



EURO AREA POLICIES

SELECTED ISSUES

July 2018

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June 29, 2018

Approved By
European Department

Prepared by Jiaqian Chen, Christian Ebeke, Li Lin, Haonan Qu, Hanni Schoelermann, and Jesse Siminitz (all EUR)

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LONG-TERM IMPACT OF BREXIT ON THE EU¹

The integration of EU27 countries and the United Kingdom has strengthened over time, reflecting shared gains from the EU's single market. Conversely, the departure of the U.K. from the EU (Brexit) will inevitably represent a loss for both sides. In this paper we use two approaches to estimate these losses. First, we create a multidimensional index that captures the depth and evolution of integration between the U.K. and the rest of the EU, taking into account trade via supply chains, financial linkages, as well as migration. We then use this index to estimate the average long-term impact of several Brexit scenarios. Second, we use a standard multi-country and multi-sector computable general equilibrium (CGE) model to estimate country- and sector-specific impacts from higher trade barriers between the U.K. and the rest of the EU countries. We find that the level of output of EU27 countries falls by between 0.06 and up to 1.5 percent in the long run. The range of estimates depends on whether we assume a "soft" or "hard" Brexit, or whether trade or other transmission channels are accounted for. These are likely losses that should be interpreted with caution, given the important uncertainty characterizing the empirical estimations. Moreover, there is substantial heterogeneity in the impact of higher trade barriers: countries such as Ireland, Netherlands, and Belgium are among the most affected in the simulations.

A. Euro Area and U.K.: How Strong are the Links?

Dimensions of Integration

- 1. EU-U.K. trade integration has benefited both parties.** For example, the euro area (EA) runs a modest trade surplus with the U.K., while the U.K. has a small surplus in financial services trade with the euro area. In recent years, the euro area's trade surplus with the U.K. increased steadily, owing to rising exports of goods, reaching 1 percent of EA GDP in 2016. In gross terms, total trade in goods and services between the euro area and the U.K. accounts for about 6 percent of euro area GDP on average over the past two decades. Trade with the U.K. is most significant for Ireland, the Netherlands, Belgium, and Luxembourg, relative to the respective sizes of their economies. The U.K. is a net provider of financial services to the euro area, driven by its large bilateral flows with Ireland. Excluding Ireland, the trade in financial services between the euro area and the U.K. is close to balance (Figure 1).
- 2. Trade with the U.K. involves complex supply chain linkages.** Most trade today—over 50 percent of goods and almost 70 percent of services trade—is in intermediate inputs, suggesting the presence of supply chains.² Therefore, it is important to capture also the indirect links via these supply chains when assessing euro area countries' trade with the U.K. Moreover, it is important to account for the value added from third countries when assessing exports to, and imports from, the

¹ Prepared by Christian Ebeke, Li Lin, Haonan Qu, Jiaqian Chen, and Jesse Siminitz (all EUR). We are grateful to Borja Gracia (EUR) for substantive comments on the paper.

² Remarks by OECD Secretary General Angel Gurría at the Istanbul G20 Trade Ministers meeting, October 6, 2015.

U.K. From a value-added perspective, euro area trade with the U.K. is a combination of direct and indirect value-added exports transiting through third countries, suggesting that supply chains also play a role. Smaller but open economies such as Ireland, Luxembourg, and Netherlands exhibit the highest exposure in value-added terms with the U.K., though this exposure is smaller than what gross trade statistics suggest (Figure 2).

3. EA-U.K. investment positions are substantial.

- *Euro area total financial claims and liabilities with the U.K. amounted to about 55 percent of euro area GDP in 2016* (Figure 3). Across countries, Ireland, Netherlands, and Luxembourg have the largest financial positions relative to their own economic size. Notably, the two-way FDI stock between Netherlands and U.K. is about 120 percent of Netherlands' GDP; the two-way portfolio investments between Ireland and U.K. is slightly below 230 percent of Ireland's GDP; and the two-way bank claims between Luxembourg and U.K. is about 220 percent of Luxembourg's GDP.
- *In net terms, the euro area provides financial capital to the U.K. amounting to about 9 percent of euro area GDP.* However, the aggregate number hides cross-country heterogeneities. The Netherlands and Ireland contribute most to the net FDI investment position (about 2.1 percent of euro area GDP in 2016). Ireland and Malta have large net portfolio investments position with the U.K., whereas most other countries are net recipients. Finally, relative to their own GDPs, Luxembourg and Ireland are large recipients of cross-border bank lending from the U.K. (more than 170 percent of GDP in the case of Luxembourg and 58 percent of GDP in the case of Ireland).

4. Migration flows between the euro area and the U.K. are small, except for some countries with historical ties to the U.K. The number of U.K. migrants living in the euro area is small relative to the euro area population, but has increased somewhat over time. The euro area has traditionally been a net sender of migrants to the U.K. for all skill levels, with a total balance of about 0.1 percent of the euro area population as of 2010. The number of migrants from Ireland, Cyprus, and Malta living in the U.K. is considerable, accounting for roughly 10 percent of these countries' population. Regarding migration from the U.K. to the euro area, there is one U.K. migrant living in the euro area for every four to five hundred euro area citizens. However, the U.K. migrant population is larger in Ireland, Luxembourg, and Spain.³

What Do the Stylized Facts Suggest of the Potential Impacts of Brexit?

5. The strength of euro area-U.K. integration implies that there would be no Brexit winners. First, the U.K. is among the top three main trading partners of the euro area. Second, the gross trade exposure masks complex supply chain linkages. Third, cross-border capital flows between the U.K. and the euro area are large. Finally, migration flows are considerable for some countries. Higher barriers to trade, capital flows and people movements following Brexit could

³ OECD does not have a complete coverage of EA countries.

disrupt these links, reducing trade, investment and labor mobility. All empirical studies so far concur that economic costs on both sides would be considerable. However, the EU27 would bear a disproportionately smaller share of the total cost due to its larger size.⁴

6. The long-run impact of Brexit is likely to be unevenly distributed across countries, with Ireland exhibiting the highest exposure. Losses would depend on bilateral integration with the U.K., sectoral specialization, the positioning of sectors within the global supply chain and the degree of substitutability between London and euro area capitals as financial centers. Countries that are more integrated (Ireland, Luxembourg, Netherlands, Belgium, Malta, and Cyprus) will likely suffer disproportionately from Brexit. Other countries, such as Germany, could also be affected via supply chains links.⁵

B. A Synthetic Index of Exposure to the U.K.

7. To account for the complexity of the exposure of EU27 countries to the U.K., we build a synthetic index for integration. As discussed in the previous section, the degree of integration has several dimensions, which are often correlated. To measure the degree of integration and its evolution over time in a less complex manner, we build a single index by aggregating the subcomponents into a synthetic country-specific, time-varying index. This index captures all the components of a EU27-U.K. economic relationships and can be used in the subsequent regressions to assess effect on euro area output and employment from integration with the U.K. Being a single index, it solves the multicollinearity problem that would arise if all the components of the economic relationship were to be used in a regression.

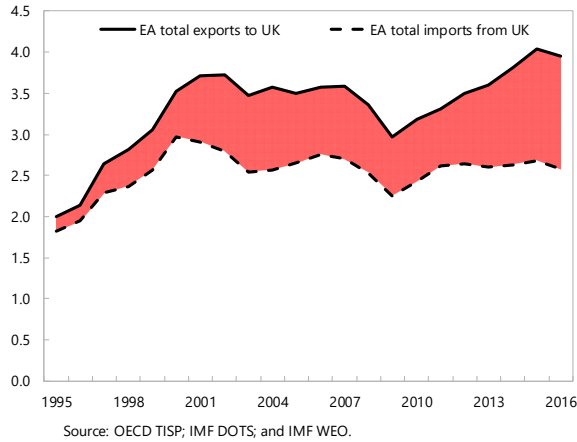
⁴ There are a number of recent estimates of the cost of Brexit on the EU27. For a thorough review, please refer to European Parliament (2017): An Assessment of the Economic Impact of Brexit on the EU27, March 2017. This review of quantitative studies suggests an average long-term impact of Brexit on EU27 output between -0.2 and -0.5 percent by 2030. Connell et al. (2017)'s new study that incorporates supply chain links between countries finds an impact of Brexit on the EU in the order of -0.4 (for the 'soft Brexit' scenario) and -1.4 percent (for the 'hard Brexit' scenario). Very recently, the consultancy groups Oliver Wyman and Clifford Chance (2018) in a [recent report](#) find that the annual 'red tape', or tariff and non-tariff, costs of Brexit for EU27 exporters is around £31 billion (0.3 percent of EU27 GDP) even after initial steps to mitigate costs have been taken. This is proportionately four times larger for the U.K. (when expressed in percent of output). The report also finds that 70 percent of the aggregate impact falls in just five sectors in the EU27: automotive; agriculture, food & drink; chemicals & plastics; consumer goods; and industrials will incur an estimated 75 percent of the impact. A future customs arrangement equivalent to the Customs Union reduces the EU27 impact to around £14 billion (0.13 percent of EU27 GDP). Another study by Chen et al. (2018) examined the exposure of regions in the EU27 to Brexit and conclude that regions in Ireland, Malta, Netherlands, Belgium, and Germany are the most likely to be affected by Brexit. Ireland appears as a clear outlier being the only EU27 country with regions facing Brexit-exposure levels similar to some U.K. regions (U.K. regions are far more exposed than regions in other EU Member States).

⁵ Connell et al. (2017) identified that industrial sectors such as "motor vehicles" and "machinery & equipment" could be the most affected sector in Germany in terms of value added.

Figure 1. Trade in Goods, Services, and Financial Services

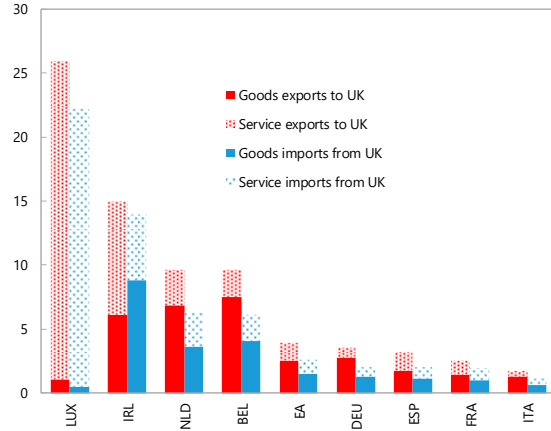
The U.K. is an important trading partner of the EA, and the EA's bilateral trade surplus has widened over the past decades...

Euro Area Total Exports and Imports vis-à-vis U.K.
(Percent of EA GDP)



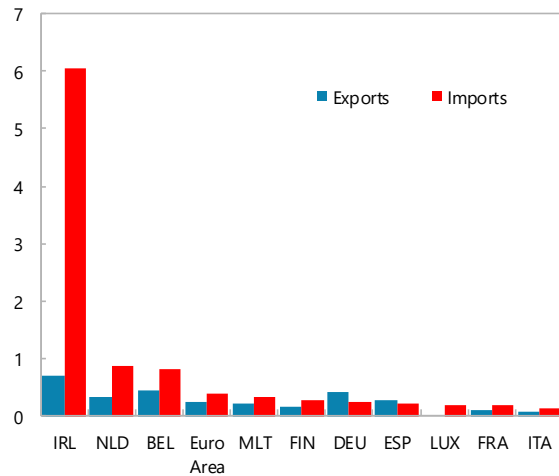
...but there is significant heterogeneity in the relative size of trade flows across countries.

Total Exports of Goods and Services vis-à-vis the U.K.
(Percent of country GDP, avg. 2014–16)



The U.K. is a net provider of financial services to the EA, except for some countries such as Germany and Spain.

Euro Area Financial Service Trade with the U.K.
(Latest data point; in percent of GDP)



In contrast, most of euro area countries are net exporters of nonfinancial services to the U.K.

Euro Area Nonfinancial Service Trade with the U.K.
(Latest data point; in percent of GDP)

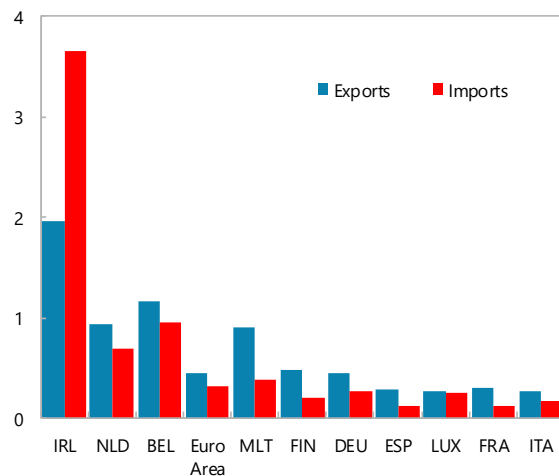
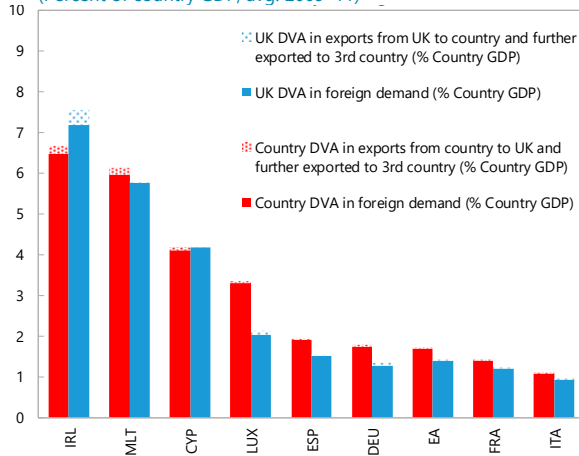


Figure 2. Trade in Value Added and Migration

The domestic value-added (DVA) trade exposure to the U.K. has been about 3.7 percent of EA GDP, representing about 65 percent of the exposure in gross trade terms.

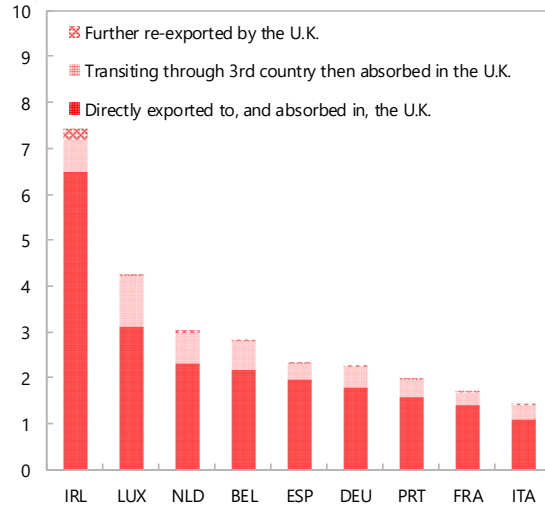
Domestic Value Added (DVA) Embedded in Exports
(Percent of country GDP, avg. 2009–11)



Source: OECD TIVA and IMF-WEO.
Note: 19 EA countries included in sample due to availability through the entire sample period.

While most of EU exports of value added to the U.K. are direct, supply chain links also play a role.

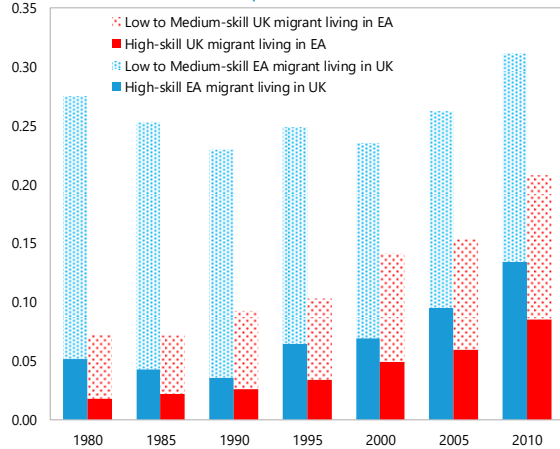
Travel of Domestic Value Added in Exports to the U.K.
(In percent of GDP; latest data available)



Sources: OECD Trade in Value Added database; IMF staff calculations.

Bilateral migration positions have strengthened, including skilled migrants living in both economies...

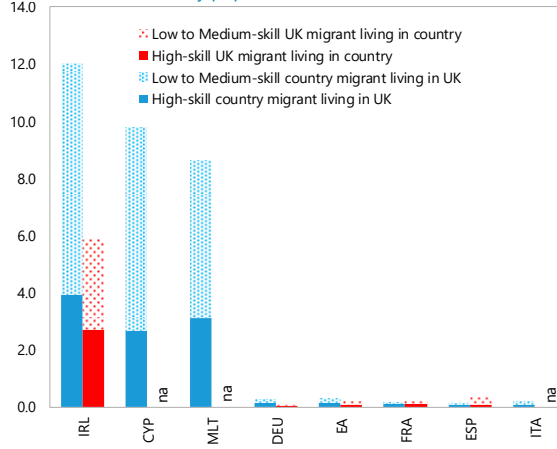
Euro Area and U.K. Migrants by Skill Level
(Percent of Euro Area Population)



Source: IAB; and IMF-WEO.
Note: Data only available in 5-year intervals. 9 EA countries included in sample due to data availability. AUT, DEU, ESP, FIN, FRA, GRC, IRL, LUX, and PRT.

...with significant cross-country heterogeneity.

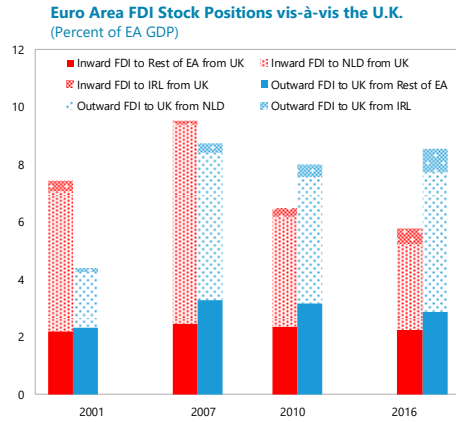
Country and U.K. Migrants by Skill Level
(Percent of country population, 2010)



Source: IAB; and IMF-WEO.
Note: Data only available in 5-year intervals. Number of UK migrants living in country not available for CYP, MLT, and ITA.

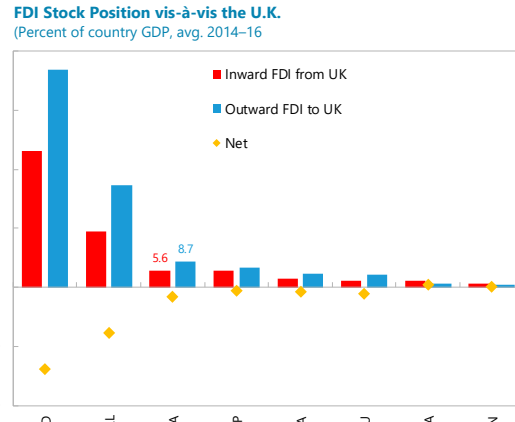
Figure 3. Financial Flows

Bilateral FDI positions are large (14 percent of EA GDP), and the EA has become a net exporter of FDI to the U.K....



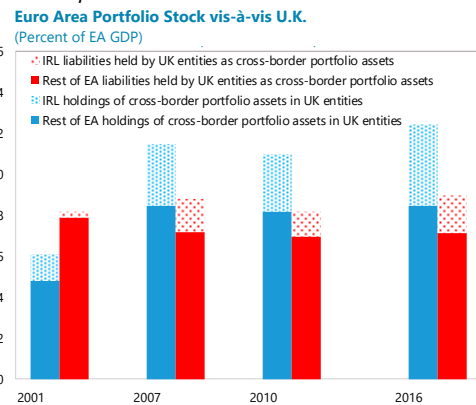
Source: OECD; IMF CDIS; and IMF-WEO.
Note: 9 EA countries included in sample due to availability through the entire sample period. AUT, FIN, FRA, DEU, GRC, IRL, ITA, NLD, and ESP. Data for ESP, GRC, and IRL have been extrapolated 1998-2001.

...mainly reflecting transactions in specific countries (Ireland, Netherlands).



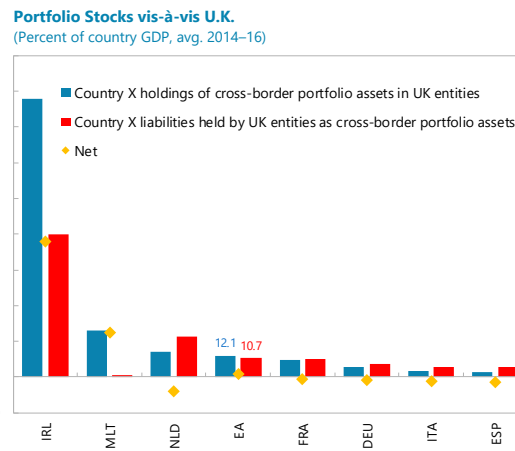
Source: OECD; and IMF CDIS and WEO.

Total two-way portfolio investment amounts to about 21 percent of EA GDP...



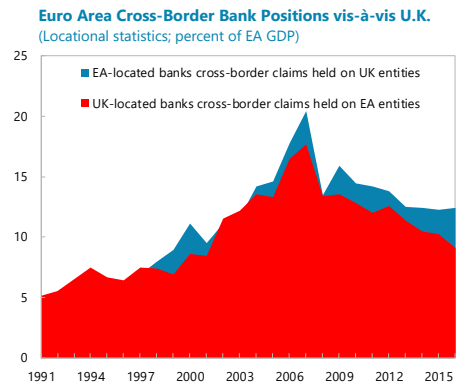
Source: OECD; IMF CPIS; and IMF-WEO.
Note: 15 EA countries included in sample due to availability through the entire sample period. AUT, BEL, CYP, DEU, ESP, EST, FIN, FRA, GRC, IRL, ITA, LUX, MLT, NLD, and SVK. Data for AUT, CYP, ESP, EST, GRC, MLT, and SVK have been interpolated in early years to cover full sample period.

...again mainly driven by Ireland.



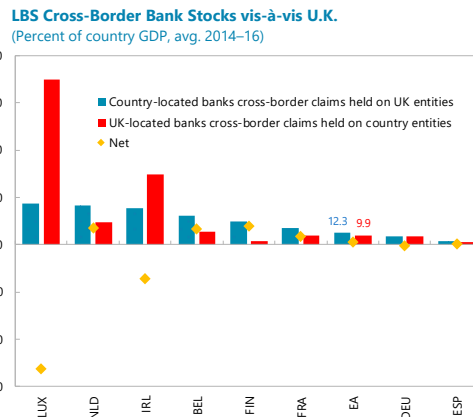
Source: OECD; and IMF CPIS and WEO.

After reaching a peak in 2007, international claims of banks located in both the U.K. and the EA have declined...



Source: BIS LBS; and IMF WEO.
Note: 11 EA countries included in sample due to bilateral data availability. AUT, BEL, DEU, ESP, FIN, FRA, GRC, IRL, LUX, and NLD. LBS bank stocks have been adjusted for structural breaks and FX adjustments.

...but remain critical in several smaller EA countries.



Source: BIS LBS; and IMF WEO.
Note: LBS bank stocks have been adjusted for structural breaks and FX adjustments.

8. To build the integration index, we use a principal component analysis. Principal component analysis (PCA) can help resolve the dimensionality problem associated with the presence of a large number of variables capturing various aspects of a common phenomenon (in this instance, bilateral economic integration with the U.K.). Moreover, reducing the dimensionality problem helps reduce the multicollinearity problem that would have otherwise arisen if each of the channels of integration was introduced additively. We therefore focus on several indicators of integration, and for which data are available for European and non-European countries and which benefit from a sufficient coverage over time (starting in early 1990s):⁶

- *Trade in domestic value added.* We derive an indicator of trade openness between each country and the U.K., measured as the sum of bilateral exports and imports of domestic value added normalized by the country's GDP. Data are based on Ignatenko et al. (2017).⁷
- *Participation in supply chains.* We use the sum of "backward" and "forward" trade linkages between each country and the U.K., normalized by the country's GDP. "Backward" linkages refer to the foreign value-added embodied in the country's and U.K.'s bilateral gross exports. The "forward" linkages refer to the country's and U.K.'s exports of value added further re-exported to third countries. The overall indicator therefore captures the extent to which trade between the country and the U.K. involves the exchange of foreign value added, but also respective domestic value added embodied in exports and then further reexported to third countries. Data are from Ignatenko et al. (2017).
- *Openness in service trade.* We use the sum of each country's exports of services to, and imports of services from, the U.K., normalized by GDP. Data are from Ignatenko et al. (2017).
- *Cross-border banking positions.* To capture the key role of London as financial center, including for cross-border lending activities, we use the ratio of claims by international banks in the U.K. on each receiving country from BIS locational data, normalized by GDP.
- *Migration.* We use the share of each country's migrants residing in the U.K., normalized by the country's total number of migrants residing in 20 OECD countries. Data are from Brücker et al. (2013) who relied on harmonized census data.⁸ Migrants are defined as foreign-born individuals aged 25 years and older, living in each of the 20 considered OECD destination countries.⁹

⁶ We use annual data covering the period 1993–2013. Due to data availability we could not retain bilateral FDI and portfolio statistics for our index of integration. However, the remaining variables should account for bilateral integration through the financial account (e.g., cross-border banking flows statistics). The index of integration with the U.K. is computed for all countries in the world for which data on sub-components are available.

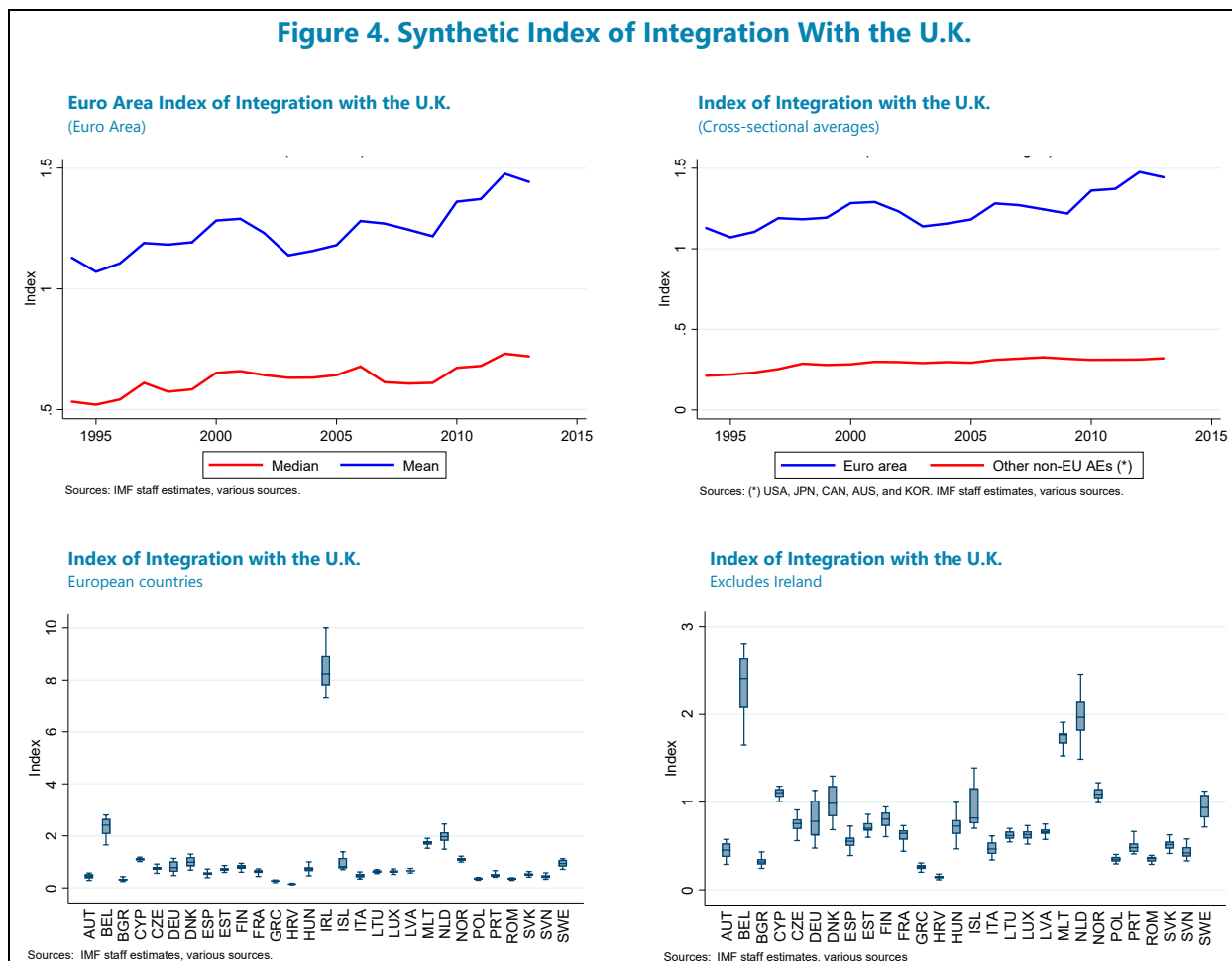
⁷ Ignatenko, Anna., Raei, Faezeh., Mircheva, Borislava, Tulin, Volodymyr (2017). Global Supply Chains: a new dataset and insights for Europe, forthcoming IMF working paper.

⁸ Brücker H., Capuano, S. and Marfouk, A. (2013). Education, gender and international migration: insights from a panel-dataset 1980-2010, mimeo.

⁹ As the database has a limited number of destination countries (20 OECD nations), it was not possible to derive reverse migration ratios from the U.K. to other destination countries beyond these 20 OECD countries, a critical piece
(continued)

The principal component analysis (PCA) identifies the relative importance, e.g., weights of the different indicators in order to build the exposure index. The exposure index is rescaled so that it ranges between 0 (minimal exposure) and 10 (highest exposure). Overall, the first principal component explains 60 percent of the total variance and is positively correlated with the seven variables used to build the exposure index. For more details regarding the PCA, see the Appendix.

9. The integration index shows that euro area-U.K. integration has strengthened over the years. The intensity of integration has increased by 40 percent over the past 25 years, split in three distinctive phases. The first one, increasing by 20 percent, in the runup to euro adoption, the second one (after euro adoption) with the index staying relatively flat, and the last phase in the aftermath of the global financial crisis when integration increases by another 20 percent. Increased integration is in large part driven by a handful of countries such as Ireland, Belgium, the Netherlands, and Malta. Other countries that exhibit considerable economic ties with the U.K. are Germany, Finland, Cyprus, and other non-euro area countries such as Denmark and Sweden.



of information needed to make the index of integration available to several countries, including non-OECD countries. Recall, the objective is to construct an index of integration with the U.K. between each country in the world and the U.K., as the index will be further used in world-wide gravity equations to derive the impacts of alternative trade arrangements.

C. An Econometric Investigation of the Long-Term Effects of Brexit on the EU

Empirical Design

10. In the empirical analysis, we assess the long-term effect on EU27 output and employment of Brexit, modeled as a partial reversal of EU27 integration with the U.K. First, we determine the relationship between EU27 countries' output and employment dynamics and their integration with the U.K., by regressing output and employment on several control variables and the integration index. Second, we will assess the impact on output and employment of a decline in integration, under different scenarios of the future relationship between the U.K. and the EU27.

11. We use panel cointegration techniques to estimate the long-run effect of the bilateral integration with the U.K. on output and employment. Three econometric issues arise. First, the integration index could suffer from endogeneity arising from an omitted variable bias or other sources. Second, the degree of integration reflects structural variables that are relatively slow moving (trade openness, participation into supply chains, financial integration, migration ties) and likely to affect output and employment mainly over a longer horizon. We are therefore interested in modelling the long-run relationships. One source of bias is that the index of bilateral integration with the U.K. can be confounded with the EU Single Market on countries or the overall degree of trade openness of a country. If this bias is not controlled for, the estimated effect of the index of bilateral integration with the U.K. will be unreliable. To reduce these concerns, the models will control for the trade openness variable for each country in the sample (total exports plus imports over GDP). We also further reduce endogeneity concerns by controlling for other determinants of output and employment such as a country's domestic investment ratio, inflation rate, and total population. The model finally controls for country fixed effects to capture the influence of time invariant or other slow-moving factors that may affect the estimations. The model is formally represented as follows:

$$\Delta \ln(y_{it}) = c_i + \Gamma_0 \Delta \ln(y_{it-1}) + \Gamma_1 \Delta X'_{it} - \rho [\ln(y_{it-1}) + \theta I_{it-1} + \Gamma_2 X'_{it-1}] + \epsilon_{it}, [1]$$

where y is the real GDP (or total employment level), I is the index of bilateral integration with the U.K., and X is a matrix of control variables (overall trade openness, domestic investment ratio, inflation rate, and total population).¹⁰ The sub-index i stands for countries, and t for the time dimension. Our main parameter of interest is $-\theta$, which captures the long-run effect of the bilateral integration with the U.K. on EU27 output or employment.¹¹

¹⁰ The annual macro variables are drawn from the IMF *World Economic Outlook* and World Development Indicators databases.

¹¹ The model is estimated for the period 1993–2013 given the availability of the index of integration. The sample is restricted to European countries.

12. As expected, we find a positive long-run effect of integration with the U.K. on EU27 output and employment. There is a positive long-run relationship between the degree of bilateral integration with the U.K. (our synthetic index) and EU27 output and employment with a long-run semi-elasticity around 0.11 and 0.05, respectively. These results already preview a key conclusion of our paper: a decline in the level of integration, through a departure from the current EU membership arrangement, will negatively affect output and employment in the EU27.¹²

13. We then calibrate the change in the integration index from post-Brexit scenarios. The main goal is to answer the following question: controlling for the traditional factors that drive the bilateral integration with the U.K. (such as distance, language, common border, size), what are the effects of EU membership, European Economic Association membership, and other Free Trade Agreements (FTAs) on the index of integration? To do this, we use a gravity model for the index of integration with the U.K. and introduce a dummy variable capturing the different economic arrangements. To ensure sufficient variability to reflect alternative trade relationships, the sample of countries is extended to non-EU countries but excludes low-income countries.¹³ More specifically, the equation takes the following form:

$$I_{it} = \phi_1 EU_{it} + \phi_2 EEA_i + \phi_3 FTA_{it} + \Gamma X'_{it} + \varphi_t + \epsilon_{it}, [2]$$

where I is the bilateral index of integration with the U.K., X is the matrix of gravitational factors (bilateral distance vis-à-vis the U.K., common border with the U.K., common language with the U.K., regional dummies, population size and GDP level). We also control for year fixed effects to capture the influence of common shocks.

14. The parameters of interest are the ones associated with each economic arrangement that exist between the U.K. and its trading partners. We have grouped them into three dummy variables: EU membership (ϕ_1 , which denotes the effect of EU membership on the integration index), the European Economic Area arrangement currently in force with countries such as Norway and Iceland (ϕ_2 , which denotes the impact of the EEA membership), and a standard free trade agreement (ϕ_3 , which is the effect of the FTA dummy). Data on these arrangements come from Baier and Bergstrand (2009).¹⁴ From equation 2, we derive the reduction in integration with the U.K. that is consistent with some specific scenarios:¹⁵

¹² This is consistent with recent findings by Connell et al. (2017) who showed that Brexit would adversely affect both output and employment in the EU.

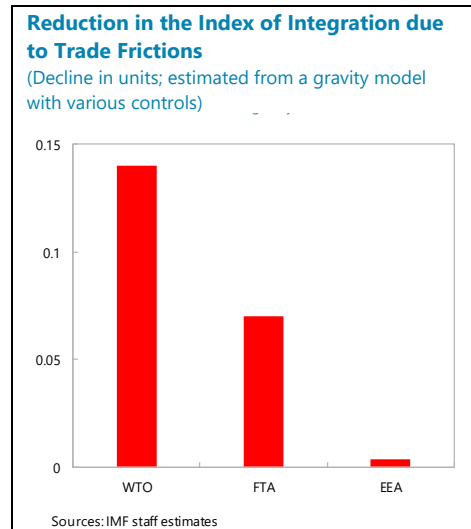
¹³ Extending the regression sample to include non-EU countries helps identify the effect of variables such as the EU membership (taking 1 for EU member states and 0 in the rest of world), the European Economic Association, and other non-EU specific trade arrangements on the bilateral integration with the U.K.

¹⁴ In economic terms, the EEA would be close, but not identical, to the status quo for a full EU membership, with full inclusion in the single market for all four freedoms, and compliance with all EEA-relevant regulatory legislation by the EU. But it excludes membership of the EU's custom union, as well as agricultural and fisheries policies.

¹⁵ Ideally, one would have also allowed for interactions between the various trade arrangements to reflect hybrid arrangements. However, there are not enough variations in the data regarding various combinations.

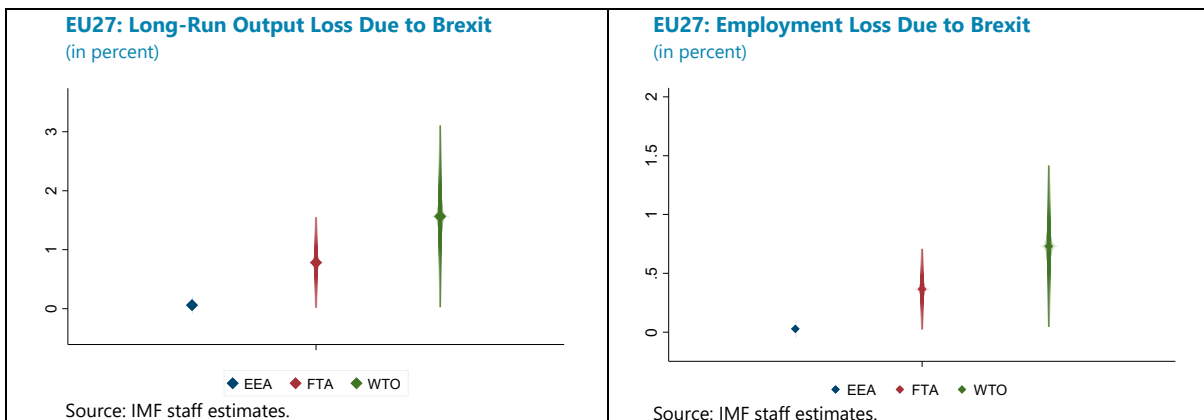
- $(\phi_1 - \phi_2)$: This refers to the decline in integration going from EU membership to an EEA.
- $(\phi_1 - \phi_3)$: This refers to the decline in integration going from EU membership to an FTA.
- (ϕ_1) : This refers to the decline in integration from EU membership to the default WTO.

15. The results confirm the expected hierarchy of the impact of various arrangements on integration. First, the model estimates confirm that the EU membership produces the highest degree of integration with the U.K. of all trade arrangements considered here. Second, settling on an EEA arrangement would lead to a moderate loss of economic integration compared with other alternative arrangements (an FTA). Third, the estimates of the integration shocks are statistically significant and with a relatively good precision.¹⁶



16. Results suggest a negative, but rather small effect of Brexit on EU output and employment in the long run. These impacts are derived by multiplying the various degrees of integration losses computed from

Equation 2, by the long-term effect of the index of integration on output and employment estimated in Equation 1. A scenario in which access to the single market is preserved while the custom union is sacrificed (the EEA model or ‘soft Brexit’) would imply an almost zero cost (0.06 percent) for the EU as a whole, for both output and employment. In contrast, introducing more trade frictions by reverting to a standard FTA or to a no-deal outcome (WTO default) would lead to higher losses in the order of 0.8 and 1.5 percent for output, respectively. For employment, these losses would be comprised between 0.3 and 0.7 percent. These estimates on average are higher compared to previous studies that used standard CGE trade models, but are broadly similar to new studies that have augmented CGE trade models with supply chain links (e.g., Connell et al., 2017). In contrast to these previous studies, which solely modelled the effect of Brexit through trade channels, the econometric approach used in this study incorporates additional channels of integration.



¹⁶ The Delta method is used to assess the statistical significance of the differences in coefficients.

17. These results should be interpreted with some caution. They remain conditional on the statistical power of the tests conducted and only represent average effects for the EU.¹⁷ Despite its technical appeal, the econometric estimations remain subject to statistical uncertainty. Furthermore, these results mask inevitable cross-country and cross-sector differences that reflect different exposures to the U.K. The economic uncertainty surrounding the post-Brexit period arrangement is also a non-negligible factor, although uncertainty is most likely to have a short-run impact. Moreover, the results assumed only polar and rigid post-Brexit scenarios, and do not incorporate the possibility, for example, that the EU and U.K. agree on a hybrid arrangement.

D. A Model-Based Approach to Quantify Long-Term Effects of Brexit Due to Higher Trade Barriers

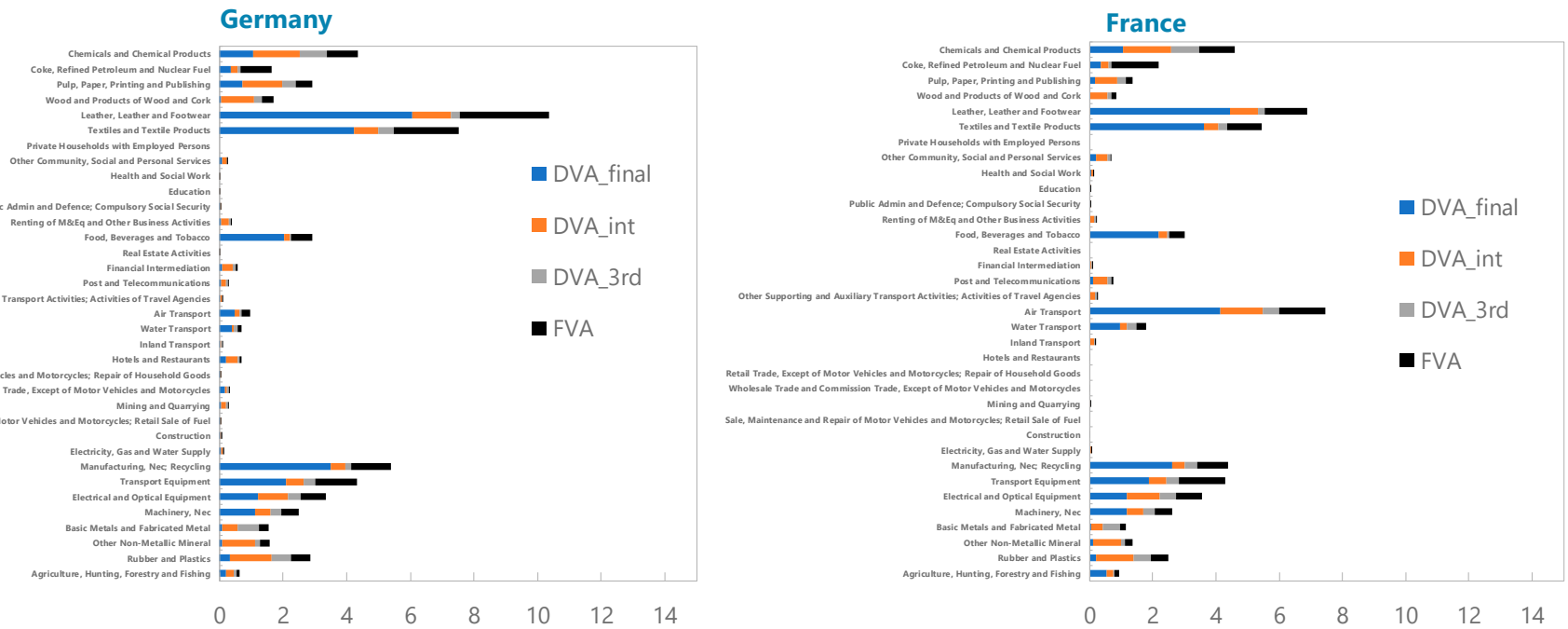
18. We rely on a CGE model to explore country-by-country and sector-by-sector effects. The econometric investigations performed so far have helped in producing average effects of post-Brexit scenarios on the euro area, but have not identified any heterogeneous effects on individual member states. Digging one step further, data reveals trade exposures to the U.K. also vary significantly across sectors (Figure 5). Against this background, this section aims to quantify the impacts from higher trade barriers on individual countries in the euro area as well as sectors within each country using a multi-country and multi-sector CGE model. In addition to the rich structure, the model is well suited to investigate ex-ante the implications of trade policies in counterfactual scenarios.

19. The core of the model is to infer changes in real income associated with changes in trade barriers.¹⁸ In the Armington model (a simple CGE model), there are n countries, with each supplying its own distinct goods. There are thus n goods, with country i being the only supplier of good i in fixed quantity, which corresponds to the country's endowment of the good. A representative household in each country maximizes its utility by consuming a variety of goods subject to a budget constraint. This implies that total expenditure (i.e., goods imported from other countries including associated trade costs) must be no greater than income (i.e., revenues from exporting good). In this case, the demand for goods from other countries (i.e., trade flows) is determined by the preference, income, cost of trade (i.e., tariffs) and price of foreign goods. Market equilibrium conditions imply demand for any good j needs to equal to the supply. Hence, when there is a change in trade costs, we solve the model by finding the pattern of income changes that is consistent with the new set of bilateral trade costs while respecting market clearing conditions. From a single-country perspective, an increase in trade cost decreases the revenues from exports as other countries buy less, reducing income with knock-on effects to other countries even if trade costs have not changed for these countries. To maintain sustainable external balance over the long run, imports will also have to fall too. In the new equilibrium, households are worse off by having lower income and consuming less varieties of goods. The key insight from the Armington model carries into more complex frameworks.

¹⁷ The next section will provide detailed results at the country and sector levels using a CGE modelling approach of the effects of Brexit via the trade channel.

¹⁸ We defer readers to Costinot and Rodriguez-Clare (2013) on the details of the model, but focusing to illustrate the main intuitions with a simple Armington model.

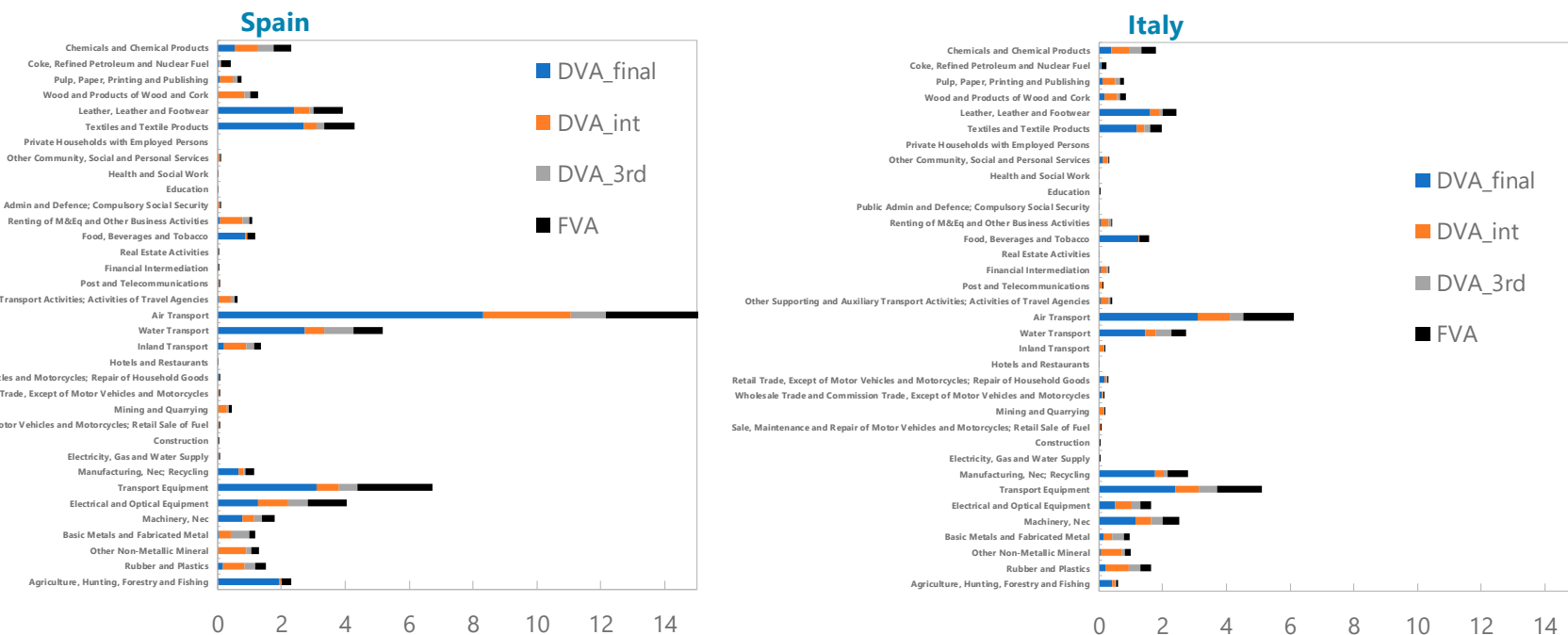
Figure 5. Gross Exports to the U.K. by Sector for Selected EA Countries
(percent of sector gross output, 2011)



Note: DVA_final stands for domestic value added of exports of final goods to the U.K. DVA_int depicts domestic value added of exports of intermediate goods to the U.K. and consumed in the U.K. DVA_3rd depicts domestic value added of exports of goods to the U.K. then re-exported to a 3rd country. FVA depicts the foreign value added. The decomposition is based on Wang, Wei and Zhu (2013). Sources: World Input-Output Tables and IMF staff calculations.

Figure 5. Gross Exports to the U.K. by Sector for Selected EA Countries (concluded)

(percent of sector gross output, 2011)



Note: DVA_final stands for domestic value added of exports of final goods to the U.K. DVA_int depicts domestic value added of exports of intermediate goods to the U.K. and consumed in the U.K. DVA_3rd depicts domestic value added of exports of goods to the U.K. then re-exported to a 3rd country. FVA depicts the foreign value added. The decomposition is based on Wang, Wei and Zhu (2013). Sources: World Input-Output Tables and IMF staff calculations.

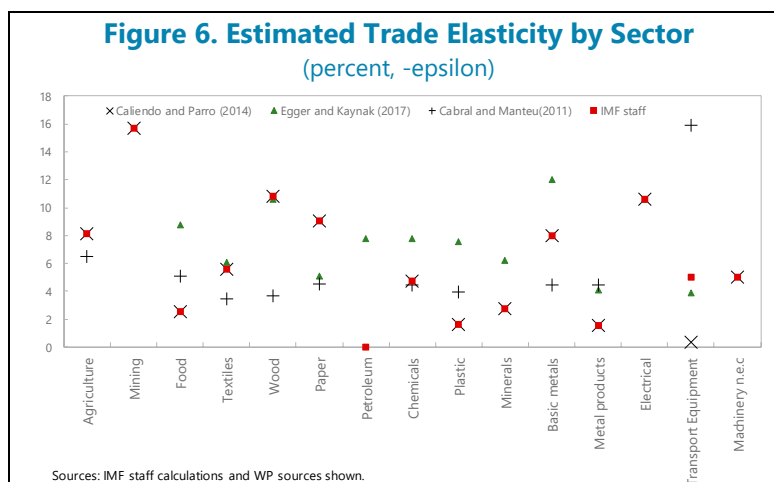
20. Our baseline model covers 34 countries and 31 sectors, assumes monopolistic competition among firms, and captures global supply chain linkages. We consider three versions of the CGE model as in Costinot and Rodriguez-Clare (2013), differing by the climate of competition among firms. The first model considers multiple countries and sectors (34 countries plus the rest of the world and 31 sectors) and tradable intermediate inputs for production to capture global supply chain linkages. It assumes perfect competition among the production firms which has been shown to provide a lower bound to the welfare effects of changes in trade costs. We then extend the model to incorporate monopolistic competition, as in Krugman (1980), which implies firm-level product differentiation of symmetric varieties. Finally, we allow for firm heterogeneity consistent with Melitz (2003) at the cost of focusing on a much smaller set of countries and sectors (10 countries and 16 sectors) to reduce computational burden. Geared with these models, we calculate the changes in real income (therefore consumption and welfare) after Brexit by defining distinct scenarios. The income loss from Brexit is obtained by comparing welfare in a scenario where the U.K. remains an EU member and in a scenario in which U.K. does not. In view of the benefit of having a more realistic market structure (i.e., monopolistic competition) and the advantage of covering a broader set of countries and sectors, in what follows, the discussion focuses on the results from the model with monopolistic competition.

Data

21. The model draws on data and assumptions from various sources:

- *Trade linkage data* are based on the World Input-Output Database (WIOD) for the year 2011. This database aggregates the world into 40 countries and covers 35 sectors which we further aggregate into 34 countries, the rest of the world and 31 sectors consistent with the setup of the model.
- Data on the applied *most favored nation (MFN) tariff* by the EU are taken from Dhingra et al. (2016), who calculated MFN tariff for the 31 sectors (consistent with the ones in the WIOD database) using information on tariffs from the World Trade Organization weighted by the EU and U.K. trade shares.
- *Non-tariff trade barriers* are related to costs of differences in product regulations, legal barriers, and other transaction costs for both goods and services—several authors point out that such costs are higher than formal tariffs (Anderson and van Wincoop, 2004). The primary source for the non-tariff trade barriers between U.K. and EU trade is from the published [EU Exit Analysis Cross Whitehall Briefing paper](#). However, the paper does not present the estimated non-tariff trade costs on all the sectors of interest, thus we complement the published measures with the estimates provided by Berden et al. (2009, 2013). The authors calculated tariffs equivalent of non-tariff barriers between the U.S.A. and the EU trade, using econometric techniques and business survey.

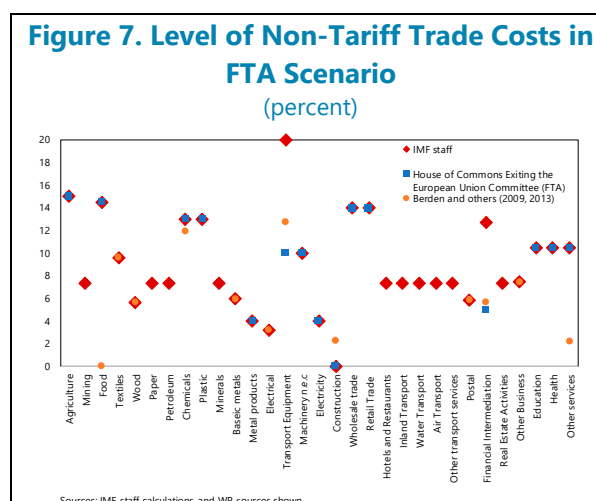
- *Trade elasticities* (Figure 6) for agriculture and manufacturing sectors are from Caliendo and Parro (2015) as their estimation procedure is consistent with all quantitative trade models satisfying the sector-level gravity equations, while trade elasticity for service sectors is simply held equal to the aggregate trade elasticity of 5 following Costinot and Rodriguez-Clare (2013).¹⁹



Alternative Post-Brexit Scenarios

22. We model post-Brexit scenarios as increase in goods tariffs and non-tariff barriers for both goods and services trade. In particular, we consider two cases:

- *'FTA' scenario*: We assume that the U.K. leaves the single market and the customs union, but the U.K. and the EU agree on a broad free trade agreement. Specifically, the scenario assumes that tariffs on goods trade remain at zero, and non-tariff costs increase moderately. With respect to the financial sector, we calibrate the size of the non-tariff trade cost such that net exports of financial services from the U.K. to the EU fall by about 40 percent, which is broadly consistent with the assumption that London-based financial firms continue to provide some cross-border financial services based on regulatory equivalence. We have also assumed a higher increase of non-tariff trade costs on the transportation equipment sector than the other studies to reflect the complicated supply chain linkage.²⁰ Figure 7 illustrates the assumed increase in non-tariff trade costs (in tariff equivalent terms) for different sector under the scenarios.



¹⁹ There are two exceptions, we set the estimated trade elasticity on coke, refined petroleum and nuclear fuel sector to close to 0 to avoid implausible sectoral level results. In addition, we calibrated the trade elasticity for transport equipment sector to be in line with the estimates in Egger and Kaynak (2017).

²⁰ We have run robustness checks using lower tariffs on the transportation equipment sector, and the results do not change significantly.

- *‘Hard Brexit’ scenario* (WTO scenario): We assume that the U.K. is no longer part of the single market nor the customs union and will trade with the remaining EU countries on the WTO terms. The U.K. would apply the MFN tariffs (see Table 1) on goods imported from the EU, while the EU would apply the MFN tariffs on goods originating from the U.K. In addition, we assume that the non-tariff trade costs would increase by twice as much as in the FTA scenario for all sectors.²¹

Table 1. UK MFN Tariff With Non-EU Countries

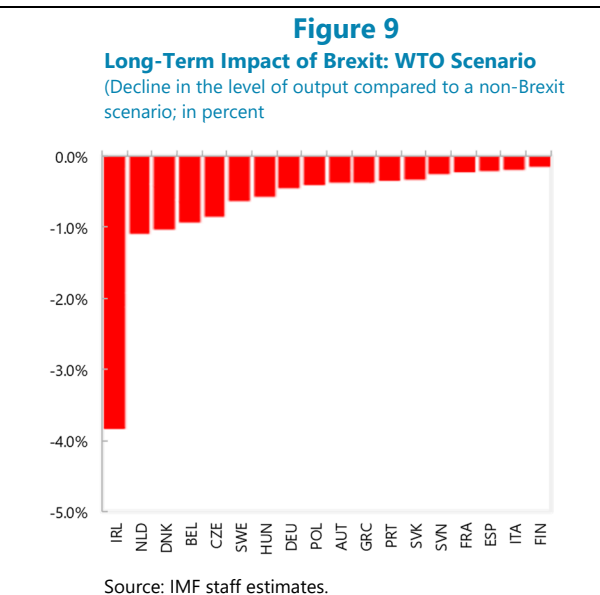
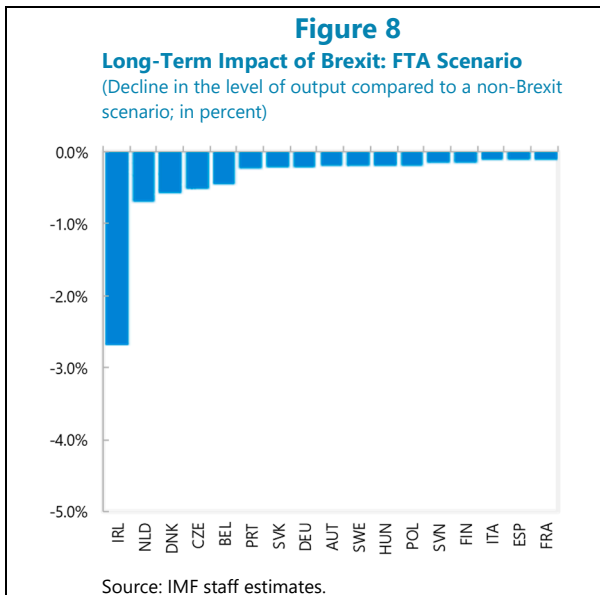
(Percent)

Sectors	Imports	Exports
Agriculture, Hunting, forestry and fishing	5.9	5.63
Mining and quarrying	0	0
Food, beverages and tobacco	7.26	4.96
Textiles and textile products, Leather	9.58	9.7
Wood and products of wood and cork	2.35	3.62
Pulp, paper, printing and publishing	0.04	0.1
Coke, refined petroleum and nuclear fuel	2.69	2.81
Chemicals and chemical products	2.71	2.16
Rubber and plastics	5.35	5.05
Other non-metallic minerals	3.78	3.32
Basic metals and fabricated metal	2.05	1.89
Machines, etc	2.05	2.13
Electrical and optical equipment	1.97	1.55
Transport equipment	8.09	7.22
Manufacturing, etc.	1.71	1.69
Weighted average (by EU trade)	4.43	3.29

Sources: Dhingra and others (2016)

Results

23. Calculations from our baseline model show EU output losses of 0.2 to 0.5 percent in the “FTA” and “hard Brexit” scenario, respectively. However, the effects vary significantly across country: Ireland’s real income is estimated to fall by about 2.5 to 4 percent similar to the estimated impact on the U.K.; Netherland’s and Belgium’s real income is estimated to fall by about 0.7 and 0.5 percent, respectively, in the FTA scenario and by about 1 percent in the WTO scenario (see Figures 8 and 9).



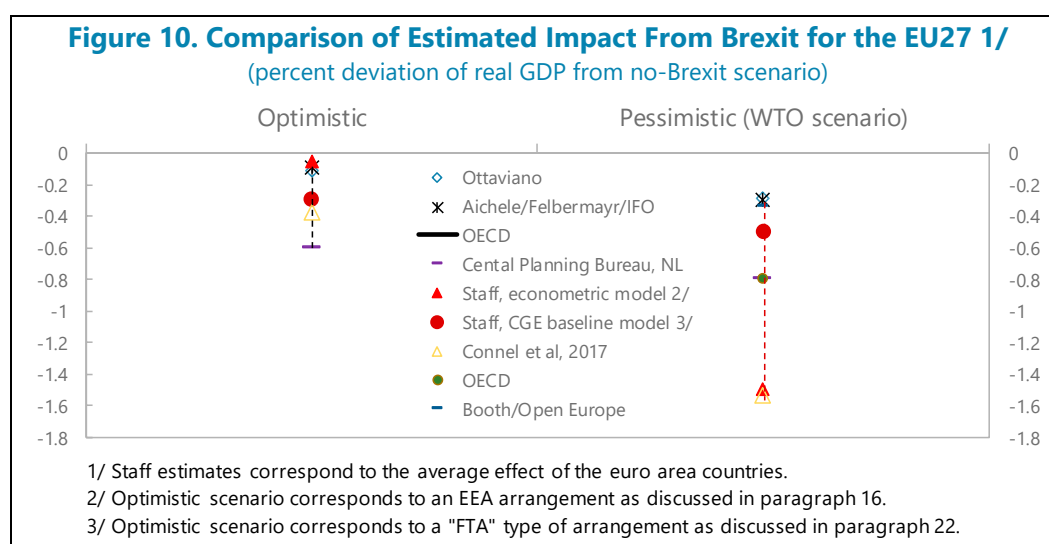
24. However, it is important to note that the quantitative results rest on important assumptions in the model as well as the estimated trade elasticities in the literature. For example, the model assumes linear cost function, and Dixit-Stiglitz preferences. Although these assumptions are common in macro models, they may be too restrictive to give a full representation

²¹ In both scenarios, we assume the U.K. and EU will transition smoothly to the new trading arrangement.

of the reality. Moreover, the quantitative estimates hinge on the assumed trade elasticities. But as pointed out by Hummels and Hillberry (2012) it is econometrically very challenging to estimate trade elasticities, and the existing estimates can vary quite significantly across paper (McDaniel and Balistreris, 2003). Furthermore, the model does not capture some important channels through which Brexit would affect the euro area. For example, the potential relocation of U.K. subsidiaries of multinational firms is not considered. That said, Caliendo and Parro (2015) show that the CGE model in their paper does a reasonably good job in capturing the impact of tariffs changes caused by NAFTA between 1993 and 2005. And CGE model remains a cornerstone of trade policy evaluation (Baldwin and Venable, 1995; Piermartini and Teh, 2005).

E. Summary of the Results

25. The estimated impacts in both empirical approaches used in this paper fall within the range of the estimates in the literature. In the pessimistic scenario, staff estimates suggest a range of output loss of between of 0.5 and 1.5 percent over the long run and with the econometric model pointing to larger impacts than CGE model-based estimates as it considers broader channels beyond trade (Figure 10).



26. The range falls within the estimates in the literature, which partly reflects uncertainty around the estimates. The CGE model used in this paper delivers estimates that are broadly similar to the results in the literature which has focused on the trade effects of Brexit (Dhingra et al., 2016; Aichele and Felbermayr, 2015; OECD, 2016; Roja-Romagosa, 2016; and Booth et al., 2016). In contrast, we find higher impacts from the econometric model which takes into account the multiplicity of possible transmission channels beyond trade. Nevertheless, the study by Connell et al. (2017) which uses a deeper CGE model with complex supply chain linkages give similar results for the EU27 as those derived from the econometric model.

F. Conclusion

27. This paper has examined the consequences of Brexit on the EU27 under various post-Brexit scenarios and using two different, complementary, approaches. Our results, which are broadly in line with recent findings in the literature, are two-fold.

28. First, Brexit would have negative effects on the EU27 as well, given the depth and the complexity of the EU-U.K. integration. Similar to various empirical studies, we find that the estimated long-term output and employment losses (in percent) for the EU27 in our study are on average lower than the corresponding losses for the U.K. estimated in the literature (Dhingra et al., 2016; Aichele and Felbermayr, 2015; OECD, 2016; Roja-Romagosa, 2016; and Booth et al., 2016). The level of output and employment are estimated to fall at most by up to 1.5 percent and 0.7 percent in the long run in the event of a ‘hard’ Brexit scenario, respectively. A ‘soft’ Brexit outcome would lead to much lower losses.

29. Second, there is significant cross-country heterogeneity. For example, very open economies such as Ireland, the Netherlands, and Belgium are among the most exposed economies to Brexit-related adverse shocks. Ireland is the only EU27 country exhibiting Brexit-related output losses of similar magnitude to those estimated for the U.K. in the literature.

Appendix. Principal Component Analysis Results

Table A1. Eigen Value and Cumulative Relative Frequencies			
Principal component	Eigen Values	Proportion	Cumulative relative frequencies
1	2.99	0.6	0.6
2	0.98	0.2	0.8
3	0.88	0.17	0.97
4	0.10	0.02	1.0
5	0.04	0.0	1.0

Table A2. Eigen Vectors	
Variables	P1
Trade in value added-to-GDP	0.57
Participation in supply chains	0.54
Service trade openness	0.56
Cross-border bank claims	0.1
Migration share	0.27

Table A3. Sectoral Aggregations

WIOD sector	WIOD31 sector code	Sector's description	Sector name
1	1	Agriculture, Hunting, Forestry and Fishing	Agriculture
2	2	Mining and Quarrying	Mining
3	3	Food, Beverages and Tobacco	Food
4	4	Textiles and Textile Products	Textiles
5	4	Leather, Leather and Footwear	Textiles
6	5	Wood and Products of Wood and Cork	Wood
7	6	Pulp, Paper, Printing and Publishing	Paper
8	7	Coke, Refined Petroleum and Nuclear Fuel	Petroleum
9	8	Chemicals and Chemical Products	Chemicals
10	9	Rubber and Plastics	Plastic
11	10	Other Non-Metallic Mineral	Minerals
12	11	Basic Metals and Fabricated Metal	Basic metals
13	12	Machinery, Nec	Metal products
14	13	Electrical and Optical Equipment	Electrical
15	14	Transport Equipment	Transport Equipment
16	15	Manufacturing, Nec; Recycling	Machinery n.e.c
17	16	Electricity, Gas and Water Supply	Electricity
18	17	Construction	Construction
19		Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	
20	18	Retail Sale of Fuel	Wholesale trade
21		Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	
22	19	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Retail Trade
23	20	Hotels and Restaurants	Hotels and Restaurants
24	21	Inland Transport	Inland Transport
25	22	Water Transport	Water Transport
26	23	Air Transport	Air Transport
27	24	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Other transport services
28	25	Post and Telecommunications	Postal
29	26	Financial Intermediation	Financial Intermediation
30	27	Real Estate Activities	Real Estate Activities
31	28	Renting of M&Eq and Other Business Activities	Other Business
32	29	Education	Education
33	30	Health and Social Work	Health
34	31	Other Community, Social and Personal Services	Other services
35	31	Private Households with Employed Persons	Other services

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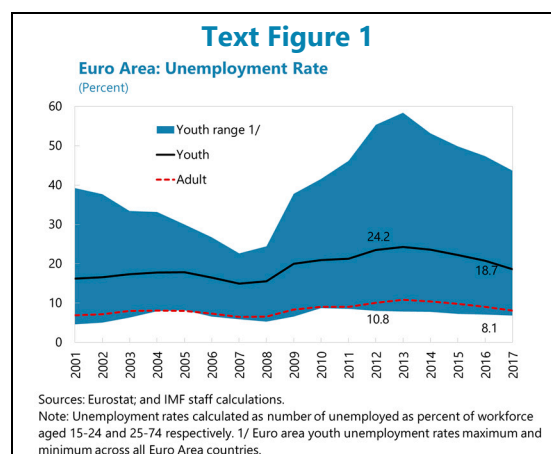
YOUTH UNEMPLOYMENT DURING THE EURO AREA ECONOMIC RECOVERY¹

The euro area youth unemployment rate has declined as the economic recovery has taken hold, but remains elevated, especially in some countries. Job creation for the young, however, has been sluggish. Instead, the decline in the unemployment rate mostly reflects a reduction in the size of the young population and a higher share of young people in education. Higher educational attainment can improve young people's labor market prospect and boost productivity, but measures are still needed to tackle youth unemployment and inactivity, by boosting new job creation and facilitating labor-market entry for the young.

A. Recent Developments of Youth Unemployment in the Euro Area

1. The youth unemployment rate for the euro area has come down in recent years, but is still high in some countries. It has declined by more than 5 percentage points to under 19 percent

by 2017, from its peak of 24 percent in 2013.² This is larger than the decline in the unemployment rate for adult workers, which fell by close to 3 percentage points, to 8 percent in 2017 (Text Figure 1). This is consistent with Banerji et al. (2014), who show that youth unemployment tends to be more cyclical than adult unemployment.³ The biggest improvements in youth unemployment since the crisis peak occurred in Ireland, Slovakia, Lithuania, Latvia, and Portugal, where youth unemployment rates dropped by more than 10 percentage points. Nevertheless, the dispersion among the countries is still high (see Box 1). Among the eight countries (YU8) with the highest youth unemployment: Belgium, Cyprus, Finland, France, Greece, Italy, Portugal, and Spain, the rate remains near or above 20 percent.



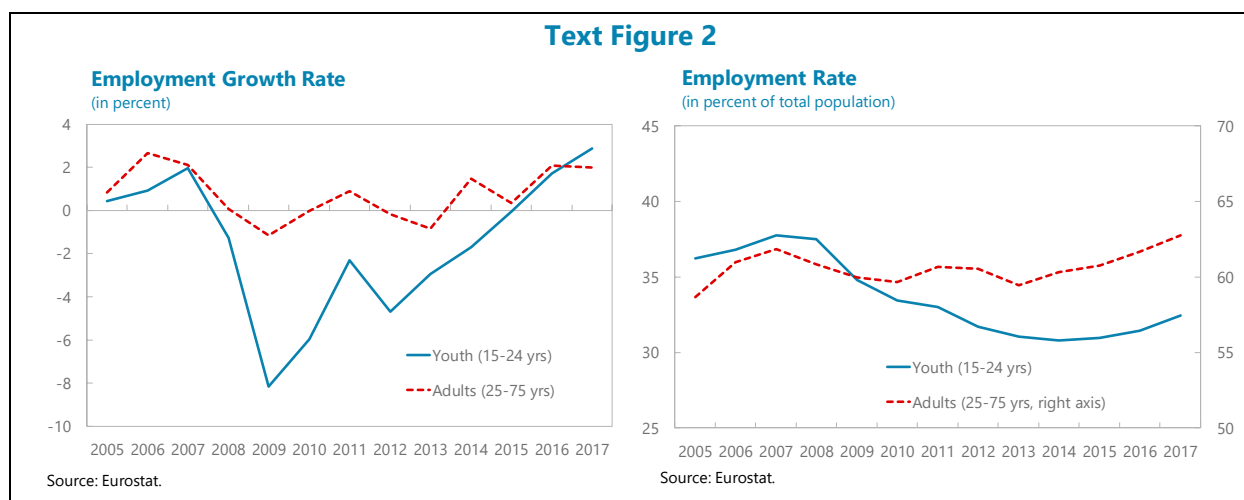
2. Youth employment only started to increase in 2016. Euro area growth has been positive since 2013, but the number of employed young continued to decline until 2016. In contrast, adult workers experienced net job creation as early as 2014 (Text Figure 2). As a result, the employment

¹ Prepared by Haonan Qu and Hanni Schoelermann. The authors are grateful for helpful collaboration and contributions from Angana Banerji at the early stage of the project. The paper has also benefited from excellent research assistance from Xiaobo Shao and Jesse Siminitz.

² In this paper, the young refer to the 15–24-year age group, adults refer to the 25–74-year age group, and prime-age workers are 25 to 54 years old, and older workers refer to the 55+ age group, unless otherwise specified.

³ The higher cyclicity reflects a number of factors, including young workers' less job-specific skills, lower job security with a greater share of the young in temporary and part-time jobs, and even perceptions of social fairness in which the young are considered to more easily cope with unemployment than older workers who may need to support families.

rate (in percent of the total population) for the young fell throughout the crisis and has only started to show signs of recovery recently, compared with a rising employment rate for adults since 2013.

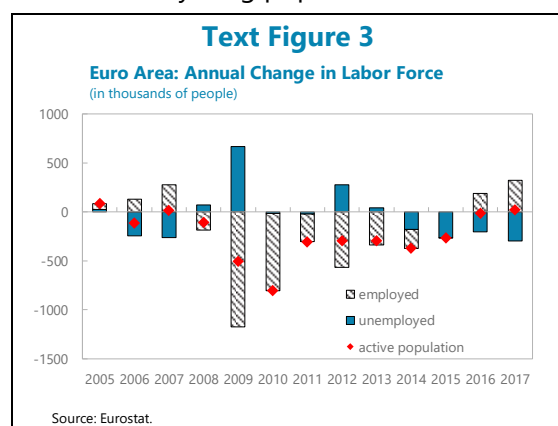


3. This paper aims to answer the following questions:

- With only limited employment growth, how was the decline in the youth unemployment rate achieved?
- Why did it take so long for the cyclical recovery to lead to new jobs for the young?
- How can one explain the different developments in unemployment and employment between youth and adults?

B. Main Drivers: A Shrinking Labor Force and a Larger Share in Education and Training

4. **The decline in the youth unemployment rate has largely been driven by unemployed people leaving the labor force, instead of job creation.** The active young population started to decline with the onset of the global financial crisis in 2008, and only stabilized in 2016. The cumulative reduction in the young labor force amounted to almost 3 million during 2008–17 (see Box 2). At the same time, more than 3 million jobs were lost. Looking at the period since 2013, the number of unemployed young declined by 0.9 million. However, only 0.3 million new jobs were created, implying a loss of more than 0.6 million unemployed people in the young labor force. In other words, more than two thirds of the decline in the number of unemployed



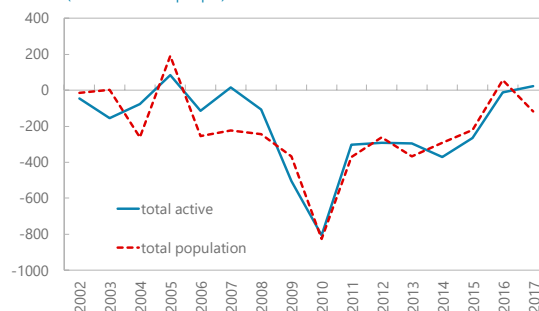
during this period was due to a shrinking labor force (Text Figure 3). The number of young people employed only started to increase in 2016.

5. The primary reason for the decline in the young labor force was the smaller size of new youth cohorts, exacerbated by lower immigration following the crisis. The loss of young labor force has been mirrored by a similar development in the young population since 2008 (Text Figure 4). Prior to the crisis, net migration inflows kept the active young population broadly unchanged. During 2008–16, however, inflows fell to about 0.2 million annually, compared to an annual average of around 0.3 million during 2006–07 (Text Figure 5). The surge of inflows in 2015—which was driven by non-EU immigrants—appears to have helped stabilize the size of the young labor force. The net inflows have been concentrated in countries with strong economic performance, such as Germany, and declined in countries such as France, Italy, and Spain, which have high youth unemployment (Text Figure 6).

6. The decline in the young labor force also reflects an increasing share of young people in education or training. The similar reduction of young labor force and population in head counts implies a more-than-proportionate decline in the labor force. This is mostly explained by an increasing share of young people investing in education, especially in the years immediately following the crisis (see Box 2). The proportion of young people in education rose almost 5 percentage points since 2008, to 57 percent in 2017 (Text Figure 7).

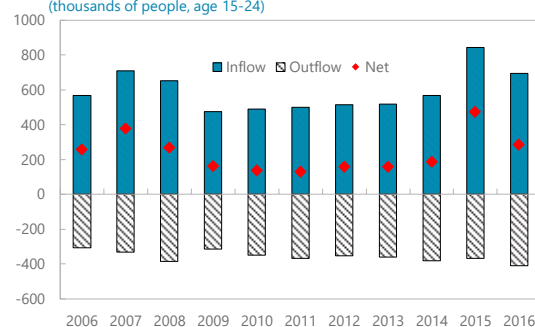
7. Finally, the share of young people that are not in employment, education and training, increased during the crisis, but is now on a downward path. The share of 20–34 years old that are not in employment, education or training (NEET) rose by several percentage points after 2008

Text Figure 4

Euro Area: Change of Young Population
(in thousands of people)

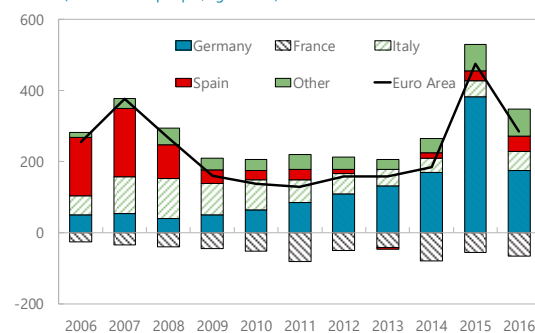
Source: Eurostat.

Text Figure 5

Euro Area: Migration Flow
(thousands of people, age 15-24)

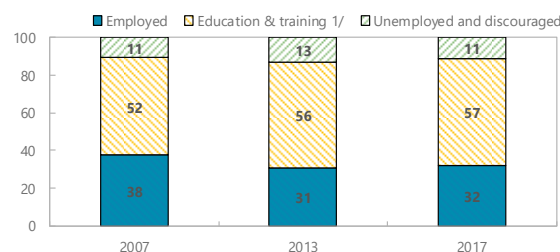
Source: Eurostat.

Text Figure 6

Net Migration Flow
(thousands of people, age 15-24)

Source: Eurostat.

Text Figure 7

Euro Area: Education and Employment
(in percent of total, age 15-24)

Source: Eurostat.

1/ excluding employed young people in education or training.

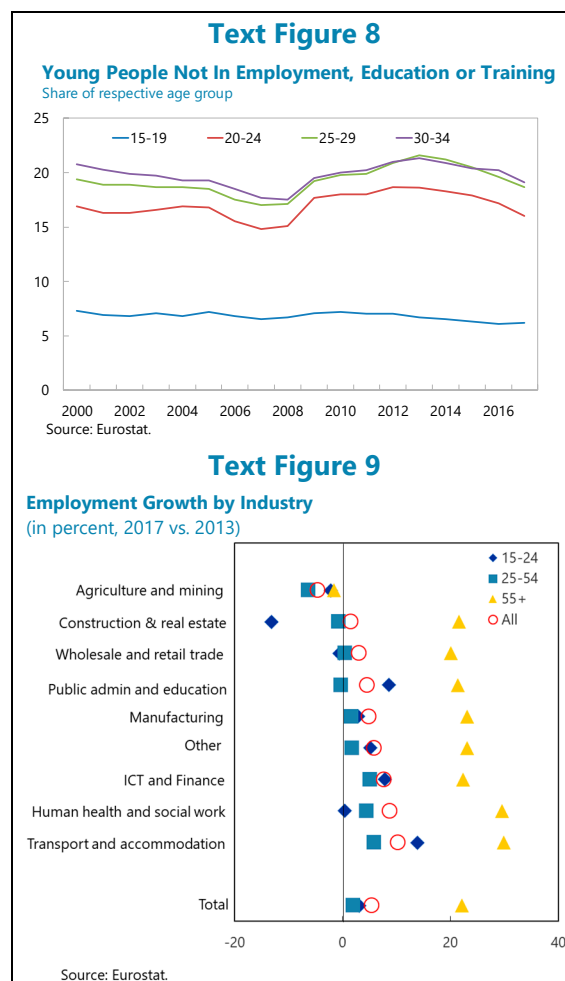
(Text Figure 8). Partly reflecting the economic recovery, the NEET rate started to decline gradually in recent years, and it was back to the pre-crisis level for the 15–24 age group by 2017. Nevertheless, the NEET rate is elevated and dispersion among countries remains large (see Box 1). A prolonged period of inactivity could make young people’s entry into the labor market more difficult and likely lead to lifetime income losses.

C. Job Creation and the Young

8. The jobs created in the economic recovery were skewed towards skill-intensive sectors that demand high levels of education and work experience.

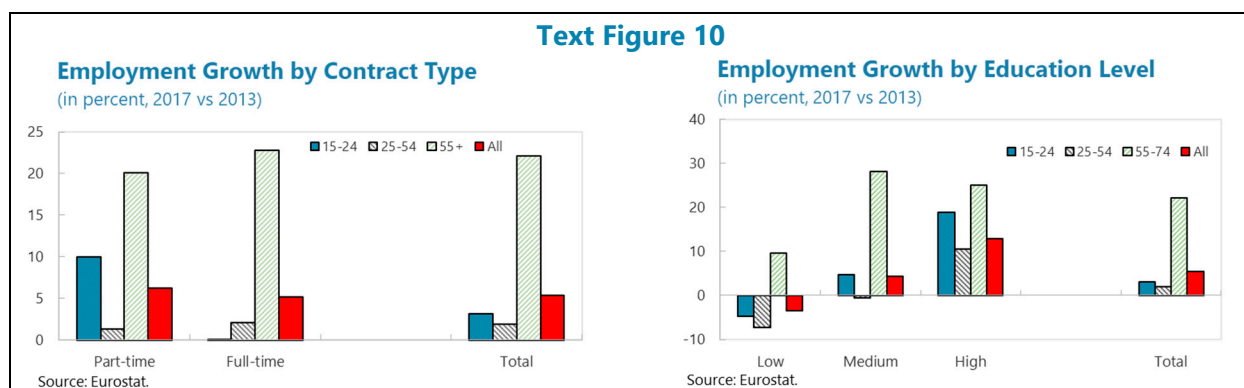
The high demand for skills may have acted as a pull factor for young people to move into education. Over the period 2013–17, total employment grew by 5.4 percent, compared with 3.1 percent employment growth for the young. Job creation in skill-intensive sectors such as ICT, finance, energy, professional services, and health accounted for close to 60 percent of this increase in employment. In sectors in which youth employment is traditionally concentrated—such as construction, accommodation, manufacturing and retail trade—employment growth was weaker, accounting for less than 45 percent of the total employment increase. The contribution of the young to employment growth in these sectors was below average except for the transport and accommodation sector (Text Figure 9). The young experienced job loss in construction and retail trade, despite an overall employment increase in these sectors. In contrast, older workers (i.e., 55+ age group) enjoyed employment growth in all sectors except for agriculture and mining where there was an overall job loss during the recovery period.

9. New jobs for the young were almost exclusively part time. Part-time jobs grew by about 10 percent for the young over 2013–17, but there was no increase in full-time jobs. In contrast, adult workers, particularly the older workers, benefited more evenly between part-time and full-time contracts. When looking at employment creation by education level, job growth was the highest for the highly educated, at close to 13 percent over 2013–17, and the increase was almost 19 percent for the young workers (Text Figure 10).⁴ The bulk of new jobs for the highly educated went to prime-age workers, who accounted for over 73 percent of this employment segment. Older workers gained

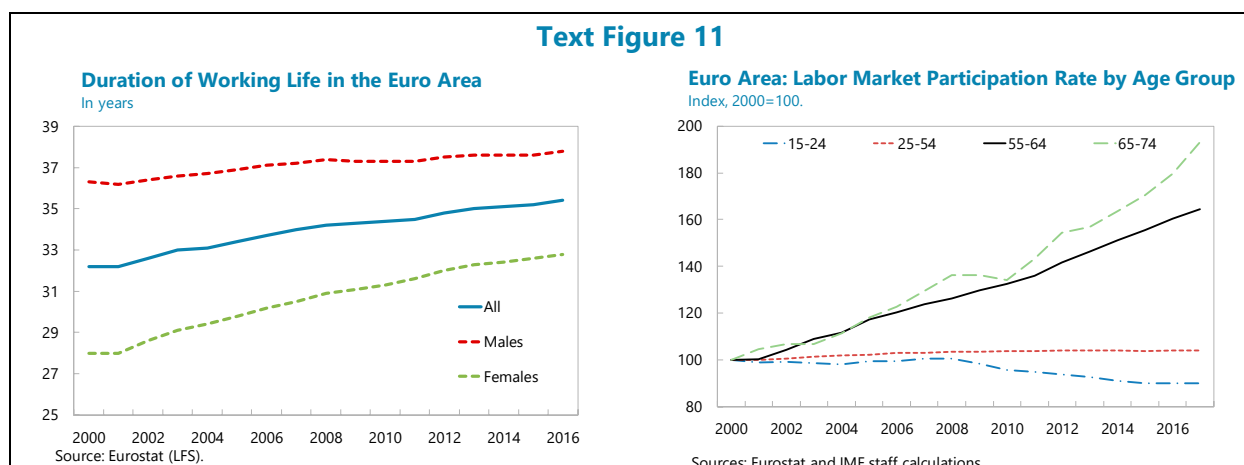


⁴ The education attainment level is coded according to the International Standard Classification of Education: “Low” indicates less than primary, primary and lower secondary education; “Medium” indicates upper secondary and post-secondary non-tertiary education; and “High” indicates tertiary education.

a large share of jobs for low- and medium-education level. Job prospects were less favorable for the young without tertiary education, especially for those with low education attainment level.



10. The weak employment growth for the young could also reflect that the economic downturn rendered more difficult the adjustment to increased female and old-age labor force participation. There has been a continued upward trend of longer working lives in recent years, especially for women, which did not slow during the crisis (Text Figure 11). At the same time, several countries reformed pensions systems and increased the retirement age during the crisis. Higher labor force participation helps alleviate pressures from ageing populations, and gives a boost to economic growth that leads to more job opportunities over the medium term, which will benefit the young. Nevertheless, during an economic downturn like the global financial crisis, extended working lives may have increased the burden on the young (Boeri and Jimeno, 2016). In the short run, competition from more experienced workers and fewer vacancies due to higher effective retirement age could adversely affect the job prospects for the young who possess limited experience and job-specific skills in an environment that lacks growth to create enough new jobs.⁵ At the same time, it may have acted as a push factor for young people to move into education.



⁵ Boeri and Jimeno (2016) Boeri et al. (2016) looked at the 2011 pension reform in Italy which increased retirement age by up to five years for some categories of workers. They found that firms that were more exposed to the increase in employment duration of senior workers significantly reduced youth hiring. Vestad (2013) also identified positive impact of early retirement of pensioners on youth employment using a micro-level dataset in Norway.

11. An empirical analysis shows that several labor market features play a role in youth employment. The approach focuses on differentiating the impact on the young versus prime-age workers. Similar to Banerji et al. (2014), the following multivariate model considers the effect of several labor market features, while allowing the impact of the business cycle to vary across countries. In addition, the analysis looked into both the unemployment and the employment rates, as this analysis shows that the developments in the unemployment rate alone do not tell the full story. More specifically,

$$e_{i,t} = \beta_{1,i} + \beta_{2,i} (y_{i,t} - y_{i,t}^*) + \sum_j \gamma_j x_{i,j,t} + \epsilon_{i,t}$$

where $e_{i,t}$ is the level of the employment or unemployment rate of country i at time t for the respective age group (i.e., the youth and prime-age population), $(y_{i,t} - y_{i,t}^*)$ is the output gap, and $x_{i,j,t}$ represents labor market feature j , in country i at year t . The panel regression covers the period of 2000–16, and the results are presented in Table 1.⁶

Table 1. EU: Multivariate Model Estimates

Variables	Employment Rate				Unemployment Rate			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Age 15-24	Age 25-54	Age 15-24	Age 25-54	Age 15-24	Age 25-54	Age 15-24	Age 25-54
Tax wedge	-0.38*** (0.07)	-0.19* (0.10)	-0.37*** (0.10)	-0.24* (0.12)	0.70*** (0.13)	0.32*** (0.08)	0.67*** (0.16)	0.38*** (0.08)
ALMP spending	0.53*** (0.08)	0.35** (0.16)	0.43*** (0.06)	0.26 (0.16)	-0.95*** (0.10)	-0.34*** (0.05)	-0.92*** (0.13)	-0.32*** (0.06)
Net replacement rate	-0.07** (0.03)	-0.03 (0.03)	-0.07** (0.03)	-0.02 (0.04)	-0.06 (0.05)	-0.01 (0.02)	-0.05 (0.05)	-0.01 (0.02)
Coordination of wage setting			0.64* (0.34)	0.50 (0.31)			-0.61 (0.51)	-0.58* (0.27)
Country-specific output gap coefficient	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	354	354	300	300	354	354	300	300
R-squared	0.667	0.605	0.703	0.664	0.750	0.744	0.772	0.789

Source: IMF staff calculations.
Note: Employment rate is calculated as the ratio of employed over total population for respective age groups. Driscoll-Kraay standard errors are in parentheses. ALMP = active labor market policy.
*p< 0.1; ** p<0.05; ***p<0.01.

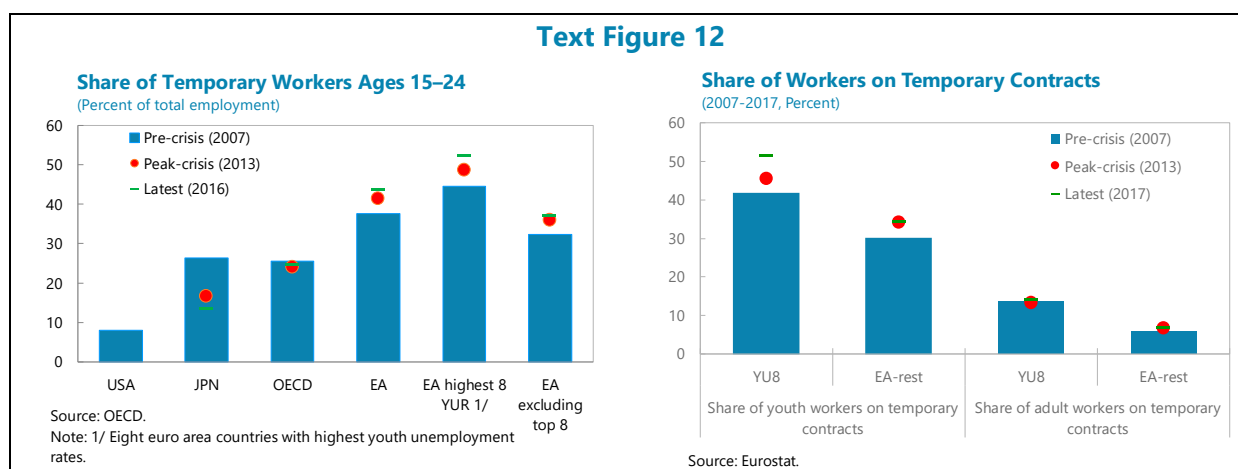
- A high labor tax wedge appears to be particularly harmful for the young: The estimated effect for the young is more than double the effect on prime-age workers when looking at both employment and unemployment rates. Young workers usually earn lower wages than more experienced workers due to productivity differentials, and the marginal cost of taxation is relatively high to hire the young when the progressivity of taxation is low (as is the case with most social security contributions), especially when minimum wages are more binding.

⁶ Please see Table 2 for full description of variable definitions and sources.

- Active Labor Market Policies (ALMPs) that focus on training and education, while boosting both young and prime-age employment, appear particularly beneficial for the young.
- A higher replacement rate can provide disincentives to work. The net replacement rate variable captures the ratio of out-of-work net income and net income while working. It takes into account unemployment benefits as well as income from other social assistance programs. While the estimates are not significant for unemployment regressions, the associated decrease in employment rate is significant for the young.
- In order to check the robustness of the results, we include coordination of wage setting index as an additional control variable and it does not seem to affect our findings (Table 1, columns 3–4, 7–8).

D. Macroeconomic Implications

12. A larger proportion of temporary contracts makes the young more vulnerable to downturns than adult workers. The share of temporary workers in the euro area is high compared to other advanced economies and continued to rise after the crisis, particularly in the YU8 where more than half of the young workers are on temporary contracts (Text Figure 12). While the risk of unemployment for the young could be even higher in the absence of temporary contracts, they usually offer less security. The high share of temporary contracts, therefore, makes the young more vulnerable than adult workers in an economic downturn (Chen et al., 2018). Temporary contracts may also negatively affect productivity by reducing employees' effort (Dolado et al., 2016), or decreasing the provision of on-the-job training by firms (Albert et al., 2005, 2010), thereby damaging the career prospects for young people (Cazes and Tonin 2010; OECD 2015).



13. Unemployment benefits offer only limited support for the young. Reflecting fiscal constraints during the crisis, access to unemployment benefits have in many cases been tightened. Because of eligibility criteria such as duration of employment and duration of unemployment benefits, many young people are not covered by unemployment benefits. Consequently, the share

of unemployed young receiving unemployment benefits has declined since 2007, and is substantially lower than the corresponding share for the older unemployed (Text Figure 13).

14. The number of young people at risk-of-poverty continues to rise in the euro area. As a result of high youth unemployment, an increase in the number of discouraged workers, and precarious employment conditions, the young have become the most at risk-of-poverty among all age groups (Text Figure 14).⁷ Prolonged unemployment and inactivity can have long-lasting effects on young people's skills and incomes due to hysteresis effects, adversely affecting human capital. Poor job prospects for the young can make them increasingly dependent on their family wealth, therefore reducing social mobility. All in all, lower human capital and growing inequality of opportunity will in the long term be detrimental to the euro area's growth potential (IMF, 2017).

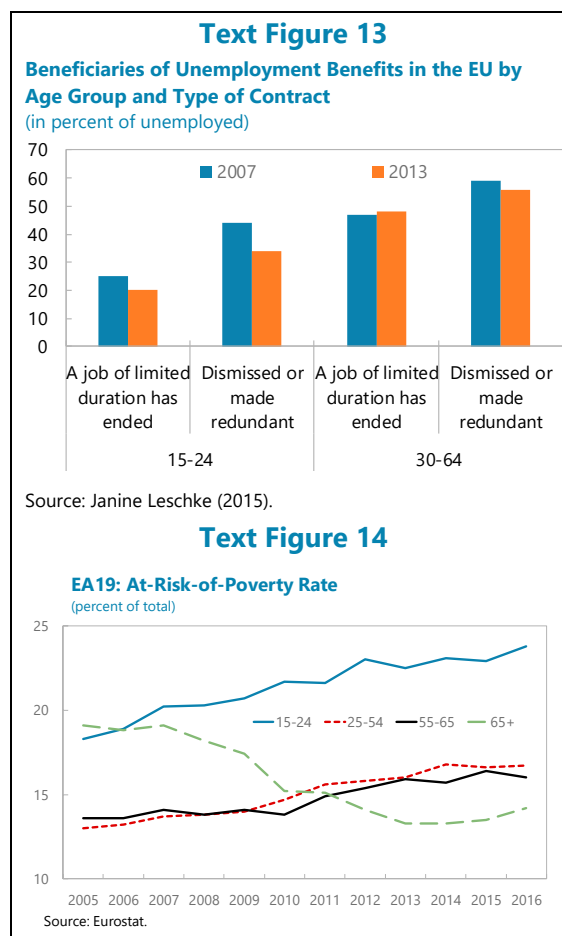
E. Boosting the Labor Market Prospects of the Young

15. The declining youth unemployment rate masks a shrinking young labor force, but also a higher share of young people in education. The decline in the labor force reflects shrinking young cohorts, exacerbated by reduced immigration flows. The jobs created during the recovery were skewed towards skill-intensive sectors which demand relatively high levels of education and work experience, possibly representing a pull factor for the young to move into education. At the same time, the economic downturn may have rendered the adjustment to increasing female and old-age labor force participation temporarily more difficult, weakening the job prospects for the young, which may have represented a push factor for the young to move into education.

16. Deeper structural reforms can help tackle youth unemployment, by facilitating labor-market entry and creating sufficient number of jobs for the young, particularly:

- *Labor market reforms:* Tackling labor market duality and ensuring efficient collective bargaining process; addressing skill mismatches and retraining through well-designed apprenticeship systems as well as ALMPs; and providing an adequate social protection system that adapts to a changing job market.

⁷ At-risk-of-poverty rate measure is from the Eurostat and presents the share of people with equalized disposable income (after taxes and social transfers) below 60 percent of the national median.



- *Fiscal policy*: Reducing labor tax wedge; ringfencing and increasing the efficiency of education spending; and targeting education spending to high-labor-demand and high-productivity areas.
- *Product market reforms* to unlock growth potential and boost labor market demand to create new jobs: Improving the business environment by cutting red tape, opening up regulated professions to facilitate market entry, and promoting further integration within the EU to benefit from economy of scale from the single market. Deeper financial markets and better personal insolvency laws can also help to promote entrepreneurship and innovation.

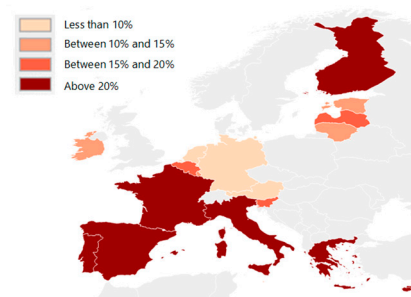
Box 1. Youth Unemployment—Cross-Country Dispersion

Youth unemployment remains unevenly distributed among euro area countries. There were a little over 2.6 million unemployed young in the euro area in 2017, of which roughly 2 million or more than 77 percent reside in eight euro area countries that account for 61 percent of the euro area young population. While the number of unemployed young reduced from 3.6 million peak in 2013 for the euro area as a whole, the significant dispersion in youth unemployment rates reflect uneven economic recoveries and persistent productivity gaps among euro area countries.

Even after taking into account the young in education or training, the significant disparities among euro area countries remain. The young who are not in employment, education, or training (NEET) in percent of the total population in the euro area fell by close to 2 percentage points from the crisis peak of 13 percent, compared with a 5 percentage point reduction of youth unemployment during the same period. The euro area countries with the highest youth unemployment rates—Belgium, Cyprus, Finland, France, Greece, Italy, Portugal, and Spain—also have the highest NEET rate at 14.1 percent as a group, compared with 6.6 percent for the rest of euro area countries in 2017.

Text Figure 1.1

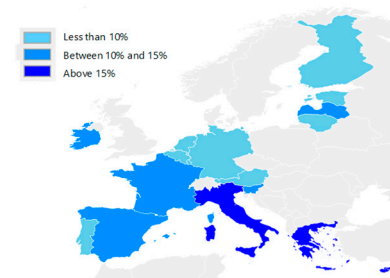
Youth unemployment rate, 2017
(in percent of active population)



Source: Eurostat.

Text Figure 1.2

Persons aged 15 - 24 neither in employment nor in education or training, 2016
(in percent of population)



Source: Eurostat.

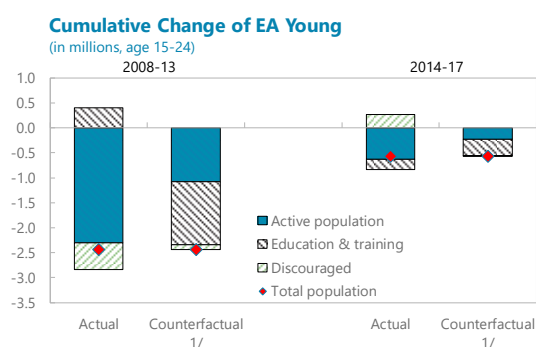
Box 2. The 3 Million Missing Young

The euro area experienced a significant reduction in its young labor force since the onset of the global financial crisis. Over the period 2008–17, over 3 million young workers lost their jobs, accompanied by a close to 3 million reduction in the active young population, or 17 percent of the young labor force in 2007. This loss was concentrated in the years immediately after the crisis (2008–13), during which youth employment was reduced by over 3.3 million and the youth labor force was reduced by about 2.3 million.

The loss of young labor force largely reflects a reduction in the young population, rather than a growing pool of inactive young. The drop in the young population, reflecting the adverse demographic trend, affected both active and inactive young. However, the similar reduction in labor force and the total population in absolute terms implies that the labor force, which has a smaller base, was disproportionately affected: The young labor force shrank by 17 percent, compared with a decline of young population by 8 percent over 2008–17. A simple counterfactual analysis is performed, under which all categories of young moved proportionally to the total population. The results show that, while the adverse demographic trend remains the main driver of the shrinking young labor force, many young people either started investing in education or became discouraged (i.e., not in labor force, education, or training) possibly reflecting the poor job prospects (Text Figure 2.1). As the unemployment rate was crawling up in the years immediately following the crisis, many young people returned to schools or stayed in schools longer, resulting an increase in the number of young in education or training despite the large population drop. This also pushed a larger reduction of discouraged young had they moved in tandem with the population during 2008–13. As the unemployment rate came down, the young labor force continued to shrink with the population over the period of 2014–17, though young people in education started to drop and discouraged young increased as a result of prolonged poor job prospects for the young.

The pattern observed in the YU8 was more volatile than in the rest of the euro area. As the crisis had a more adverse impact on the young in the YU8, the decline of the labor force even exceeded that of the population during both the recession and the economic recovery, resulting a growing pool of inactive young as many went for education. While the young in education continue to increase during the decline of youth unemployment in the YU8, the number of discouraged young started to rise, similar to the rest of the countries.

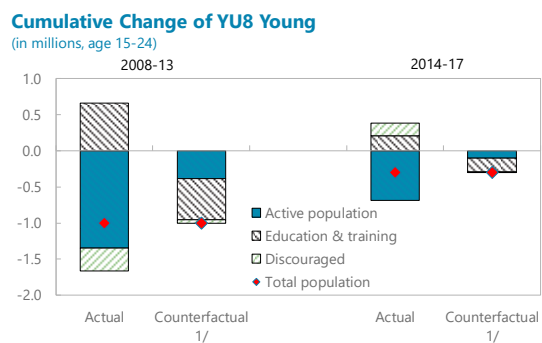
Text Figure 2.1



Source: Eurostat and IMF staff estimation.

1/ The percentage change of population applies to all categories.

Text Figure 2.2



Source: Eurostat and IMF staff estimation.

1/ The percentage change of population applies to all categories.

Table 2. Data Definitions

Variables	Definition	Source
ALMP spending	Spending on active labor market policy measures (categories 2-7) millions of purchasing-power-parity euros per thousand unemployed. These categories include: training; job rotation and job sharing; employment incentives; supported employment and rehabilitation; direct job creation and start-up incentives. They exclude labor market services (category 1), out-of-work income maintenance and support (category 8), and early retirement schemes (category 9).	Eurostat
Coordination of wage setting	Index from 1 to 5. 1=fragmented wage bargaining, confined largely to individual firms or plants 2=mixed industry and firm-level bargaining, weak government coordination through minimum wage setting or wage indexation 3=negotiation guidelines based on centralized bargaining 4=wage norms based on centralized bargaining by peak associations with or without government involvement 5=maximum or minimum wage rates/increases based on centralized bargaining	Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts database
Employment rate	Employed population as percent of total population in corresponding age cohort.	Eurostat
Net replacement rate	Net benefits replacement rate is defined as the ratio of net income while out of work (mainly unemployment benefits if unemployed, or means-tested benefits, if on social assistance) divided by net income while in work. A lower net replacement rate is associated with greater incentive to search for and take up a job when unemployed.	European Commission Tax and Benefits Indicators Database
Output gap	(Real GDP - Real potential GDP) as percent of real potential GDP.	WEO
Tax wedge	Proportional difference between the costs of a worker to their employer and the employee's net earnings.	European Commission Tax and Benefits Indicators Database
Unemployment rate	Unemployed population as percent of labor force in corresponding age cohort.	Eurostat

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