



# LUXEMBOURG

## SELECTED ISSUES

June 2022

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May 12, 2022

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European Department

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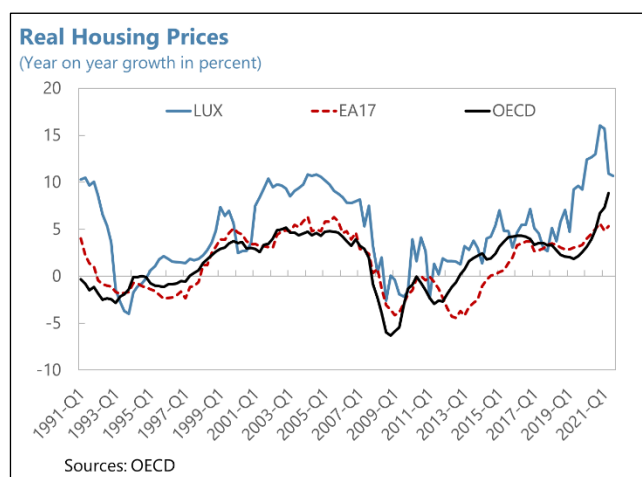
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# A MULTI-PRONGED STRATEGY TO REDUCE HOUSING MARKET IMBALANCES IN LUXEMBOURG

With residential real estate prices more than doubling in a decade and (60 percent in the last 4 years), housing is becoming a key challenge in Luxembourg. Although 2/3<sup>rd</sup> of households are homeowners, affordability concerns have been on the rise, including for the middle-income. If continued, these trends could hamper the country's competitiveness and attractiveness for workers and pose risks for financial stability in the medium term. Building on [previous IMF analytical work](#), and looking at the drivers of the recent housing trends as well as the government's policies, the paper advocates for a comprehensive strategy to reduce imbalances in the housing market. The approach includes measures to: i) boost housing supply (e.g., by mobilizing vacant dwellings and unused land, using existing resources more efficiently by building more, denser, faster, and at a lower cost), while increasing the share of affordable homes, ii) contain demand pressure and reduce its geographic concentration, iii) increase residential mobility, and iv) reduce under occupation. The paper also emphasizes the need for a more effective and coordinated implementation of reforms.

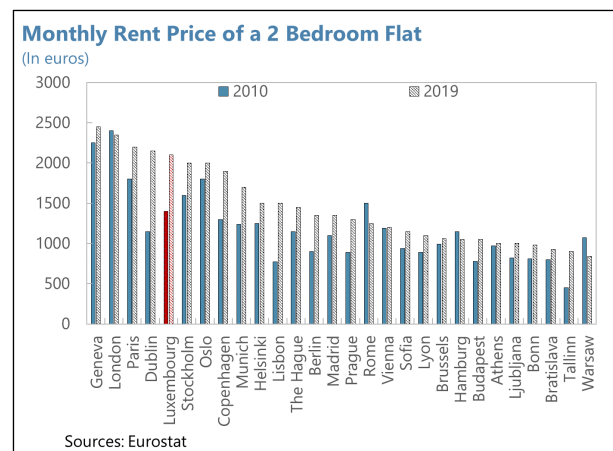
## A. Housing Prices Dynamics

**1. Luxembourg's housing market has been historically buoyant, mirroring the country's attractiveness.** On average, housing prices grew by about 5 percent per annum in real terms in the last 30 years, three times faster than the average euro area and OECD country. Along with the transformation of the country into a global financial center, the country's population grew by more than 60 percent, mostly driven by foreign labor force attracted by employment opportunities, high living standards, as well as political and social stability. As the structure of the labor force has been gradually shifting towards high skilled workers and well-paid jobs, the demand for higher quality homes has increased. Other sociodemographic factors could explain the increasing housing demand, such as rising female employment/participation rates and higher share of single-person/single-parent households.



**2. Housing prices have accelerated markedly over the past few years.** After hovering around 5½ percent over 2010–18, housing prices have been growing by double digits since 2019. While this acceleration is not unique to Luxembourg, the magnitude is one of the highest among the OECD countries and major cities. Starting in Luxembourg City, the surge has been more generalized during the pandemic, with prices in the other cantons also registering fast growth recently. The reduced yields (because of higher prices) in Luxembourg City and pandemic-led changes in preference might explain these dynamics.

**3. Rental prices show a more mixed picture.** On one hand, their growth has not been commensurate with housing prices. On the other hand, in comparison to major cities in Europe, rents in Luxembourg have been growing faster and Luxembourg city has become one of the most expensive in Europe. Also, there seems to be some heterogeneity between new rentals and long-term rentals. According to [a recent BCL analysis<sup>1</sup>](#), one additional year of tenancy decreases the monthly rent by around 20 euros per 100 square meters, which may be due to landlords not adapting the existing rental contracts to the price development for new contracts. Other possible explanations include avoiding transaction costs and information asymmetry.



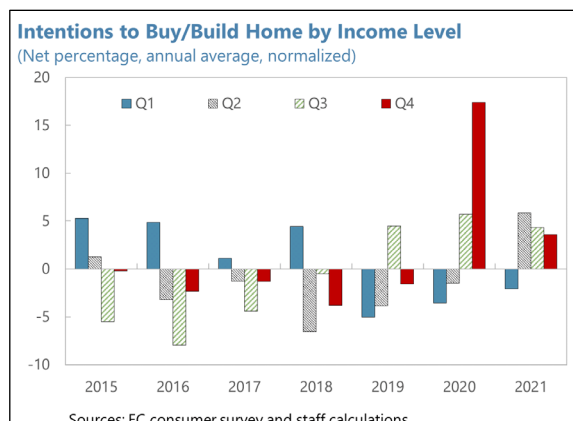
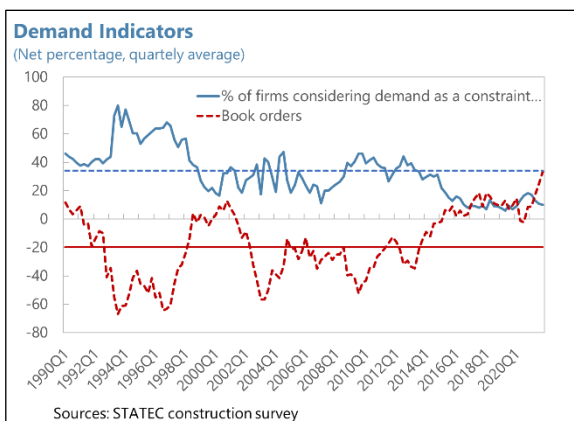
## B. Drivers of the Boom in Housing Prices

*In addition to demographic and labor factors, supportive fiscal policy and easy financing conditions have increased the expected return on real estate investment and exerted pressure on demand in recent years. At the same time, supply in Luxembourg has not been able to keep up with demand mainly due to capacity constraints, burdensome administrative requirements, and land hoarding. These imbalances have remained large during the pandemic as high excess savings sustained demand, while mobility restrictions and supply bottlenecks have weighed on the supply of new homes and construction costs. In what follows, staff analyzes the determinants of demand and supply with a focus on the contribution of policies to these dynamics.*

### Heightened Demand Pressure

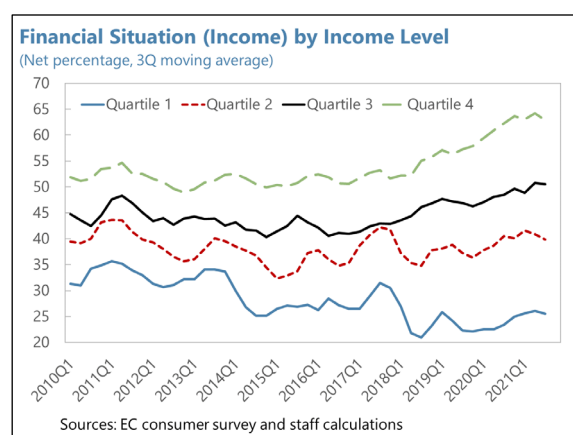
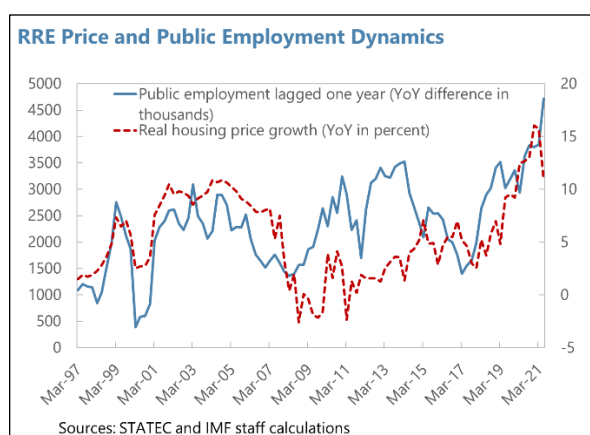
**4. In recent years, soaring demand has been mostly driven by the higher income quartiles and likely buy-to-let transactions.** The demand surge started in mid-2010s (left chart). Yet, according to the European Commission's (EC) consumer expectations survey, demand has not been even across income levels during this period. The share of households intending to buy/build homes has risen significantly above trends for the 3<sup>rd</sup> and 4<sup>th</sup> income quartiles during the pandemic (right chart). Meanwhile, housing demand from the bottom quartile has trended down. These trends coincided with an increase in rentals listing, which may suggest a shift toward buy-to-rent investments.

<sup>1</sup> Chen, Y., P. Guarda, T.Y. Mathä, G. Pulina and M. Ziegelmeyer (2021): *Do newer tenants pay higher rent?*, BCL Bulletin 2021-01, Analyse 1 pages 77-84.



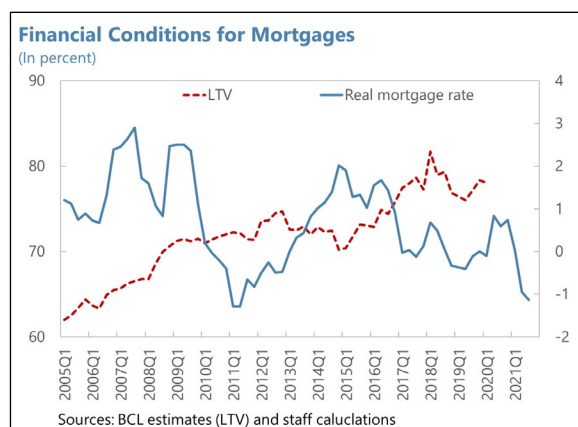
## 5. Fiscal policy has contributed to housing demand through different channels.

- Increased recruitment by the public sector.* Public sector jobs account for more than 20 percent of total employment and more than 40 percent of resident employment. The contribution of public wages to the growth of compensation of employees in the economy has exceeded 50 percent during 2018–20. This large contribution of public wages to the overall wage bill has been driven by higher public recruitment, contributing to the surge in demand for housing (left chart).
- More generous, untargeted, housing support measures.* The 2017 tax reform abolished the taxable rental value and increased mortgage interest deduction for the main residence and introduced an increased threshold for deducting home purchase savings contributions. In 2015, the ceiling for the VAT super reduced rate on newly constructed home, previously linked to the value of the house, was replaced by a ceiling on deductibility.
- Lower tax wedge.* In 2017, the temporary budgetary compensation tax of 0.5 percent was abolished, and several tax credits have been introduced, reducing the tax wedge, and hence increasing disposable income and savings, especially for the middle- income quartiles (right chart).



**6. Low for long interest rates have also pushed prices higher in recent years through different channels.**

Borrowers benefited from historically low mortgage rates, which increased their capacity to borrow and expected returns.<sup>2</sup> Rising real estate prices have also likely increased access to loans for existing homeowners through the collateral channel. Accordingly, the acceleration in housing prices has been accompanied by an increase of credit growth. On the credit supply side, in addition to the lower



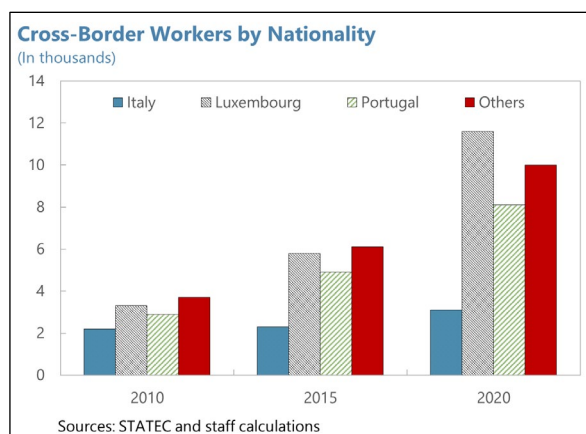
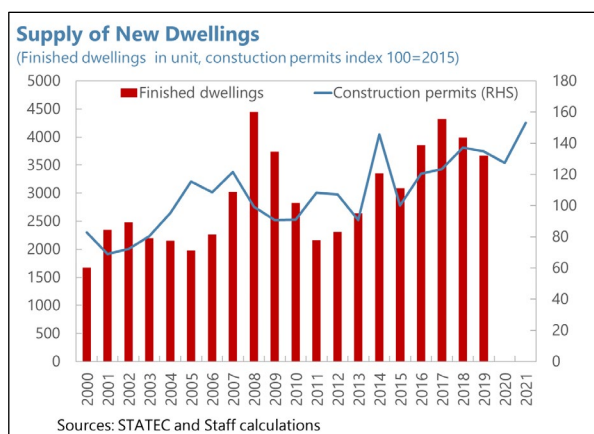
funding cost, the search for yield increased competition between banks. The loan-to-value and the share of fixed rate mortgages increased gradually, reducing interest rate risk for borrowers.<sup>3</sup> Finally, easy financial conditions have boosted real estate developers' demand for land, contributing to higher land prices. In response, the macroprudential authority (the National Systemic Risk Committee, *CdRS*) has recommended the activation of borrower- and capital-based measures to address the related risks.

### Strained Supply

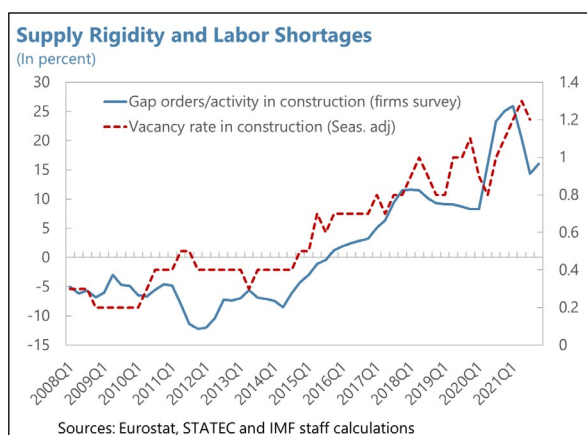
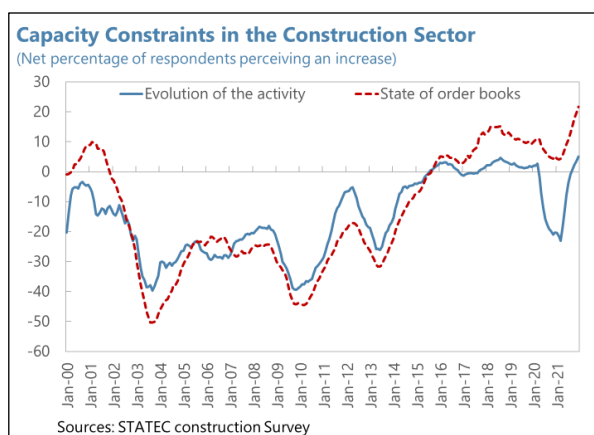
**7. Supply has increased but not enough to keep up with demand.** New constructions and construction permits have been increasing steadily until 2017, though from low levels. However, the stock of housing per capita continued to fall, as population growth outpaced growth of dwellings. In 2018-19, the number of new dwellings fell even as construction permits kept rising. Moreover, the supply of new dwellings remained relatively concentrated in Luxembourg canton and its neighborhood. Despite the authorities' efforts, the stock of social and affordable housing in public hands remains comparatively low (below 2 percent). The cross-border housing market has contributed to balance demand and supply, with an increasing number of workers (non-citizens from neighboring countries) moving across borders. The sales of existing inventories have been also rising.

<sup>2</sup> Effective mortgage rates are even lower as many borrowers benefit from bonified/subsidized rate as well as interest payment deductibility on loans for acquisition or construction of main residence.

<sup>3</sup> The establishment of a ceiling on penalties for refinancing loans in 2016 may have facilitated refinancing for borrowers having entered mortgage contracts after mid-July 2018 (by lowering refinancing costs and thus their debt service, and increasing their capacity to borrow).



**8. Supply rigidity partly reflects capacity constraints in the construction sector.** The enterprise survey in the construction sector shows a decoupling between production (activity) and orders (demand). The widening gap between both indicators has been associated with rising job vacancy rates. This has been exacerbated by the pandemic, with 60 percent of the firms considering labor shortages as a major obstacle to growth and construction costs increasing by about 9 percent in 2021H2. Abstracting from the pandemic effects, these trends could be explained by aging labor force and reduced interest in construction jobs, including from cross-border workers and foreigners (90 percent of employment in the sector). The latter is due to unfavorable or dwindling wage differential (in construction) with neighboring countries, lack of affordable housing, and greater competition from the public sector.<sup>4</sup>

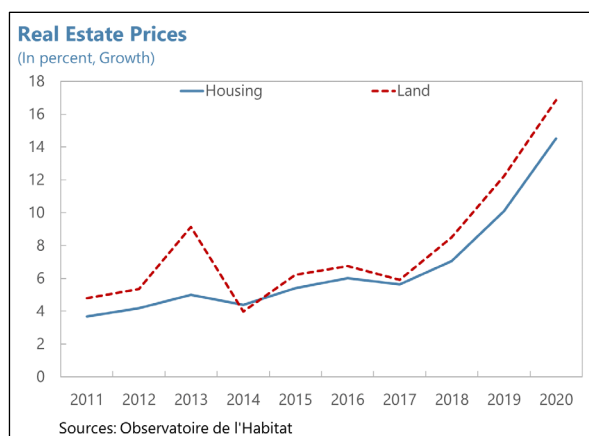


<sup>4</sup> <https://adem.public.lu/content/dam/adem/fr/publications/adem/etudes-sectorielles/ADEM-etudes-sectorielles-Construction-vf-V.pdf>



**9. Land hoarding by landowners and developers may have restricted the supply of land, increasing land prices as an input and stifling supply of housing.**

Constructible land in Luxembourg is abundant but is concentrated among a few private owners and real estate developers.<sup>5</sup> Benefiting from low interest rates and increased land supply (following the temporary reduction of taxes on capital gains on immovable assets between July 1, 2016 and December 31, 2018), large developers were



incentivized to build up land banks, and bid very high prices to eliminate competitors, rising land prices and concentration further (+12½ percent on average over 2018–20).<sup>6</sup> In such an oligopolistic land ownership market, it is in the developers' interest to hoard land and release homes slowly. Uncertainty around land prices and irregular supply of land increases the option value of land, and thus speculative behavior, leading to the so-called "land trap". Another potential consequence of high land prices is the shift in housing supply toward high-income/high-end dwellings and stagnant densification, further crowding out lower income households.

**10. Productivity hurdles in the construction sector could have led to delays and increased construction costs.** Productivity gains were relatively limited. The high share of labor cost and high land prices may have led to lower investment in technology and skills development. Moreover, long procedures to get permits (e.g., due to environmental requirements) and lack of availability of landfills could have also impeded productivity gains and could have increase costs to builders (e.g., renting their equipment for longer).

### C. Potential Impact of Housing Prices

*High housing costs and rising income inequality have risen affordability concerns and could also pose financial stability risks in the medium term. The lack of affordable housing already resulted in increased vacancies in some occupations and sectors, including construction, with feedback effects to housing supply and prices. Should fast housing price growth continue, housing price differentials with major cities in the neighboring countries could become a competitive disadvantage.*

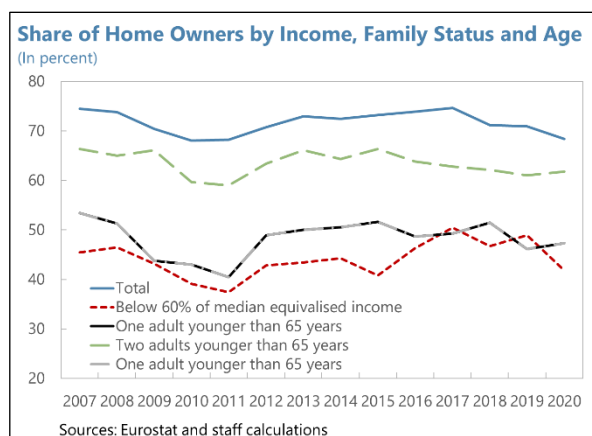
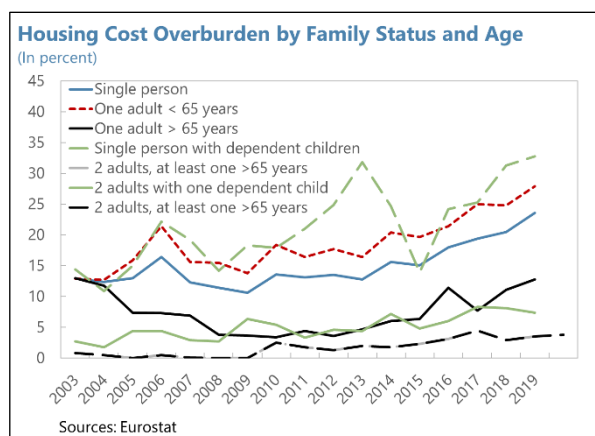
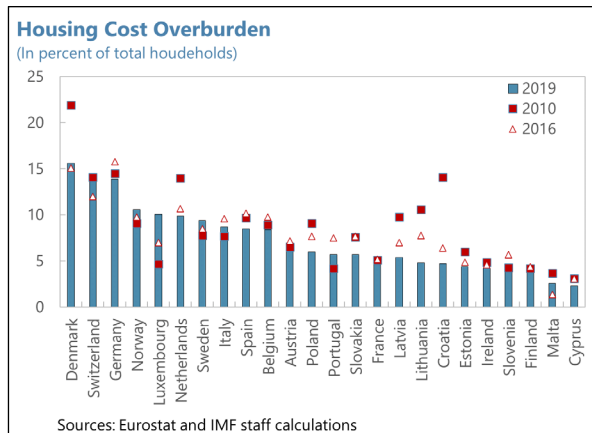
<sup>5</sup> [Note 29 : La détention du foncier constructible pour l'habitat au Luxembourg en 2020/2021 : distribution et typologie de propriétaires - Logement.lu - Ministère du Logement - Luxembourg \(public.lu\)](#)

<sup>6</sup> According to housing observatory, the cost of land is estimated to account for 20-42 percent of housing construction sales value (maximum in Luxembourg-Ville).

### 11. Despite higher housing assistance and tax incentives, housing affordability has worsened, and homeownership rates have declined.

Luxembourg recorded the largest increase among European countries in the share of overburdened households, which has doubled in the last decade to over 10 percent, albeit from a relatively low level in comparison to other European countries. The housing cost burden (Eurostat definition) has been steadily increasing, as prices and rents grew notably faster than average income. As income inequality widened

due to the increased polarization of the labor market, the bottom quintiles have been disproportionately affected. However, if the fast pace of housing price increases continues, affordability could become a more pressing issue for some middle-income households. Housing affordability worsened more for renters, as homeowners benefited from the low interest rate environment and rental subsidies to those in need remained too restrictive. Also, not surprisingly, new renters (leases less than 5 years) and new homeowners (less than 2 years) tend to spend a higher share of their disposable income on housing (40 percent and 35 percent, respectively).<sup>7</sup> The overburden rates tend to be higher for foreigners (likely because of lower rate of homeownership), singles, and single parent households (one source of income). Finally, lower mortgage rates and housing support measures have not prevented the decline of homeownership rates.



**12. If continued, housing price dynamics could hamper the attractiveness of the country for workers and become a competitive disadvantage.** Luxembourg has been able to attract foreign workers thanks to relatively high wages, advantageous benefits, and high quality of life. In recent years, high housing prices have pushed many workers to look for housing across the borders. Yet, the balancing role of the cross-border housing market may weaken going forward due to

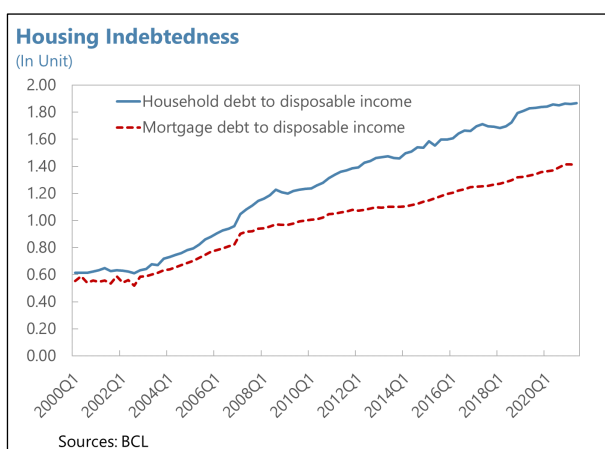
<sup>7</sup> For more details, see Observatoire de l'habitat, Note 27 ([Note 27: Évolution du taux d'effort des ménages résidents du Luxembourg selon leur mode d'occupation et leur niveau de vie entre 2016 et 2019 - Logement.lu - Ministère du Logement - Luxembourg \(public.lu\)](#))

higher private transportation costs and longer commuting time and as housing prices in neighboring regions gradually increase. The initial effects have been already felt through rising vacancies in recent years in sectors where the wage differential with neighboring countries is not high or has been negative (construction and industry). In the medium term, with increased competition for talents, relatively high housing prices in Luxembourg could reduce the country's capacity to attract and retain skilled workers, and/or exert upward pressures on wages, hampering competitiveness.

**13. Finally, while there are some mitigating factors in the short term, elevated housing prices could pose financial stability challenges in the medium term.**<sup>8</sup> Reflecting

the rapid increase in real estate loans, households' debt-to-income doubled in the last 2 decades and exposures across domestically-oriented banks to the real estate sector (including real estate developers and construction firms) increased. Staff estimates housing price overvaluation to about 15 percent in 2021Q2.<sup>9</sup> While the likelihood of a sharp

correction in the short term is rather low, if continued, these trends could pose risks for financial stability, although those risks are mitigated by effective oversight frameworks, a resilient and highly capitalized banking sector, and high households wealth.



## D. Authorities' Response

*The Government's strategy to address the housing situation in Luxembourg builds upon measures, such as the Housing Pact 2.0. The strategy dedicates more resources to the supply of affordable and social housing, while increasing incentives to mobilize existing inventories of land and dwellings. The second pillar of the strategy is to increase housing assistance to enhance affordability.*

**14. To increase the supply of affordable housing, the government has introduced a vast array of measures in recent years.** These include collective housing subsidies for the construction of affordable housing in the Housing Pact 2.0 (€350 million since 2019) to land purchases for building reserves purposes. In November 2020, the government has introduced a draft law on the so-called 'Baulandvertrag' (construction plot contract). The contract foresees that any plot newly designated as "constructible land" needs to be developed for housing purposes within a maximum

<sup>8</sup> Reinesch, Gaston (2022): Blog post 14 - Residential real estate prices in Luxembourg, The Governor's blog, [www.bcl.lu](http://www.bcl.lu)

<sup>9</sup> This estimate is done using the model described in Box 3 of selected issues paper "Housing Market: Assessment and Policy Recommendations" (2018). There is a large uncertainty around these estimates; the ECB most recent assessment point to an overvaluation of 51 percent.

of four years of the date of the designation. Should the owner fail to comply, the plot will have to be used for the construction of dwellings of public interest, such as social housing.

**15. In December 2021, the government followed up with a draft 'affordable housing law', which proposes a continuum of affordable and low-cost housing:**

- *Affordable rental housing.* 50 percent of households in municipalities are eligible for the allocation of this type of housing. The rent will be calculated according to the concept of the affordable lease, considering the income level of the tenant.
- *Social rental housing.* These are dwellings, often owned privately, that fall under the social rental housing management regime and have not benefited from housing subsidies. Only the management of the dwellings can be eligible for a financial contribution, provided that the organization in charge of the management has previously concluded an agreement with the Housing Ministry. These dwellings are not subject to the affordable rent rules.
- *Affordable housing sale.* Affordable housing sale is implemented only by public promoters. This regime is comparable to the current regime of "subsidized sale" with long lease and right of repurchase. It is planned to set eligibility limits so that 60 percent of communities will have access to it.
- *Low-cost housing sale.* This is implemented by public promoters. The regime is comparable to the current 'unsubsidized sale' regime. The ceiling will be designed to make 70 percent of communities eligible for the acquisition of this type of housing. Finally, the two public promoters 'Fonds de Logement' and 'Société Nationale des Habitations à Bon Marché' have ramped up their activity significantly in the past years and plan to maintain the pace.

**16. The authorities also plan to reform property taxation to mobilize existing inventories of dwellings and plots.** The draft law will be tabled to parliament by end-2022 with two components. First, the value of each plot of land will be reassessed based on a new formula with reviewed and updated data (the current valuation method is based on figures from 1941). The newly calculated property values will then be used as a base for a revised property tax. Second, an additional tax on empty and non-developed plots located in a designated construction zone will be introduced. The property tax will be flanked by a housing tax, which applies a similar principle: houses or flats not used for the owner's own purposes nor rented will be subject to an additional tax. The detailed modalities of the package are currently being discussed.

**17. On the demand side, a second bill has been tabled aiming at simplifying the system of allowances and extending support measures to help cope with rising prices.** Key elements of the so-called 'individual housing allowance law' are:

- A revision of the eligibility criteria to allow more people to benefit from the allowances
- An increase of the amounts and ceilings to reduce the effort rate of the people who benefit from the allowances
- Administrative simplification and digitalization of the system.

## E. Policy Proposals

Efforts to boost housing supply through supply of affordable and social housing and taxation of unused land and empty dwellings are welcome. However, these measures will take time to materialize and may face implementation challenges. To alleviate the current housing pressures, a multipronged approach is needed. First, more efforts are needed to contain demand pressure. Second, against the background of capacity constraints (in particular labor and land hoarding), it is critical to mobilize and use existing resources more efficiently, while addressing capacity constraints and hurdles to productivity.

**Table 1. Luxembourg: Summary of Objectives and Policy Proposals**

Demand	Supply
<p><b>Contain demand pressure</b></p> <ul style="list-style-type: none"> <li>- Consider tightening macroprudential policy</li> <li>- Prudent recruitment and wage policy in the public sector</li> <li>- Reduce expected returns (property taxation reform)</li> <li>- Better target housing assistance</li> </ul>	<p><b>Mobilize vacant properties, reduce under occupation, and foster residential mobility</b></p> <ul style="list-style-type: none"> <li>- Higher property taxation (especially for secondary homes)</li> <li>- Link tax incentives on rental properties to affordability of rent to increase affordable supply</li> <li>- Encourage residential mobility of older people (increase housing options)</li> <li>- Lower transaction costs for buyers replacing their main residence</li> <li>- Limit the eligibility for exemptions from capital gains tax on inherited properties to 1-2 years after the inheritance</li> </ul>
<p><b>Reduce geographic concentration</b></p> <ul style="list-style-type: none"> <li>- Spatial planning: promote activities outside current clusters and close to borders</li> <li>- Promote remote work, further develop transport infrastructure</li> </ul>	<p><b>Build more, faster and with lower costs</b></p> <ul style="list-style-type: none"> <li>- Build higher and smaller units</li> <li>- Increase supply of affordable and social housing (by the public sector) and expand density bonuses for private real estate developers (especially near transit)</li> <li>- Promote modular/prefab construction</li> <li>- Streamline procedures for permits (one-stop shop)</li> <li>- Increase availability of landfills and promote circular construction</li> <li>- Address supply bottlenecks in construction sector</li> <li>* Land. Taxation of unused land to reduce land hoarding, faster mobilization of public land, grouping of Bauluken, mechanisms for land value capture</li> <li>* Labor. In the short term provide incentives for existing workers to stay at work, promote cross sectoral reallocation, limit competition from the public sector. In the medium term, increase training opportunities and improve career prospects.</li> </ul>
<p><b>Increase housing affordability</b></p> <ul style="list-style-type: none"> <li>- Reduce occupation cost (higher and more progressive eco-renovation support)</li> </ul>	

## Measures on the Demand Side

**18. Without action, demand pressures are likely to continue in the near term.** Some recent measures like the introduced differentiated loan-to-value (LTV) limits and the lower accelerated depreciated rate could moderate these pressures. Yet, several factors will contribute to sustained demand, including the tight labor market, the large recruitments in the public sector in 2021–22, the fiscal measures to support affordability, the large savings accumulated during the pandemic, the low real interest rate environment, and potential reallocation from financial assets in a context of higher volatility and uncertainty.

**19. Macroprudential policy should be tightened further to curb demand in the real estate sector and prevent further increase in households' indebtedness.** The introduction of the LTV limits in January 2021 have had mixed results so far, with household indebtedness remaining high. The authorities should consider further tightening of the macroprudential stance by introducing debt-to-income or debt-service to income limits as well as concentration limits on real estate loans for banks. These measures will protect vulnerable households against high indebtedness and complement the LTV limits and capital-based measures already in place (which include a positive rate of 0.5 percent for the Countercyclical Capital Buffer and a risk-weight floor of 15 percent on mortgage loans granted by internal rating-based banks to the purchase of residential property in Luxembourg). They could be accompanied by compensatory fiscal support measures targeted to low-income households to reduce the potential adverse impact on affordability.

**20. Better targeting help-to buy-policies and tax expenditures is paramount.** Increasing subsidies and tax incentives when supply is constrained may fuel demand and prices and end-up to be a transfer to producers, while exacerbating affordability problems. Many housing assistance programs in Luxembourg are not means-tested and some benefit mostly the wealthiest. In particular, the authorities could consider phasing out deductibility of interest payments for the main residence and make the Bellegen Akt (credit on transfer tax) more progressive and available only to first-time homebuyers. Support to overburdened renters should be continuously adjusted to preserve their capacity to buy homes in the future. In parallel, the authorities should also steer demand away from real estate investments by reducing expected return (e.g., increasing transfer tax for secondary homes, limit exemptions on capital gains for secondary homes, or revisit accelerated depreciation schemes).

**21. Fiscal policy could play a broader role in containing demand for residential real estate beyond housing assistance and property taxation.** As highlighted earlier, public employment, public wages, taxes, and social benefits could have unintended consequences for housing prices with welfare and distributional effects. Hence, the authorities should be mindful of these considerations when designing and calibrating such measures.

**22. Lowering the geographic concentration of demand for housing could help reducing pressures on prices.** For Luxembourg to remain attractive for cross-border workers and to benefit from the balancing role of the cross-border housing market, future spatial plans should not only aim at further developing infrastructure (transport, amenities) but also promoting activities closer to the

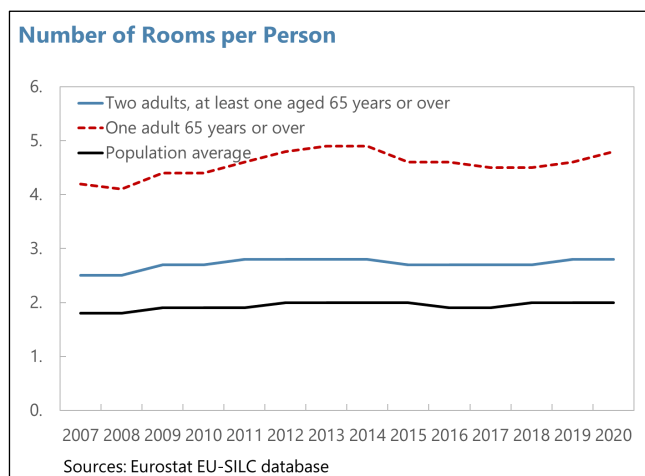
borders in coordination with neighboring regions. At the same time, promoting remote work could reduce congestion and change housing/location preferences, reducing pressure on current activity hubs.

## Measures on the Supply Side

**23. A broad-based comprehensive reform of property taxation could increase residential mobility and reduce under occupation.** Taxing vacant dwellings may pose definition and monitoring challenges, and the experience in large cities has not been conclusive about its effectiveness in boosting supply of rental housing. Staff recommends adopting a simplified framework for property taxation and regularly updating house valuations.

This, together with lower transaction costs for buyers replacing their main residence and

limiting the eligibility for exemptions from capital gains tax on inherited properties to 1–2 years after the inheritance, could help increase market fluidity and reduce under occupation. In the same vein, specific incentives could be considered to enhance residential mobility (or co-living) of older people that live in underoccupied dwellings (e.g., by expanding housing options for older persons). Finally, linking some tax incentives on rental properties to affordability of rent could help to increase affordable rental supply in the market.



**24. Priority should be given to promoting a more efficient use of existing resources.** The unused land tax could increase supply and reduce the price of land as an input cost. However, it may take time to bear fruit. The following measures could be envisaged.

- *Constructing higher, ecologically sustainable buildings with greater density.* This is an immediate solution to the problem of land and labor shortage. Scaling up the concept of “density bonuses” (allowing developers to build bigger projects near public transportation/transit), together with mechanisms to promote modal shift, could increase affordable housing and reduce congestion.<sup>10</sup> Adapting the housing supply to evolving needs and lifestyles (e.g., micro-units, co-living) should be also encouraged.
- *Mobilizing constructible public land more rapidly and focusing resources on large projects with big impact.* In addition, municipalities should play a more active role in grouping Baulucken in private hands to construct larger buildings (remedy to coordination failure).

<sup>10</sup> This program was implemented successfully in Los Angeles.

**25. Addressing supply bottlenecks and increasing productivity in the construction sector are key to unlock supply potential and reduce construction costs.** This entails:

- *Streamlining procedures to get permits.* The current procedures are highly complex, involving several ministries (interior, environment, housing, etc.) and efforts made by the government are thwarted by new administrative requirements according to construction companies. The environmental objectives and the political priority of providing sufficient affordable housing must be better balanced. To increase the supply of housing, the authorities should aim at reducing delays and addressing coordination problems, for example by establishing a one-stop shop for construction permits and a platform to track land under development.
- *Improving the availability of landfills and promoting circular construction.*
- *Promoting offsite/modular construction and investment in digitalization.* Less than 1 percent of new buildings are prefabricated. A greater reliance on offsite construction could help improve productivity and reduce construction costs, hence increasing affordability. More investment in R&D in partnership with the private sector could also help advance technological improvement (e.g., innovative construction techniques and materials) and reduce costs going forward.<sup>11</sup>
- *Addressing labor and skills shortages.* In the short term, this will require providing incentives for existing workers, especially aging ones, to stay longer in activity, training of those unemployed with the necessary pre-existing skills, promoting reallocation across sectors, and limiting competition from the public sector. Over the medium-term, the efforts, in coordination with private sector, should focus on attraction and retention of new workers and the provision of new training opportunities (including in future skills) to enhance career prospects and wages in the sector.

### Implementation and Monitoring

**26. The challenging implementation of housing policies by municipalities in the past is a typical principal agent problem and should be tackled.** Many measures and tools to mobilize existing stock of land and dwellings and increase supply of affordable and social housing (taxation, spatial planning, and zoning) were little used by municipalities. Several factors could explain that. First, maximizing the local voters' welfare is in most cases not consistent with the national welfare (e.g., social housing is associated with downscaling) and those in need of social housing are mostly nonvoters. Second, municipalities have low financial incentives to increase housing supply, given the bigger role of municipal business tax compared to property taxes. Also, the cost of construction of additional infrastructure which is provided by municipalities could be high for many small municipalities. The Housing Pact 2.0 conditioned subsidies to the construction of social and affordable housing, which is a step in the right direction. The increase of property taxation could also further enhance implementation and could be accompanied with mechanisms that enable the

<sup>11</sup> The construction sector in Luxembourg is relatively small and dominated by SMEs. The intervention of the government (e.g., though public R&D) could be needed to promote technological upgrade.



public capture of the increased value of the land due to new infrastructure and amenities ([Paccoud et al., 2021](#)), as in several major cities (e.g., London, Hamburg, etc.). To avoid the stigma linked to social housing, public projects could be diversified. Finally, establishing coordination mechanisms between different stakeholders, defining clear goals and responsibilities, and strengthening the accountability framework would contribute to a more effective implementation of policies.

**27. There is a need to step up efforts on data collection in the real estate market to better formulate policies and monitor their implementation.** The register of vacant properties is a step in the right direction. Further efforts are needed to enhance the timeliness and availability of data on stock and flows of dwellings (rental properties, finished dwellings, main residence/secondary etc.). Also, more data should be collected to track land under development and commercialization of dwellings. Similarly, data about residential mobility (including cross-borders), commercial real estate (prices, vacancy rates, etc.).<sup>12</sup> More granular data on the construction sector (including real estate developers), could help better analyze construction costs and mark-ups as well the market structure. Data on the beneficiaries of the tax incentives and housing assistance (by income level) are needed to better assess fiscal incidence.

## F. Conclusions

**28. Luxembourg's housing prices have grown rapidly in recent years, rising affordability concerns and posing challenges to attractiveness for workers and financial stability in the medium term.** While this is not unique to Luxembourg, the magnitude of the price growth is one of the highest among OECD countries and major cities. On the back of constrained supply due to labor shortages and land hoarding, the surge was driven by high demand, mostly the top 50 percent and buy-to-rent transactions. These developments reflect, in part, policies, including low property/land taxation, increased untargeted support to homeownership, large recruitments in the public sector, and lower personal income taxation. The low-for-long interest rate environment has reinforced demand for housing and land.

**29. Solving the housing problem is a complex endeavor and requires a multi-pronged approach.** The authorities' recently undertaken and planned measures with a greater focus on supply of affordable and social housing are welcome but will take time to bear fruits.

- Priority should be given to containing demand pressure and using existing resources more efficiently—build more and faster with lower cost, mobilize vacant properties, and increase residential mobility and reduce and under occupation. At the same time, the share of affordable housing supply should be increased not only by the public but also by the private sector.
- Implementation is key. Housing is a cross-cutting issue involving many policies (social, environmental, fiscal, financial and development). It also involves different government

<sup>12</sup> Some progress is being made by national authorities under the scope of Recommendation ESRB/2016/14 to close data gaps on the commercial real estate market.

entities (central/local governments, different ministries, public and private entities). Hence, it requires to establish coordination mechanisms, clear goals, and responsibilities as well strengthen the accountability framework.

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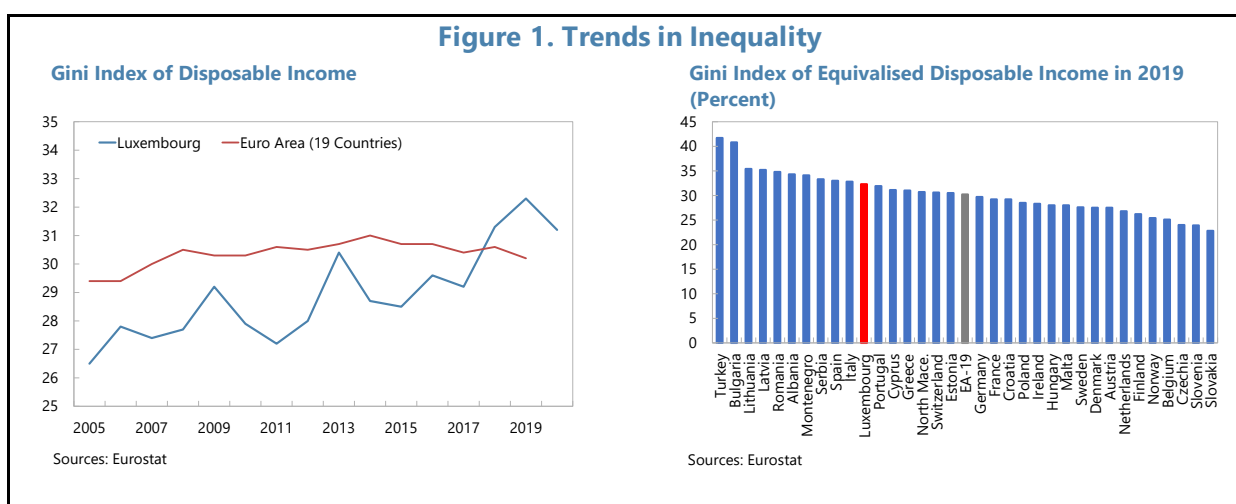
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# LUXEMBOURG: DIGITALIZATION AND RISING INEQUALITY IN THE LABOR MARKET

The labor market has become increasingly skill intensive over the past several years which has increased labor market and income inequality in Luxembourg. These trends have been driven in part by increased digitalization, which has intensified during the pandemic. This paper uses a structural model calibrated to fit the key characteristics of the Luxembourg labor market to examine the drivers of the higher labor market and income inequality and explore policy tradeoffs. Specifically, the paper looks at how a broad set of policies related to re-skilling of workers, support for medium-skill occupations, and improved firm-worker matching affect labor market inequality and, more broadly, income inequality.

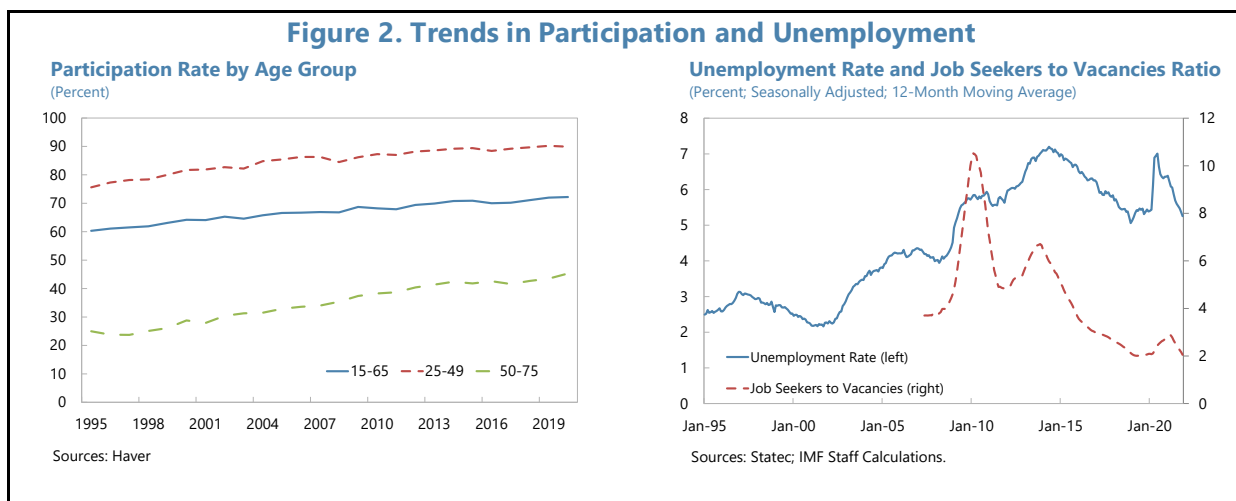
## A. Long-Term Trends in the Labor Market

**1. Income inequality in Luxembourg has been growing relatively fast and is now higher than the euro area average.** Historically, Luxembourg has fared comparatively better than others in the region in terms of inequality. However, this has recently begun to change as Luxembourg's Gini index (after taxes and social transfers) has been growing faster over the past several years and has surpassed that of the euro area countries since 2018 (Figure 1).<sup>1</sup> The paper takes an indirect approach to interpret trends in labor market outcomes and the implications for income inequality by using a structural model calibrated to match the key features of Luxembourg's labor market. While the trends are interpreted as being driven by the digitalization and automation of the labor market, these factors could be also seen as reflecting broader technological improvements. The model is used to forecast the implications of increasing digitalization for the labor market. Finally, the paper discusses tradeoffs, including for income inequality, of policies used to improve labor market outcomes.

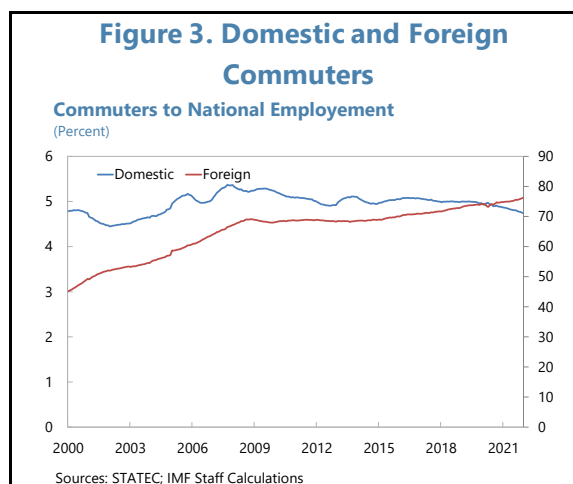


<sup>1</sup> There are potentially important measurement issues with the Gini inequality measure (especially, when making cross-country comparisons), given Luxembourg's small population and high reliance on foreign labor.

**2. Both the participation and unemployment rates have grown gradually over the past several years.** The participation rate in Luxembourg has increased by just under 10 percentage points from the early-2000s to 2019 (the pre-pandemic period).<sup>2</sup> The unemployment rate has increased from a low of just over 2 percent in the early-2000s to just under 6 percent in the pre-pandemic period, while the share of job seekers experiencing long duration unemployment has increased gradually. The increase in the unemployment rate has also coincided with an increase in labor market tightness, suggesting that unemployed workers are facing more difficulties when finding jobs (Figure 2).



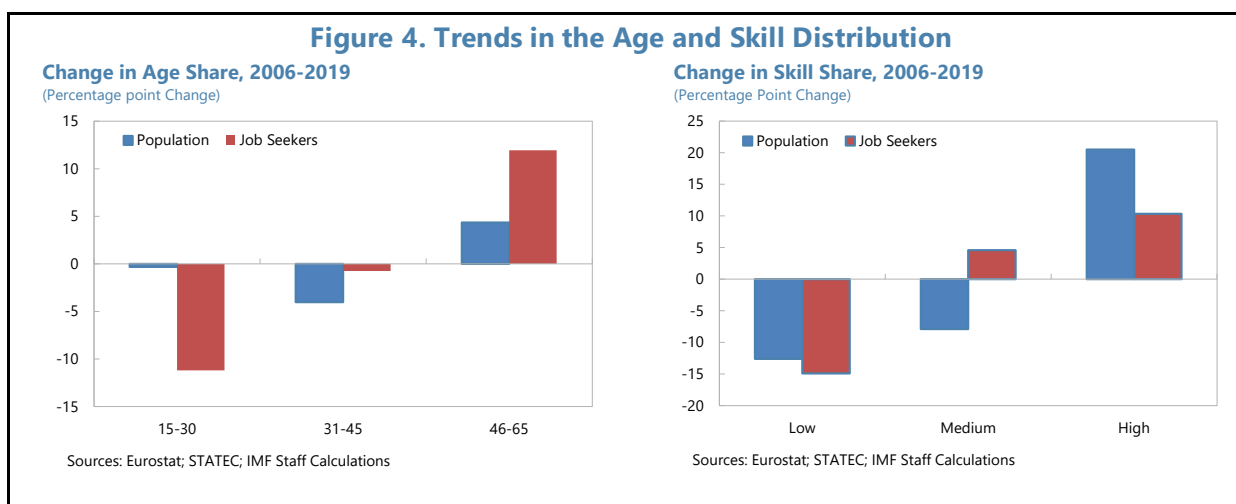
**3. Foreign commuters are an increasingly important source of labor.** The ratio of foreign commuters to national employment has increased by around 30 percentage points since the early-2000s. The increase was sharpest prior to the global financial crisis (GFC), driven by opportunities in the financial sector. Following the GFC, the growth in foreign commuters has remained robust, albeit slower, driven by continued comparatively strong demand for foreign labor in Luxembourg. On the other hand, the share of domestic cross-border commuters has remained relatively flat over this period, accounting for around 5 percent of the active population (Figure 3).<sup>3</sup>



<sup>2</sup> Despite the increase, the participation rate in Luxembourg remains low compared to other European countries. See IMF (2019) for further analysis on related structural issues in the labor market and the participation rate.

<sup>3</sup> Around 80 percent of domestic commuters in Luxembourg are workers employed in international organizations, which may not be directly comparable with more standard commuters. Given that these workers account for a small share of the total labor force, their inclusion in the analysis does not have a substantial effect on the results presented in Section C.

**4. The aging of the population has coincided with increasingly worse labor market opportunities for older workers.** The share of the older workers (age 46 to 65) in the population has increased by around 5 percentage points since the mid-2000s, with the increase almost entirely matching a decrease in prime age workers (age 31 to 45). In terms of job seekers, the share of older workers has increased by 10 percentage points, over double the increase in the population, while the share of younger workers (age 15 to 30) has declined by a similar rate (Figure 4).<sup>4</sup> These trends reflect shifting and increasing opportunities for younger workers in the labor market.



**5. The labor market has become increasingly skill intensive, suggesting a hollowing out of medium-skilled workers.** The high-skill share of the population has increased by around 20 percentage points since the mid-2000s, one of the highest increases in the region, driven by equal declines in the low- and medium-skill shares of the population.<sup>5</sup> While the share of high-skill among job seekers has increased by around 10 percentage points, it has not kept pace with the overall shifts in the population, suggesting improving labor market opportunities for high-skill workers. The share of medium-skilled within job seekers has increased despite the decline in the medium-skilled share of workers. At the same time, the shares of the low-skilled among job seeker and in the population have experienced similar declines. Together, the trends suggest a hollowing out of opportunities for medium-skilled workers.<sup>6</sup>

<sup>4</sup> Unlike other economies, Luxembourg records workers with disability in the unemployment statistics, leading to a larger share of recorded older unemployed workers. Given that the analysis focuses on changes in the share of unemployed older workers, this statistical convention should not affect the main results of the analysis.

<sup>5</sup> Low-, medium-, and high-skill workers are defined based on the education level of individuals.

<sup>6</sup> While these trends do not suggest that low-skill workers are becoming worse off, their initial position in terms of unemployment and job-seeker shares were substantially higher than the other groups. Evidence from the United States suggests that the decline in medium-skill and low-skill occupations over this period has been associated with an increased computerization (Autor, Dorn, and Hanson, 2015) and, more recently, automation (Acemoglu and Restrepo, 2020) of the economy.

## B. A Structural Model of the Luxembourg Labor Market

**6. To better understand the interactions between the labor market trends and implications for policy, staff constructed a structural model of the Luxembourg labor market.** Luxembourg is modeled as a small open economy populated by heterogeneous workers that can work either domestically or commute to a foreign labor market. Similarly, foreign workers can commute into Luxembourg. Workers differ in terms of their underlying ability, which determines their relative productivity when employed. Firms employ workers in either a low-, medium-, or high-skill technology that determines the returns to the workers' ability (Box).

**7. The economy is calibrated to match the features of the Luxembourg labor market described in Section A.** To examine the effect of digitalization on the labor market, the model is calibrated to fit the statistical properties of the labor market (ratios, averages, etc., see Table 1) for both an early period (2000) and a late period (2019).<sup>7</sup> The unemployment rate and labor market tightness determines the matching efficiency  $M$  between workers and vacancies as well as the cost of posting vacancies  $I$ . The 80–20 ratio—labor income of the top 20 percent of workers divided by the labor income of the bottom 20 percent of workers—determines the distribution of worker abilities  $\mu$ .<sup>8</sup> The relative skill share of workers determines the cost  $x_\kappa$  of technologies, while the share of job seekers by age group pins down the average ability  $v_\alpha$  of each group. Finally, the relative number of foreign-to-domestic and domestic-to-foreign commuters (set to match the values in Figure 3) determine the utility from being active in the foreign labor market  $\bar{U}$  and the utility cost of commuting  $\chi$ . The model replicates the targeted data moments as well as other qualitative features of the economy that are not directly targeted in the calibration (Table 1).

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<sup>7</sup> To abstract from the effects of the pandemic on long-term trends, staff use 2019 rather than more recent data. IMF (2022) summarizes several factors—reduced participation, especially by women and older workers, changes in occupational preferences, and increased skills mismatches—that have led to increased market tightness in advanced economies in the aftermath the pandemic. While important for Luxembourg, these factors are likely, in part, temporary and unrelated to longer term trends in the digitalization of the economy.

<sup>8</sup> The 80–20 ratio does not account for transfers to workers. Consequently, inequality in the model results should be interpreted as wage inequality before transfers.

**Table 1. Luxembourg: Model and Data Moments**

Moment	Early Period (2000)		Late Period (2019)	
	Data	Model	Data	Model
<b>Calibration Targets:</b>				
Wage Rate 2/	1.00	1.00	1.22	1.21
Unemployment Rate	2.1%	2.1%	5.5%	5.6%
Average LM Tightness 1/ 3/	0.3	0.3	0.5	0.4
80-20 Ratio 1/ 4/	4.2	4.3	5.3	5.6
Domestic Commuters / Active	4.7%	4.8%	4.7%	4.7%
Foreign Commuters / Active	46%	46%	70%	72%
Participation Rate	64%	63%	72%	74%
Participation Rate Old	29%	31%	45%	45%
Population Skill Share	[38 , 45 , 17]	[38 , 44 , 18]	[27 , 32 , 41]	[27 , 32 , 41]
Job Seekers by Age 1/	[31 , 38 , 31]	[37 , 40 , 22]	[20 , 37 , 43]	[24 , 39 , 37]
<b>Untargeted Moments:</b>				
Inequality 1/ 4/				
95-5 Ratio	10.6	9.7	17.3	9.3
90-10 Ratio	6.6	6.6	9.2	7.3
75-25 Ratio	3.6	4.3	4.5	5.6
St. Dev. Wage	-	1.8	-	1.4
Gini Coefficient	26	41	32	35
Search Duration				
Share > 1 year 1/	34%	2%	44%	21%
Unemployment Rate (%)				
By Age	-	[1.7 , 1.9 , 2.7]	-	[2.7 , 4.7 , 8.6]
By Skill	-	[2.7 , 2.2 , 0.9]	-	[9.1 , 6 , 2.9]
1/ Data for 2000 is unavailable, 2006 data is used instead.				
2/ Constant 2015 euros, normalized by early period wage rate				
3/ Job vacancies divided by job seekers				
4/ The X-Y Ratio is defined as income by works above the top X percentile divided by income of workers below the bottom Y percentile				
Source: Haver, STATEC, Eurostat, IMF Staff Calculations				

## 8. The model parameters capture key structural shifts in the economy over the time horizon.

Table 2 summarizes the parameters in the early and late periods. We interpret the differences in parameters in terms of the digitalization of the labor market that has occurred over this period but note that this should not be taken as direct evidence of the impact of digitalization. The change in the estimated parameters of the model between the two periods suggest the following key developments in the Luxembourg labor market:



- a. Matching efficiency has declined but the cost of posting vacancies has also declined.** The model interprets the simultaneous increase in unemployment and labor market tightness (Figure 2, right panel) as a decline in matching efficiency  $M$ —i.e., the ex-ante rate at which an unemployed worker finds a job—and a decline in the cost of posting a vacancy  $\Gamma$ . The cost of posting a vacancy has likely declined in part due to the rise of the internet and online job boards (e.g., as offered by ADEM) over this period, while the decline in matching efficiency may capture difficulties with screening online job applications and a higher degree of sectoral mismatch.<sup>9</sup>
- b. The returns to high-skill workers have increased.** The decrease in the cost of the high-skill technology  $x_h$  has led to higher wages at the top end of the income distribution. This could be interpreted as the digitalization of the economy increasing the returns on formal education and the need for specialized education.
- c. The labor market has become increasingly favorable to younger workers.** The model interprets the decline in the share of young job seekers as a decrease in the relative skill profile of older workers. That is, all else equal, firms now prefer to hire younger workers for the same occupation than in the past where they might have preferred a prime age worker. While the ex-ante skill gap between young and old workers has not changed much, the increased return on the high-skill technology has led to an increase in the ex-post income gap between these groups. This could be interpreted as lower returns on experience or a faster rate of skill obsolescence than in the past. It could also reflect active labor market policies, such as the Youth Guarantee scheme introduced in 2014, that have benefited younger workers.
- d. Other parameter changes suggest important trends in worker participation and commuting.** The increase in the participation rate, especially amongst older workers, suggests that the benefits from remaining inactive have declined relative to the benefits from remaining employed over this period.<sup>10</sup> The model also interprets the growing share of foreign commuters as an increase in the relative benefits of being active in the domestic labor market, despite the increase in the unemployment rate. However, these trends have not been shared equally, with higher ability workers experiencing a comparatively higher share of the benefits.

<sup>9</sup> Empirical studies looking more broadly at Europe (e.g., Suphaphiphat and Miyamoto, 2020) similarly find that rising (long-term) unemployment is associated with rising skill mismatches and declining labor market matching efficiency.

<sup>10</sup> This should not necessarily be interpreted as retirement benefits becoming less generous as other indirect factors (e.g., rising housing prices or life-expectancy) may lead workers to remain in the labor market for longer than in the past. Luxembourg continues to have one of the lowest participation rates of older workers in the region and one of the most generous retirement benefits.

**Table 2. Luxembourg: Model Parameters**

Parameter		Early Period (2000)	Late Period (2019)
Externally Chosen Parameters			
Discount Rate	$\rho$	0.05	0.05
Emp. Status Preference	$\alpha$	1.4	1.4
Separation Rate	$\delta$	0.1	0.1
Labor Share	$\beta$	0.3	0.3
Matching Coefficient	$\eta$	0.5	0.5
Parameters Calibrated to Internal Targets			
Productivity	$A$	1	0.9
Inactivity Benefits	$B_a$	[ 0.38 , 0.38 , 0.2432 ]	[ 0.3 , 0.3 , 0.096 ]
Commuting Cost	$\chi$	350	495
Matching Productivity	$M$	11	4
Firm Search Cost	$\Gamma$	66	32
Idiosyncratic Skill Parameter	$\mu$	6.7	7
Technology Curvature	$\sigma$	2	2
Technology Cost	$x_\kappa$	[ 0 , 1.25 , 6 ]	[ 0 , 0.2 , 2.5 ]
Skill-by-Age	$v_a$	[ 2.3 , 2.2 , 1 ]	[ 2.2 , 1.8 , 1 ]
Age Share of Population		[ 30 , 37 , 33 ]	[ 29 , 33 , 38 ]
Utility of Foreign	$\bar{U}$	3.1	2.16
Foreign Population	$L^*$	2	2
Age Share of Foreign		[ 30 , 37 , 33 ]	[ 29 , 33 , 38 ]

### C. Model Results

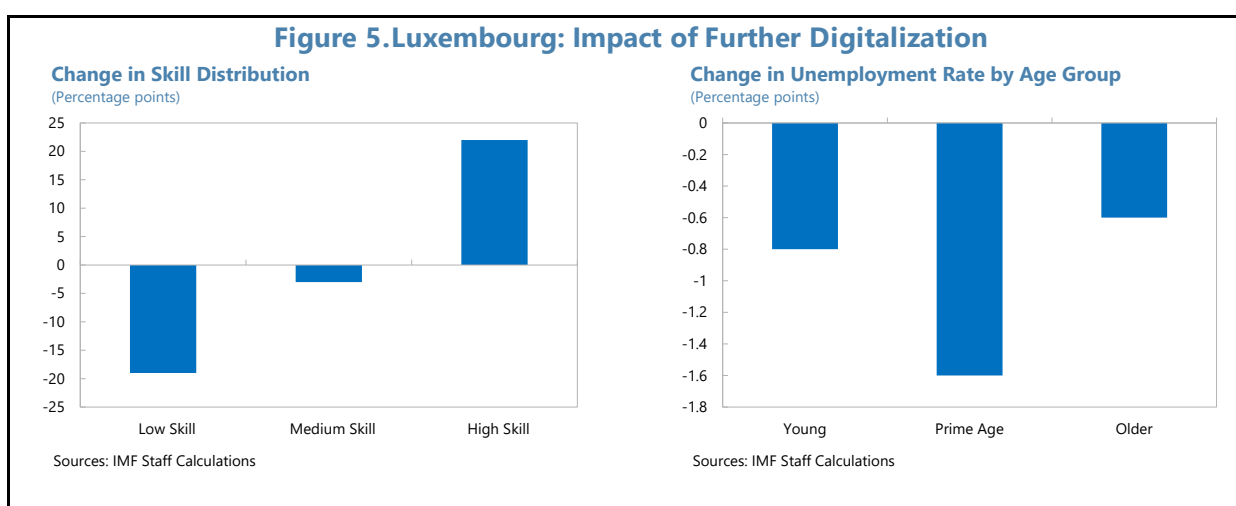
#### 9. The model interprets the increasing inequality as being primarily driven by increasing returns to higher skilled workers due to falling technology costs.

Three channels drive the changes in inequality in the calibrated model: (i) the cost of adopting the medium-skill  $x_M$  and high-skill  $x_H$  technologies; (ii) the dispersion of worker ability  $\mu$ ; and (iii) the average ability of age groups  $v_a$ . The first channel over-explains the increase in inequality, implying that inequality would be lower if technology costs had not declined. The second channel explains a negligible share of the increase in inequality, since the change in the ability dispersion between the calibrations is quantitatively small. The third channel implies a decline in income inequality but is also important for understanding the winners and losers of the structural shift in the labor market. Specifically, prime age and older workers have been net losers to the structural shift, while younger workers have been net winners.

#### 10. Further digitalization in the future is likely to increase inequality and solidify between-group income gaps.

The model is used to forecast how a similar increase in digitalization as it was

observed between 2000 and 2019 may affect the economy going forward. Specifically, the economy is adjusted by assuming that the cost of the medium-skill technology decreases by a further 84 percent and that the cost of the high-skill technology decreases by a further 58 percent. The returns on young and older workers remains the same reflecting the assumption that digitalization has increased the rate of skill obsolescence. As illustrated by Figure 5, further digitalization will increase the high-skill workers' share and has a relatively small effect on the medium-skill workers share. The figure also shows that while unemployment declines, the benefits are shared across the age distribution with prime age workers benefiting the most. While older workers benefit, the decline is not enough to offset their initial unfavorable position in the labor market relative to other groups.<sup>11</sup> The effects of further digitalization on inequality are ambiguous. Income at the top end of the distribution increases relative to the bottom end, but more workers benefit from the wider-spread adoption of the high skill technology leading to a slightly lower Gini coefficient.



**11. The model is used to simulate three broad policy schemes that could be implemented to combat increasing inequality.** The setup of the policy schemes in the model is as follows.<sup>12</sup>

- a. **Re-skilling of older workers.** This policy is simulated by increasing the ability of older workers, such that the idiosyncratic component  $u_i$  of worker ability increases to  $u'_i = u_i^{1.3}$ . This policy is most directly related to re-skilling programs, such as those organized by ADEM, or on-the-job training programs that help workers acquire new skills. However, the policy could also be thought of as programs that may have longer-term effects on the ability distribution of older workers. For example, lifelong learning programs, including extending

<sup>11</sup> Additionally, older and low-skill workers are particularly susceptible to labor-saving automation in the future, which may reverse any gains that are expected in the simulated digitalization scenario.

<sup>12</sup> Broadly speaking, the literature distinguishes between active labor market policies (ALMPs) that target employee job seeking incentives, employer hiring incentives, and matching efficiency (Card, Kluve, Weber, 2010; Brown and Koettl, 2015). The three policy considered here correspond to each of these categories, with the first two targeting specific sub-groups of the population.

existing efforts by the professional chambers, that help workers develop new skills throughout their career, as opposed to targeting only older workers.

- b. Support for medium-skill occupations.** The policy is simulated through a direct subsidy that increases the after-tax revenue of a medium-skill match (i.e.,  $y'(s, m) = 1.1 * y(s, m)$ ). This policy could be most directly related to support programs for either medium-skill occupation—e.g., through occupation-specific subsidies or tax benefits—or through support of firms that hire medium-skill occupations. The policy could also be thought of as capturing programs that indirectly benefit occupations—e.g., increased public hiring of disadvantaged workers—but do not include direct subsidization.
- c. Improved worker-firm matching.** The policy is implemented by directly increasing the matching efficiency, such that  $M' = 1.05 * M$ . This policy captures any type of program that would help match workers with job vacancies. For example, this would include improvements to existing job boards, job counselling services, and apprenticeship programs. At the same time, it could also include less direct actions to facilitate matching such as improved access to language programs, fast tracking regulatory requirements (e.g., lowering turn-around time for specialty licenses for truck drivers), or broader accreditation of skills that help firms identify well-suited employees.

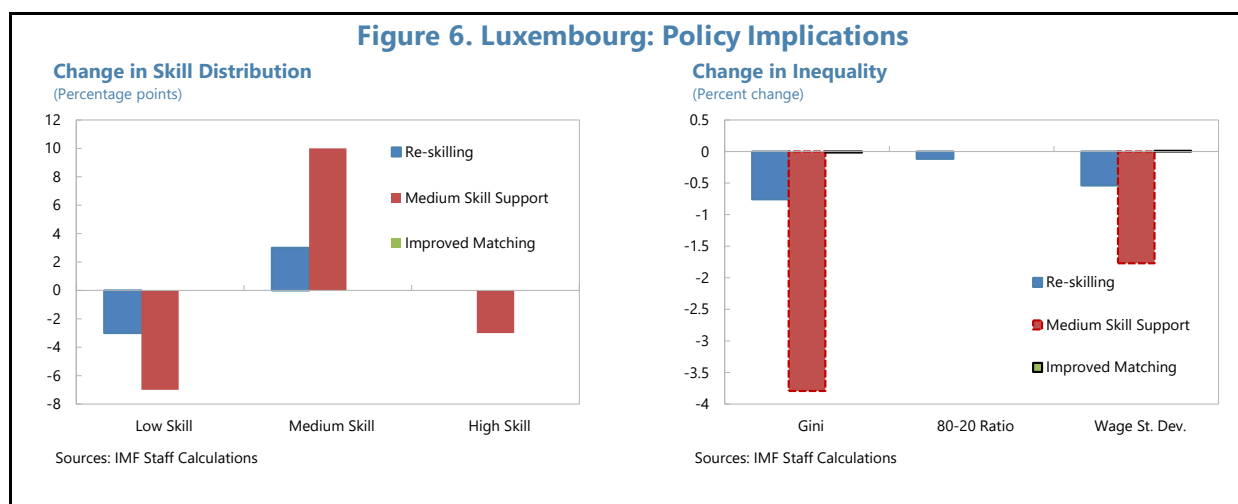
**12. The model results suggest that policy responses to increased inequality feature important tradeoffs that may hinder their effectiveness.** Figure 6 shows the impact of the policies on outcomes related to the skill distribution, income inequality, and labor market opportunities. The policies are set to match a qualitatively similar decline in the unemployment rate of older workers as a benchmark.

- a. Re-skilling of older workers.** Re-skilling of older workers leads to a reallocation of older workers from low skill to medium-skill occupation. Given the relatively low ability of older workers, the policy has little effect on the share of high skill workers in the economy. The policy lowers inequality by increasing the wages of older, low-skill workers, who have the lowest wages in the economy. However, the effects on inequality are relatively minor as older workers have a relatively low participation rate and, consequently, do not account for a large share of workers. The policy also results in an increase in the unemployment rate of medium-skill workers, although, this is driven by marginally lower ability workers being added to medium-skill occupations.<sup>13</sup>
- b. Support for medium-skill occupations.** Supporting medium-skill workers has a more substantial effect on the skill distribution, causing a large increase in the share of medium-skill workers. The policy decreases inequality, notably the Gini, by allowing some low-skill

<sup>13</sup> Additionally, while not directly considered in the model, training and re-skilling programs are generally found to be more effective at stimulating employment in the medium term (Card, Kluve, and Weber, 2010, 2018). This is likely to be especially true of programs with longer horizons, such as lifelong learning. In contrast, the other policy options considered are likely to have more immediate impacts on the labor market.

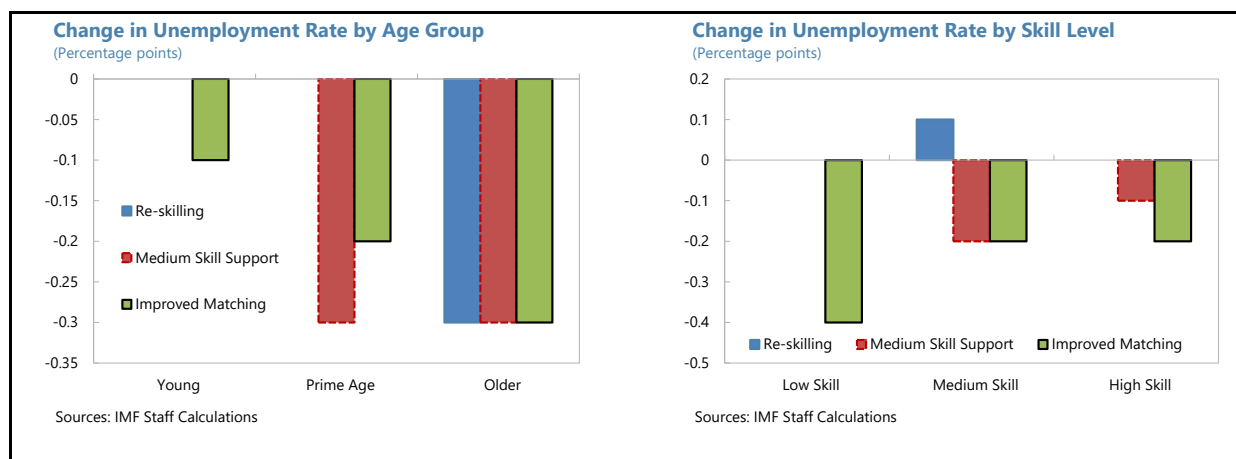
workers to adopt the medium-skill technology and because a slower adoption of the high-skill technology tends to lower inequality. The policy does not have a major impact on the extreme tails of the income distribution since these workers are employed in either the low- or high-skill occupations. Finally, the policy decreases unemployment for medium-skill and the older age groups.<sup>14</sup> However, the downside of the policy is that many workers that would be otherwise employed in high-skill occupations find it beneficial to remain in medium-skill occupations.<sup>15</sup>

- c. Improved firm-worker matching.** The policy has no effect on the skill distribution because it does not affect the value of matched firm-worker pair. By the same reasoning, the policy does not have a large effect on income inequality. However, the policy does have a relatively uniformly positive impact on the unemployment rate across the age groups and skill levels. While older and low-skill workers tend to benefit more, this is a consequence of their initially weak starting position relative to the other groups.



<sup>14</sup> The decline in the unemployment rate of high-skill workers is also driven by the marginally lower-skill workers becoming medium-skill workers.

<sup>15</sup> Additionally, the implementation of these types of programs should be carefully calibrated. Card, Kluve and Weber (2010) and Kluve (2010) find that ALMPs tend to have limited effectiveness. On the other hand, tax benefits or subsidies to private firms may distort hiring incentives (e.g., increased short-duration hires) or crowd out other worker types.



## D. Conclusion and Discussion

**13. While policy can help to lessen pressures on disadvantaged groups in the labor market from trends in digitalization, policymakers need to be mindful of the tradeoffs.** Broader policies, such as improved matching, can benefit the largest group of workers, but have little impact on inequality or the skill distribution and may miss the most disadvantaged workers in the economy. On the other hand, targeted policies, such as medium-skill support, may be able to directly support disadvantaged groups and lessen inequality, but potentially distort investment or adoption of skills. Policies that target inherent characteristics of workers, such as the re-skilling programs, avoid this tradeoff, but their effectiveness is potentially limited by the size of the worker group they target. Given these tradeoffs, a combination of broad-based policies and directed policies should be used to deal with the issues facing the labor market.<sup>16</sup>

**14. The analysis abstracts from other factors that should be considered when designing policy.** The public sector is a large employer, especially of domestic workers, that is not directly considered in the analysis. Public sector employment may provide another path to support medium-skill workers or to improve opportunities for older, low-skilled workers (or other disadvantaged groups). However, it faces similar tradeoffs as the support for the medium-skill occupation schemes described above (e.g., possibly distorting incentives for workers to invest in skills). Relatedly, the model does not consider issues of labor-market pressures stemming from increased public employment which may weigh on Luxembourg's international competitiveness. Another factor abstracted from is between-sector skills and reallocation. In the post-pandemic recovery, sectoral imbalances have emerged as the labor market experienced high vacancies along with relatively high unemployment by historical standards (Figure 2).<sup>17</sup> In this regard, the discussed matching policies

<sup>16</sup> Luxembourg spends a high share on ALMPs per unemployed worker compared with other European countries and its policies are relatively more complex from a regulatory perspective (Laurinson and Luske 2021). Given this, consolidation of and increased support for effective programs may be more suitable than additional programs.

<sup>17</sup> Other countries have also experienced rising sectoral mismatch in the aftermath of the pandemic. For example, Barrero, Bloom and Davis (2020) show evidence that the COVID-19 shock will also lead to a substantial reallocation of economic activity across sectors within the United States. This could limit the ability of Luxembourg to attract foreign workers with the appropriate skills to the extent that this is a problem faced by neighboring economies.

would benefit from increased focus on between-sector reallocation while re-skilling policies should account for skill requirements of growing sectors. These policies should also be mindful of minimizing job risks from future digitalization and automation.

### Box 1. Luxembourg: Description of the Structural Model

**Worker types and preferences.** The economy is populated by a unit mass of workers  $i$  that differ in their ability  $s_i$ , demographics  $a_i \in \mathcal{A}$ , employment status  $o_i$ , and preferences over their employment status  $\epsilon_i$ . The employment status of each worker can either be active in the domestic labor market, active in the foreign labor market, or inactive. Formally, household preferences are given by:

$$\underbrace{\int_0^{\infty} e^{-\rho t} C_i(t) dt}_{=U_i} - \ln \chi^{o_i} + \ln \epsilon_i^{o_i},$$

where  $C_i$  is the consumption of worker  $i$  and  $\chi^{o_i}$  is a preference for working abroad and takes value  $\chi$  if the workers chooses works abroad and one otherwise. We assume that preferences over occupations follows a Frechet distribution with CDF  $e^{-\epsilon^{-\alpha}}$ , as in Ahlfeldt, et al. (2015). Workers that choose to be inactive in the market receive benefits such that  $U_i = B_a$ , where benefits depend on the worker's demographics  $a$ . These benefits could capture both any formal benefits (e.g., pension) or any indirect benefits from not working (e.g., increased leisure). Active workers can be either unemployed or employed by a firm. Unemployed workers receive benefits that we normalize to zero,  $b = 0$ , while domestically employed workers receive wage  $w_{s_i}$  that depends on their ability  $s_i$ .

**Worker productivity.** The ability  $s_i$  of workers determine their relative productivity in the labor market and their wage rate. We allow for demographics  $a_i$  to affect skill as well as an idiosyncratic component of worker productivity which we denote as  $u_i$  and assume follows a Pareto distribution with CDF  $1 - u^{-\mu}$ . The ability of a worker is given by:

$$\ln s_i = \nu_{a_i} + \ln u_i,$$

where the value of  $\nu_a$  determines the relative return on the labor market of being in demographic group  $a$ . In the model calibration, we take the demographic groups as being younger workers, prime-age workers, and older workers. The value of  $\nu_a$  could capture, for example, the value of young workers with new digital skills or the returns to experience in the group of older workers.

**Firms and production.** Firms employ at most one employee. Production depends on the ability  $s_i$  of the firm's employee and a technology  $\kappa$  chosen by the firm. The firm's chosen technology can be the low-, medium-, or high-skill technology (denoted by  $\ell, m, h$ ) and determines the relative returns to the ability of the worker. Production is given by:

$$y(s_i, \kappa) = A[s_i^{\sigma_\kappa} - x_\kappa]$$

where  $A$  is common to all firms and captures the aggregate productivity of the economy,  $\sigma_\kappa$  determines the returns to skill of technology  $\kappa$ , and  $B_\kappa$  is an adoption cost of technology  $\kappa$ . Firms without an employee produce zero output. We assume that technologies are parameterized such that  $\sigma_h > \sigma_m = 1 > \sigma_\ell = 0$ , such that the high-skill technology is more complementary to worker ability than the medium-skill technology, which is more complementary to worker ability than the low-skill technology. Additionally, we set  $x_h > x_m \geq x_\ell = 0$  such that the high- and medium-skill technologies are more expensive than the low-skill technology. Firms pay a constant share  $1 - \beta$  of revenues to workers as their wage.<sup>1/</sup>

**Foreign Commuters.** The foreign economy is populated by  $L^*$  workers with the same demographic and ability distribution as the domestic economy. An unemployed worker that chooses to enter the foreign labor market has expected utility from consumption equal to  $\bar{U}$ .

**Labor Market.** Households are matched to vacancies through a search process. A new vacancy—a firm without an employee—for a worker with ability  $s$  is created by paying flow cost  $\Gamma$ . A firm is matched with a worker at rate  $M u_s^\eta v_s^{1-\eta}$  where  $M$  is the matching efficiency,  $u_s$  is the number of unemployed ability  $s$  workers, and  $v_s$  is the number of vacancies in the market for ability  $s$  workers. A matched firm-worker pair is destroyed at rate  $\delta$  in which case the firm exits the market, and the household becomes unemployed.

<sup>1/</sup> This assumption simplifies the model solution compared to the standard Nash bargaining assumption (as in, for example, Mortensen and Pissarides, 1994). Nash bargaining is intractable given the assumption on household preferences across occupations.



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