion of the U.S. shale industry might only lead to moderate price reductions.

ticipants would be able to compensate for the decline in OPEC capacity (Figure 7). In the case of major disruptions in production, however, the price effect would intensify because the output potential of other producers is not sufficient to compensate for the missing production. Even in the case of a decline of 15 percent—the highest case that we assume—, simulated prices remain below 70 U.S. dollars. Production disruptions of this magnitude can be regarded as unlikely, even in the case of a limited military conflict in the Middle East. A decline of ten percent would approximately equal the total output capacity of Iran, while 15 percent is slightly above the current production of Iraq.

However, the simulated price trend does not take into consideration the possible behavioral effects of market participants, such as speculation or panic buying (see above). Such effects could significantly influence the spot price of crude oil, as was the case with the price increase at the beginning of November 2017 when political uncertainty in Saudi Arabia increased significantly.

Conclusion: moderate oil price to be expected in the short term

In comparison to the beginning of the decade, competition in the global crude oil market has intensified. The establishment of U.S. shale oil in the market has countered any OPEC bid to increase market power in the short term. The market for crude is in a new equilibrium, with prices significantly below levels at the beginning of the decade.

Fundamental data on both the supply and demand sides are fairly stable at the moment. Total, oil output is high although OPEC has largely implemented its agreement with other key oil exporting countries to curb output. Due to increased efficiency in the U.S. shale oil sector, fracking can at least partially offset the production limits of conventional extraction.

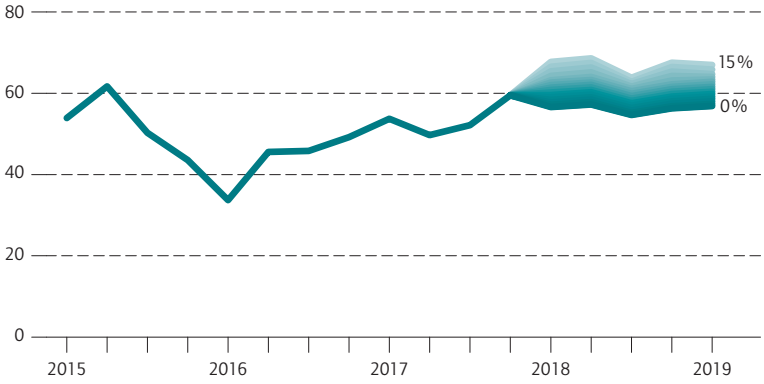
Model-based simulations show that the price effects of additional shale oil production heavily depend upon whether or not OPEC producers counter with strategic reductions in output. If OPEC cuts production accordingly, additional shale oil production would only lead to a slight drop in oil prices; while the decline in prices if OPEC production does not react would be more significant (although still moderate).

The current political tension in the Middle East increases the risk of a partial disruption of OPEC oil production. The relevant simulation shows that a moderate decline could be compensated for without dramatic price effects. Nevertheless, expectation-driven price effects are possible which cannot be captured by the model.

Based on the present study, we conclude that economic forecasters can assume a moderate oil price in the absence of any new, major shocks. However, from the perspective of climate policy, the anticipated trend in oil prices increases the need for action: At least in the short term, oil consumption is not expected to fall due to rising oil prices.

Figure 7

Oil price trajectory for an OPEC supply disruption
In U.S. dollars per barrel



Note: Actual market prices are shown until 4th quarter 2017, followed by simulated prices starting from 1st quarter 2018. Percentage numbers show the degree of the assumed supply disruption in OPEC countries.

Sources: U.S. Energy Administration; authors' own calculations with OILMOD-E.

Even for larger supply disruptions, price effects are still moderate.

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