



BELGIUM

SELECTED ISSUES

March 2018

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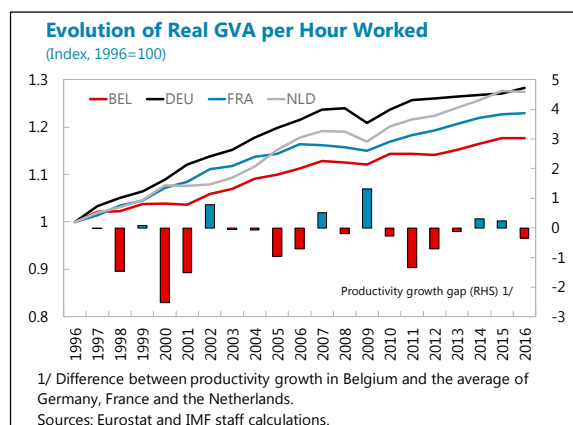
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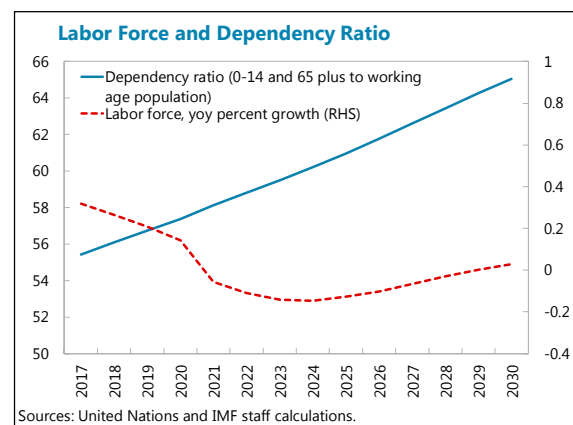
UNDERSTANDING PRODUCTIVITY GROWTH IN BELGIUM: SECTORAL AND FIRM-LEVEL ANALYSIS¹

A. Introduction

1. Productivity growth in Belgium has declined and fallen short of many peer countries. Average labor productivity growth declined from 2 percent in the 1990s to 1.3 percent in the 2000s before the crisis to only 0.7 in 2010–16. While many advanced economies have experienced a similar trend, the productivity slowdown has been more pronounced in Belgium. The shortfall in labor productivity growth relative to the average of Germany, France, and the Netherlands has averaged 0.4 percentage points over the last two decades. The employment growth, however, was 0.1 percentage points higher on average and may have generated some downward pressures on the level of labor productivity. The difference in productivity slowdown between Belgium and neighboring countries may also partially reflect how the crisis affected each economy and which policy responses were pursued.



2. Slow productivity growth is a particular concern in Belgium in light of population aging and the need to preserve external competitiveness. Belgium's economic dependency ratio is projected to reach 65 percent by 2030 (from current 55 percent). This means that maintaining a positive medium-term GDP per capita growth will require improvements in labor productivity growth. In addition, productivity, together with nominal wages, determine unit labor costs—a key measure of competitiveness for small and very open economies such as Belgium. If productivity growth continues to diverge from peer countries, wage moderation alone will not be sufficient to preserve competitiveness.



3. A variety of factors could be responsible for weak productivity growth in Belgium.

The broader literature on the productivity slowdown in advanced economies identifies a number of structural reasons, several of which are relevant to Belgium, including: i) sectoral shifts, with a growing share of less productive service sectors in total employment (Dabla-Norris et al., 2015); ii) lack of public investment and deteriorating quality of infrastructure; iii) slowing productivity in

¹ Prepared by Anna Shabunina (EUR).

some ICT related activities (Adler et al., 2017); iii) aging populations and underinvestment in human capital (Feyrer (2007), Aiyar et al. (2016)); and iv) lack of competition, particularly in service sectors, and regulatory distortions (Duval et al., 2015; Gal et Hijzen, 2016). A number of papers have emphasized the importance of these factors for Belgium, e.g. Dhyne et Fuss, 2014; Biatour et Kegels, 2017; Bourles et al., 2010; Ariu et Vandenberghe, 2014. In particular, Cette et al. (2016) have estimated a long-run increase in productivity of 6 percentage points if labor and product markets regulations in Belgium were reduced to the best practices in the OECD; and Andrews et al. (2015) have linked the weak dynamics of the firms' population in Belgium to high entry and exit barriers and increased misallocation of resources.

4. The purpose of this paper is to provide new empirical evidence that assesses a broad range of factors that have contributed to the slowdown of productivity growth in Belgium.

In contrast to the existing literature, our analysis combines regulatory parameters with other factors that have played an important role in Belgium, such as infrastructure quality and aging. We also look separately at the role of secular shifts in sectoral employment.

- *Sectoral shifts in employment.* Continued deindustrialization of advanced economies has implied a reallocation of resources to service sectors, where productivity growth is generally slower. In Belgium, the share of manufacturing in total employment has declined and the share of services, both tradable and non-tradable, has increased considerably. We examine whether this sectoral shift was more pronounced in Belgium and resulted in a larger drag on aggregate productivity, thus explaining part of the productivity gap with the neighbor countries.
- *Sector-specific factors: barriers to competition, public infrastructure, and workforce aging.* The analysis focuses on the following questions: i) What is the impact of barriers to competition on firms' performance in regulated sectors? ii) What are the spillover effects on the productivity of companies in downstream sectors (e.g., sectors that rely on inputs from the regulated sectors)? iii) What is the sector-specific role of infrastructure quality? iv) What is the impact of the increasing share of older workers. The use of firm-level data allows us to control for additional firm-specific characteristics such as size and access to finance.

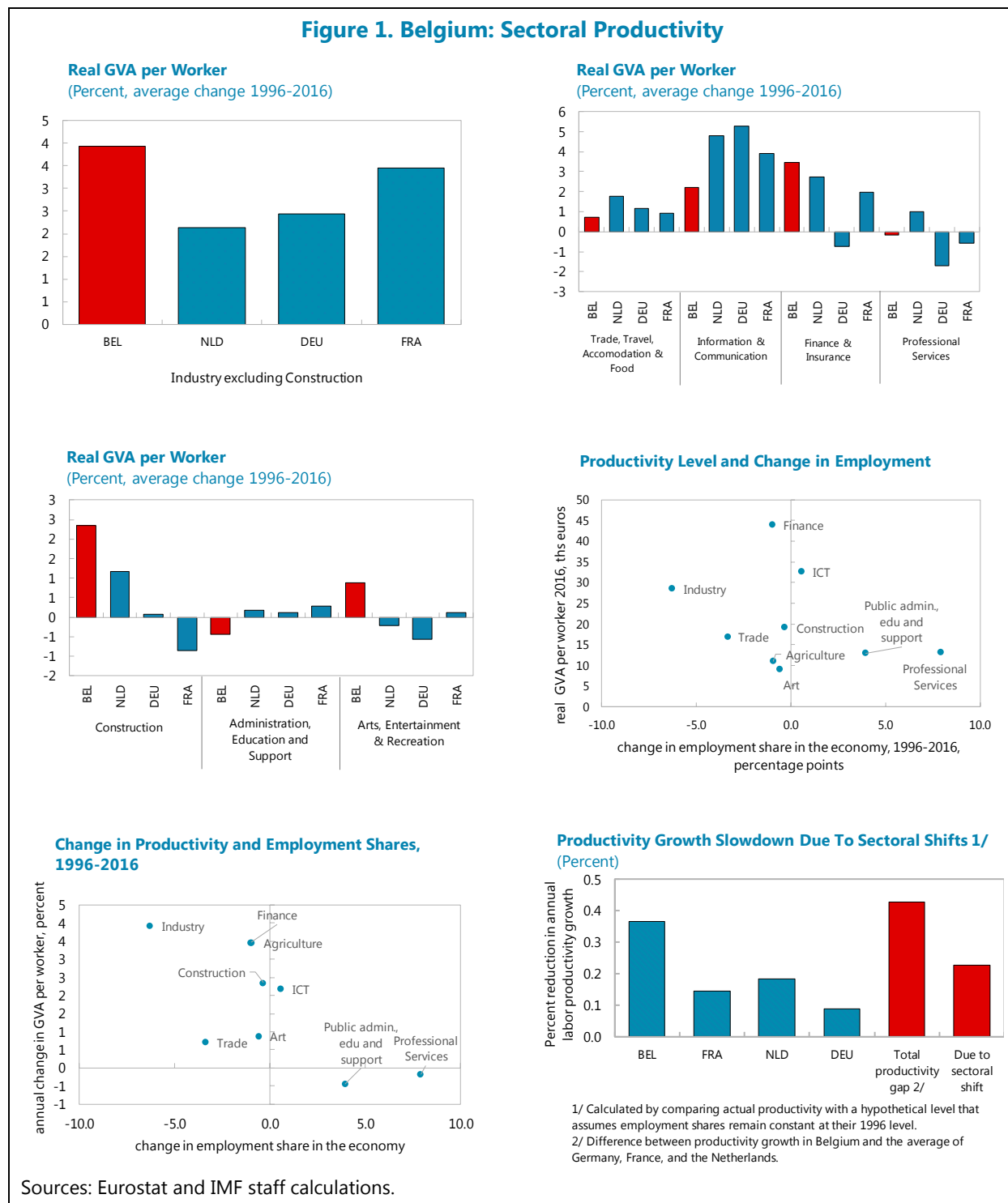
5. The paper is structured as follows. Section B describes sectoral developments in Belgium's productivity and assesses the relative role of sectoral shifts in the productivity slowdown. Section C describes key explanatory variables and their expected effect. Section D outlines the empirical strategy and firm-level data. Section E presents the econometric estimation results and counterfactual simulations. Section F concludes.

B. Sectoral Productivity and Sectoral Shifts

6. Productivity developments in Belgium have been heterogeneous across economic sectors. Manufacturing, construction, and finance have been performing at or above the regional average in terms of value-added per hour worked. For instance, the average annual growth in Belgian industry was 4 percent versus an average 2.7 percent in Germany, Netherlands and France. At the same time, service subsectors with large employment shares—including trade, travel,

accommodation, public administration, education, and science—have seen subdued productivity growth. Labor productivity growth in ICT services has been particularly poor compared to peer countries (almost two times slower on average) and might have negatively affected total factor productivity (TFP) in the rest of the economy (Bart van Ark, 2014) (Figure 1, charts 1–3).

Figure 1. Belgium: Sectoral Productivity



7. Sectoral compositional effects have amplified the adverse productivity trend. Over 1996–2016 the employment share of industry has declined by more than a third, while the share of professional services has doubled and the share of other non-tradable services has also increased. Figure 1, chart 5 shows that sectors with stagnating productivity growth have increased their employment the most, while those with high productivity growth have seen shrinking employment shares.

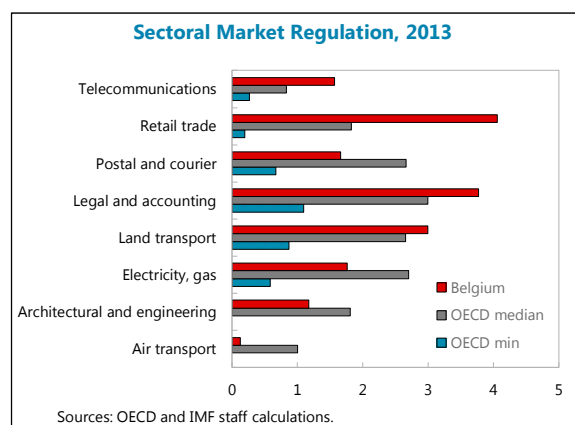
8. Sectoral reallocation effects explain about half of the cumulative productivity growth gap relative to peers since 1996. To estimate the role of sectoral shifts in the slowdown of aggregate productivity growth and the widening of the gap with peer countries, we calculate a hypothetical total labor productivity growth rate that assumes unchanged sectoral shares of employment at 1996 levels combined with actual labor productivity growth by sector (at one digit NACE). Figure 1, chart 6 shows the difference between the counterfactual and actual aggregate productivity growth. The results show that if the structure of the economy in Belgium had remained the same as in 1996, aggregate annual productivity growth would have been 0.4 percentage points higher. This difference is significantly higher in Belgium than in France, Germany, and the Netherlands and accounts for half of the productivity growth gap with these countries.

9. In the next section, we explore whether sector-specific factors could be responsible for the remaining gap in productivity. The next section focuses on other factors that may have contributed to the gap, namely underinvestment in public infrastructure, an aging population, and policy distortions, including regulations that limit competition in services.

C. Potential Explanatory Variables: Regulation, Infrastructure and Aging

10. Belgium has excessive regulation of network industries and professional services.

While Belgium’s overall product market regulation score is not worse than the OECD average, several service sectors, including telecommunications, retail, legal and accounting, and land transportation face comparatively high barriers to entry and competition according to the OECD PMR sectoral indicators for 1996–2013. Moreover, the new OECD dataset for 2014–16, which collects information on trade restrictions across 19 major services sectors (STRI), shows that virtually all service sectors in Belgium are more closed to foreign competition than the service sectors in France, Germany or Netherlands.

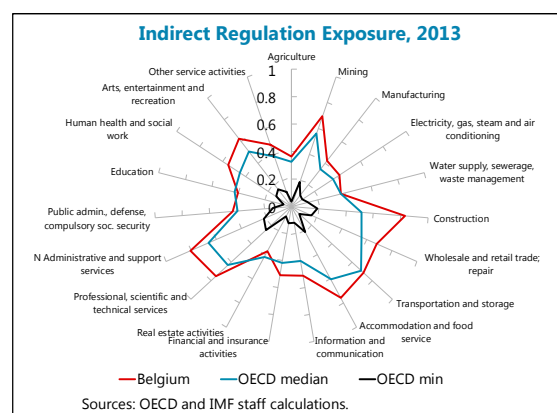


11. Obstacles to competition in services can hurt productivity and push up prices in the regulated sectors. A number of studies have looked at the impact of product and labor market imperfections on productivity (e.g., Aghion and Howitt, 2009). In theory the impact of regulations causing or supporting these imperfections can go both ways: on the one hand, incumbent firms, protected by barriers to entry or other regulations limiting competition, have less incentive to be

efficient and innovate; on the other hand, they might have more resources to invest in innovation. Most empirical studies, however, show that the first mechanism dominates, and therefore higher anti-competitive regulatory protection has a negative impact on firms' productivity (Duval et al 2015, Gal et Hijzen, 2016). In addition, barriers to entry consistently enable incumbent firms that are shielded from competition to raise their prices, while a lack of regulatory transparency and complex administrative procedures tend to add to firms' operating expenses. An empirical OECD study (Rouzet et Spinelli, 2016) explored the relationship between services trade policies and mark-ups at the firm level. The authors found that restrictive regulations enable firms to charge higher mark-ups in a majority of services sectors. In addition, high entry and exit barriers may result in misallocation of resources to less productive firms and reduce aggregate productivity.

12. Higher prices and lack of competition in regulated sectors can have significant negative spillovers to downstream sectors and the rest of the economy. Higher rents and market power in regulated sectors can result in higher costs of inputs in downstream industries, thus lowering productivity in the connected industries.²

A number of empirical studies find evidence that anticompetitive upstream regulations have significantly curbed productivity growth in downstream industries (Bourles et al. 2010, WEO 2016, Chapter 3, Gal et Hijzen, 2016). Biatour and Kegels (2017) show that market services in Belgium have seen higher price increases than in neighboring countries. Annual report by the Belgian Price Observatory also points to high market concentration in a number of service sectors.³



13. Our estimates show that most Belgian sectors have high intensity of indirect regulation. Following Lanau, Topalova (2016), we construct a measure of indirect exposure to regulation for each sector:

$$\left(\sum_{k=1}^J Int_{kj} * PMR_{kct} \right)_j$$

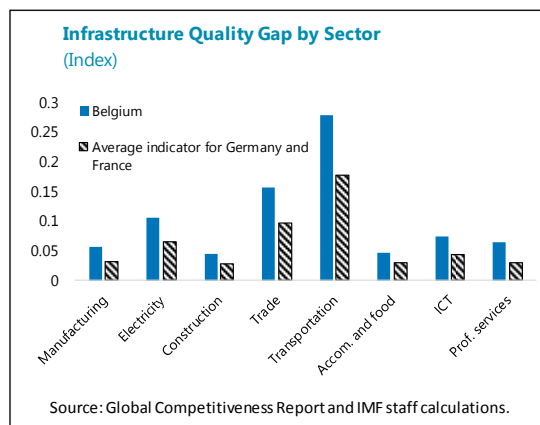
where PMR_{jct} is the OECD sectoral product market regulation index for country c sector j in year t ; Int_k is the share of intermediate inputs provided by each sector k to sector j . To calculate the share of intermediate inputs, and to avoid endogeneity issues, we use the US Input Output matrix in European 2-digit NACE sector classification.

² Some studies focusing on the network sectors regulation estimate forward linkages of regulation, e.g. impact of higher output of the regulated sectors on the demand for intermediate inputs from upstream sectors. This was not the focus of our paper.

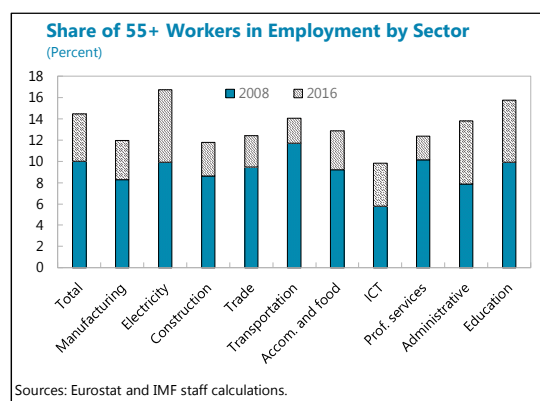
³ "Market Functioning in Belgium: Horizontal Screening of the Sectors (2016)," http://economie.fgov.be/en/modules/publications/statistics/economy/marche_en_belgique_screening_2016.jsp

14. Productivity in some sectors might be more affected by the declining quality of infrastructure.

A long period of low public investment in Belgium has brought the net stock of public capital well below peers, which has negatively affected the quality of infrastructure.⁴ According to the Global Competitiveness Report (GCR), the quality of Belgian infrastructure in general, and roads especially, has been declining for years and is well below comparator countries. As some industries are more dependent than others on transportation for their inputs, the quality of infrastructure will have varying effects on sectoral productivity. To take this into account, we construct a sector-specific indicator by interacting a country-level measure of infrastructure quality with the intensity of infrastructure use by each sector. The intensity of use is measured by the share of transportation in total intermediary inputs of the sector using the US Input Output matrix at 2-digit NACE sector classification. The index shows that the transportation, trade, and electricity sectors in Belgium are most affected by infrastructure quality and have the largest gap.



15. Belgium has a rapidly aging workforce. The share of 55+ workers in Belgium has increased two-fold from 6.5 percent in 2000 to 15 percent in 2017. While this is a positive development in general, it may have had an impact on labor productivity growth, with some studies linking workforce aging to declining labor productivity in Belgium (e.g. Ariu et Vandenberghe, 2014).



D. Firm-Level Data and Empirical Strategy

16. The empirical strategy follows Lanau, Topalova (2016) and expands the analysis by including public infrastructure and aging. To assess the impact on productivity of the factors discussed in the previous section we estimate several empirical specifications. We start by replicating specifications of the previous studies.

- Equation 1 estimates the direct impact of regulation on the sample of companies in service and network sectors subject to regulatory barriers:

$$Y_{it} = \beta_1 PMR_{jct} + \gamma X_{it} + \alpha_c + \alpha_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is a performance measure of firm i in year t (these include TFP growth, labor productivity growth, value added growth, markup); PMR_{jct} is the OECD sectoral product

⁴ Please see accompanying SIP "Simulating an Increase in Public Investment"

market regulation index for country c sector j in year t ; X_{it} are additional firm-level controls, including proxies for financial constraints (debt-to-asset ratio), firm size (using lagged value added) and age; α_t and α_c are time and country dummies that are used to directly control for macroeconomic fluctuations in country c , and all other factors that may affect productivity equally across firms. Negative sign of coefficient β_1 would indicate direct positive impact on firms' productivity from reduced regulatory obstacles in these sectors.

- Equation 2 estimates the spillover impact of regulation on a sample of companies in downstream industries:

$$Y_{it} = \beta_2 \left(\sum_{k=1}^J Int_{kj} * PMR_{kct} \right) jct + \gamma X_{it} + \alpha_c + \alpha_t + \varepsilon_{it} \quad (2)$$

where Int_k is the intensity of sector k input use by sector j . Negative sign of coefficient β_2 would indicate positive spillover impact on productivity of companies in downstream sectors.

- Equation 3 estimates both effects on a pooled regression of both samples and with added controls of infrastructure quality and aging:

$$Y_{it} = \beta_1^p PMR_{jct} + \beta_2^p \left(\sum_{k=1}^J Int_{kj} * PMR_{kct} \right) jct + \delta_1 Infr_{jct} + \delta_2 e55_{jct} + \gamma X_{it} + \alpha_c + \alpha_t + \varepsilon_{it} \quad (3)$$

where $Infr_{jct}$ is the GCR index of infrastructure quality weighted by the industry specific intensity of infrastructure use; $e55_{jct}$ is an employment share of 55+ employees in total employment of sector j .

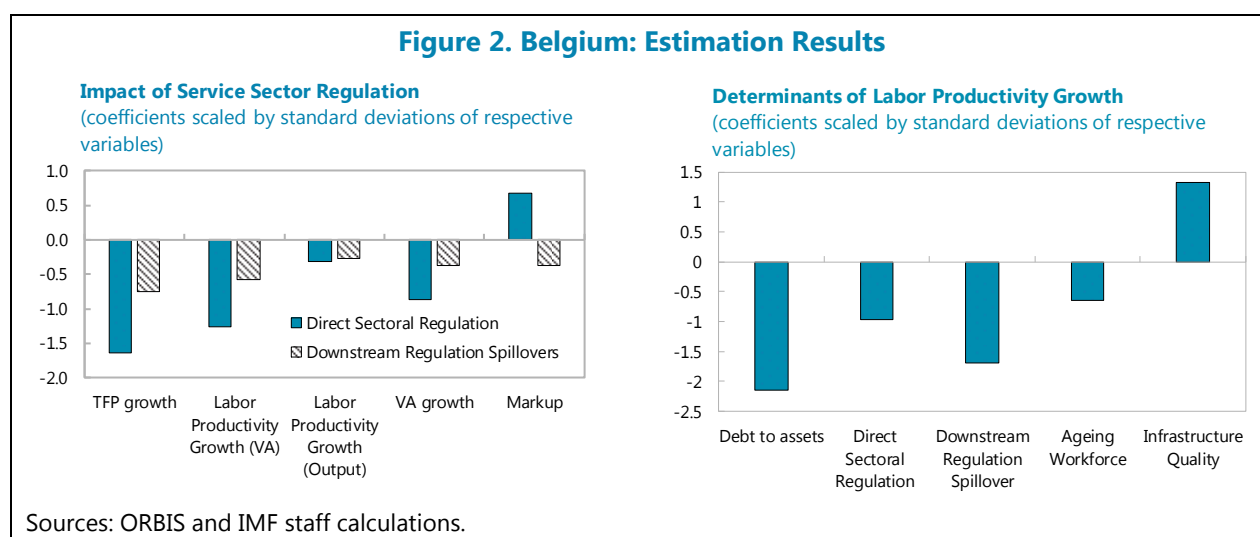
17. We use data extracted from the ORBIS database of Bureau van Dijk, compiled by the IMF's research department (Gal and Hijzen, 2016). We use data on balance sheets, income statements, and sectoral classifications of around 650,000 active companies from 14 advanced economies over 1996–2013. For Belgium the number of companies varies from 5,000 to 8,500 depending on the year (Table 1). Table 2 shows the sample breakdown in terms of NACE 1-digit sectors for the whole sample and for Belgium. We use the OECD sectoral regulation measures (PMR) that cover electricity, gas, telecom, post, air, roads, rail, accountants, lawyers, architects, engineers, and retail. We use the Global Competitiveness Report measure for infrastructure quality and Eurostat data on employment by NACE2 2-digit industry and age. To measure the indirect exposure to regulation by different industries we use the US Input Output table in European classification.

E. Empirical Results and Counterfactual Simulations

18. We find evidence that higher regulatory barriers are associated with lower productivity and higher mark-ups. Product market restrictions have a significant and negative impact on firms' value-added growth, as well as labor productivity and TFP growth (Table 3). Figure 2 chart 1 shows standardized coefficients β_1 (blue bars) for the Equation 1, that estimates the direct impact of regulatory restrictions on the productivity indicators for the sample of companies in the regulated service sectors. The estimations show that an increase in regulations by one standard

deviation will hurt TFP growth of these companies by 1.5 percentage points, labor productivity growth by 0.5 to 1 percentage points depending on the measurement, and value-added growth by more the 1 percentage point. These results are in line with previous literature findings. Moreover, and as expected from theoretical literature, we find evidence that regulatory barriers increase mark-ups in the regulated sectors.

19. Indirect exposure to regulation is associated with lower productivity and low mark-ups in downstream sectors. The estimations show a significant negative impact on the productivity growth of firms in connected industries, ranging from 0.3 to 0.5 percentage points. The sign of the impact on the mark-ups, however, is reversed: higher regulation reduces mark-ups in the downstream industries (Table 4). Figure 2 chart 1 shows standardized coefficients β_2 (grey bars). The above results hold in a pooled regression of both samples and with added controls of infrastructure quality and aging (equation 3, Table 5). Figure 2 chart 2 shows standardized coefficients for equation 3.

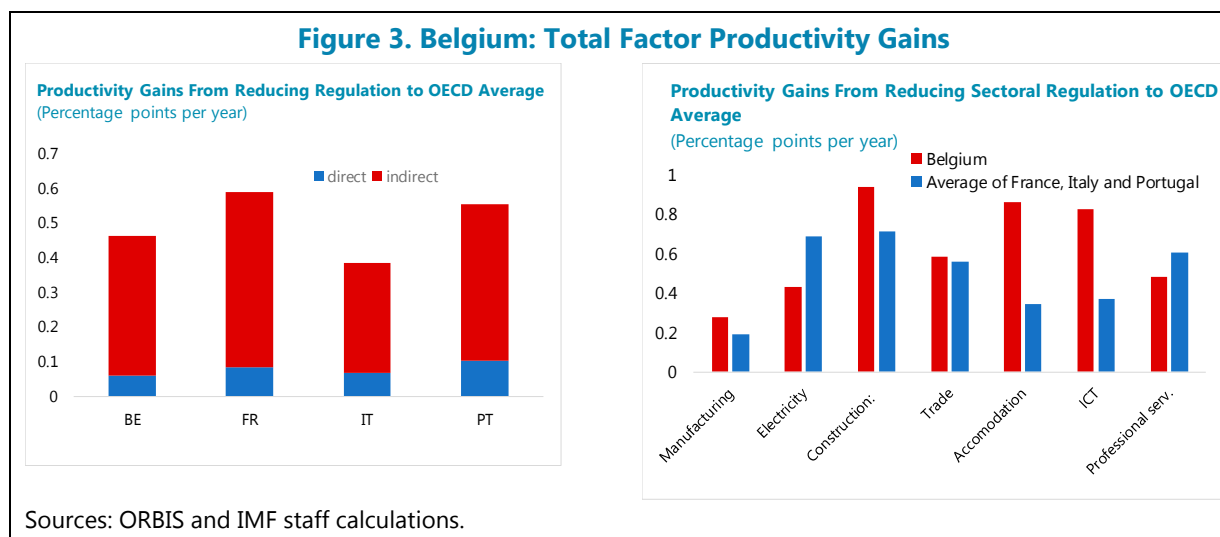


20. The quality of infrastructure has a significant positive impact on the productivity of industries that have high transportation costs. An increase in the quality of infrastructure by one standard deviation results in an increase in labor productivity growth by 1.4 percentage points.

21. A higher share of older workers in overall employment has a negative impact on productivity. An increase in the share of 55+ workers in the sector by one standard deviation reduces labor productivity growth by 0.7 percentage points. This result should be interpreted with caution as the aging structure at sectoral level may reflect the structure of large companies in a given sector. Firm-level data on worker's age would have provided better estimate of the aging effect, however, was not available for our sample.

22. Bringing regulatory practices to the average level in the OECD could have a very significant positive impact on productivity in Belgium. Under a hypothetical policy scenario, where all sector-specific regulation is reduced to the OECD average, firms total factor productivity could

increase by 0.2 to 1 percentage points depending on the sector (Figure 3 chart 2). The potential gains are the highest for construction, ICT, accommodations, food, and retail industries. Most of the total gains for the economy are coming from the indirect effect of deregulation (Figure 3 chart 1). Compared to neighboring countries, Belgium stands to gain more than Italy but less than France from reducing barriers to competition. This counterfactual exercise should be interpreted with caution. While the productivity level increases in the counterfactual scenario, some inefficient firms might be forced to exit the market. The magnitude of potential transition costs from eliminating incumbent protection will depend on the cyclical position and whether macroeconomic policy support is provided.



23. Policymakers could consider a variety of measures that might boost productivity over the medium term, including promoting competition in service sectors and investing in public infrastructure and human capital. The degree of competition in different markets depends on many factors, including technology and product market specifics (e.g., high entry costs due to the fixed investments required), obstacles imposed by self-regulatory associations (e.g., additional licenses, bans on advertisement), and regulatory restrictions that raise barriers to entry and protect the incumbents. A review of the regulations that may limit competition in different sectors could help policymakers develop productivity-enhancing reform options. This could be usefully complemented by providing additional support to the institutions that are in charge of addressing anti-competitive behavior. Increasing the efficiency of bankruptcy procedures could also help raise firm dynamism and reduce resource misallocation. Improving the quality of infrastructure is equally important for raising productivity growth, especially for sectors that have high transportation costs.⁵ Addressing the productivity challenges of an aging workforce will require a comprehensive set of measures that target the demand and supply sides of training and lifelong learning.

⁵ Please see Selected Issues Paper “Simulating an Increase in Public Investment” for the discussion of policy options and recommendations.

F. Conclusions

24. Belgium's subdued productivity growth can be explained by a combination of sectoral employment shifts, barriers to competition, the declining quality of infrastructure, and an aging workforce. The shift of employment toward lower productivity service sectors, common to many advanced economies, has been more pronounced in Belgium and explains half of the productivity gap with neighboring countries. Population aging is another secular factor that has contributed to the productivity slowdown. In addition, barriers to competition in some service sectors have lowered productivity growth and raised rents in these sectors. Higher prices and lack of competition in upstream sectors can cause significant negative spillovers, as higher indirect exposure to regulatory barriers is associated with lower productivity in downstream sectors. Bringing regulatory practices to the average level in the OECD could have a significant positive impact on productivity in Belgium. Another important factor is the declining quality of transport infrastructure, which has adversely affected productivity in the sectors using it intensively.

Table 1. Sample Size by Country

Country	Average Number of Firms Year 1996–2013
BE	6,727
CZ	11,779
DE	10,313
ES	205,285
FI	9,168
FR	126,245
GB	17,819
IT	125,631
JP	11,998
KR	9,532
PT	49,351
SE	60,637
SI	1,387
SK	6,559
Total	646,424

Table 2. Belgium: Description by Sector

	Number of Observations		Average number of Firms	
	Total	Belgium	Total	Belgium
Agriculture	260,821	364	14,490	20
Mining	48,950	638	2,719	35
Manufacturing	2,603,180	31,153	144,621	1731
Electricity	34,479	298	1,916	17
Water supply	75,881	1,495	4,216	83
Construction	1,806,319	10,204	100,351	567
Trade	3,405,777	43,556	189,210	2,420
Transportation	637,931	9,527	35,441	529
Accom. and food	624,125	909	34,674	51
ICT	376,294	5,128	20,905	285
Financial and insur:	85,096	1,089	4,728	61
Real estate activitie	440,860	2,356	24,492	131
Prof. services	908,278	9,365	50,460	520
Administrative	435,749	5,009	24,208	278

Table 3. Belgium: Regressions with Direct Regulatory Effect

	(1)	(2)	(3)	(4)	(5)
	TFP growth	Labor Productivity Growth (VA)	Labor Productivity Growth (Output)	VA growth	Markup
Size (lag value added)	-0.06***	-0.07***	-0.06***	-0.08***	0.00***
Debt to assets	-0.10***	-0.05***	-0.03***	-0.07***	-0.02***
Direct Sectoral Regulation	-0.01***	-0.01***	-0.00***	-0.01***	0.01***
Time Dummies	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes
_cons	1.08***	1.32***	1.02***	1.49***	0.17***
Number of obs.	1,443,501	1,443,501	1,443,501	1,443,501	1,443,501
Number of firms	399,401	399,401	399,401	399,401	399,401
R-sq between	0.02	0.02	0.01	0.02	0.09

Table 4. Belgium: Regressions with Indirect Regulatory Effect

	(1)	(2)	(3)	(4)	(5)
	TFP growth	Labor Productivity Growth (VA)	Labor Productivity Growth (Output)	VA growth	Markup
Size (lag value added)	-0.05***	-0.06***	-0.05***	-0.06***	0.00***
Debt to assets	-0.08***	-0.02***	-0.01***	-0.05***	-0.02***
Indirect regulatory effect	-0.03***	-0.03***	-0.03***	-0.01***	-0.01***
Time Dummies	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes
_cons	0.81***	0.81***	0.81***	1.12***	0.08***
Number of obs.	6,779,865	6,779,865	6,779,865	6,779,865	6,779,865
Number of firms	1,644,206	1,644,206	1,644,206	1,644,206	1,644,206
R-sq between	0.02	0.02	0.02	0.02	0.01

Table 5. Belgium: Regressions with TFP growth as Dependent Variable

	Labor Productivity Growth (Output)
Size (lag value added)	-0.05***
Debt to assets	-0.10***
Direct Sectoral Regulation	-0.01***
Downstream Regulation Spillover	-0.06***
Infrastructure Quality	0.03***
Ageing Workforce	-0.00***
Constant	0.75***
Number of obs.	2,977,397
Number of firms	1,043,826
R-sq	0.06

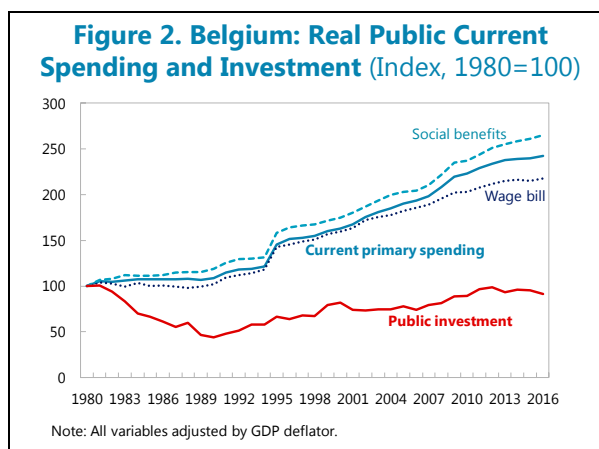
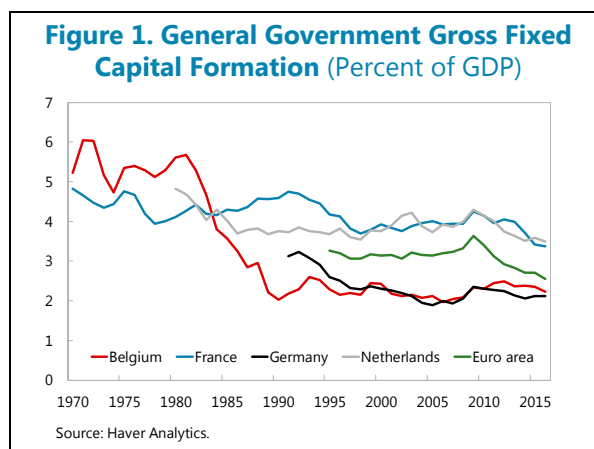
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SIMULATING AN INCREASE IN PUBLIC INVESTMENT IN BELGIUM¹

A. Introduction

1. The share of public investment in GDP has halved since 1970, standing at 2.2 percent—significantly below the average in neighboring countries. This decline is mainly the result of fiscal consolidation efforts in the 1980s that targeted public investment rather than current expenditures and led to a decline in public investment from about 5.7 percent of GDP in 1980 to 2 percent of GDP in 1990 (see Figure 1). Investment as a share of GDP remained broadly constant since then, while France and the Netherlands maintained an investment share roughly twice as large.² The level of government investment in real terms barely recovered from its decline during the fiscal consolidation episode and currently stands roughly at its 1980 volume (see Figure 2). This is in sharp contrast to the evolution of real current spending, which more than doubled since then.

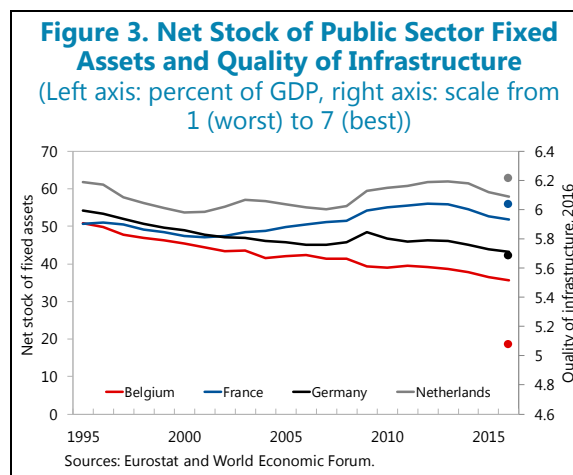


2. The sustained period of low investment witnessed a significant decline in the stock (and quality) of general government fixed assets as a share of GDP, which currently amounts to only 36 percent, compared to 43 percent in Germany, 52 percent in France, and 58 percent in the Netherlands (see Figure 3). These cross-country differences are in line with results of the 2016 World Economic Forum Quality of Infrastructure Survey: On a scale from 1 (worst) to 7 (best), Belgian infrastructure is rated 5.1, while Germany, France and the Netherlands are rated 5.7, 6.0 and 6.2 respectively (indicated in the figure by dots). Transport infrastructure, both rail and road, is notoriously poor and has deteriorated in recent years, with traffic congestion becoming an increasingly serious problem. Since network density is already high, the priority should be on

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² Data shown in Figures 1 and 3 is compiled in accordance with European System of National and Regional Accounts (ESA 2010) rules, in which the definition of general government excludes entities controlled by the government but considered "market producers". The amount of fixed assets held by these entities may differ across countries. Hence, the picture presented here may not reflect the evolution of fixed assets of the broader public sector. There is no directly available data based on a more comprehensive definition of the government.

maintenance and efficiency improvement. Regarding energy infrastructure (proxied by the “Quality of electricity supply” indicator in the World Economic Forum 2017–18 Global Competitiveness Ranking), Belgium ranks 6.5, which is slightly below the Netherlands and France (both 6.8), but before Germany (6.2). The subpar state of Belgium’s public capital stock was flagged by the National Bank of Belgium (NBB, 2016), the Federal Planning Bureau (FPB, 2017), and the European Commission (EC, 2017). On a global level, IMF (2014) reports that the stock of public capital as a share of GDP has declined significantly over the past three decades in advanced, emerging market, and developing economies.



3. The literature suggests that public investment can have important short and long run effects on growth. The elasticity of private output with respect to public capital has been studied extensively, but no consensus on its size has emerged. The literature can be divided into studies with a narrow focus on the impact of public capital on the production process and studies with a broader focus on the dynamic relationship between public investment and output. The former strand of literature typically estimates a production function augmented by the stock of public (infrastructure) capital as an additional input factor. Estimation results are dispersed over a wide range as they differ across data sets and estimation techniques.³ The meta-study Bom and Ligthart (2014) analyzes 68 papers published between 1983 and 2008 and finds that the average elasticity for core capital installed at the national level is 0.131 in the short run and 0.17 in the long run. Although this elasticity is crucial to quantify the benefit from public capital, it does not inform policymakers about general-equilibrium feedback effects caused by a change in public investment. For example, it does not speak about the differential impact on output of alternative options to fund public investment, e.g. spending cuts, revenue mobilization or the issuance of debt. Empirical studies in the second strand of literature do not suffer from this shortcoming as they employ Vector Autoregressive (VAR) models that capture general-equilibrium effects.⁴ Evidence from these studies is mixed, but generally points towards a positive impact of public investment on output. Theoretical structural general-equilibrium models are a widely-used alternative to study the dynamic relationship between public investment and output, with Baxter and King (1993) being an early example. While general-equilibrium models typically generate an output expansion in the short and long run in response to higher (productive) public investment, Leeper and others (2010) present a model that can produce a negative short-run output response. A common approach—which is also adopted in this chapter—is to incorporate results from the estimation of a production function into the calibration of a model and simulate the implications of an exogenous change in public investment. Elekdag and Muir (2014) is an example that employs the same model as this chapter to study higher public investment in Germany.

³ See European Commission (2014) for a recent survey.

⁴ See Kamps (2005), Jong-A-Pin and De Haan (2008), Broyer and Gareis (2013), IMF (2014), and ECB (2017) for examples.

4. Relative to the existing literature on public investment in Belgium, this chapter adds the analysis of a comprehensive shift from current spending to public investment in IMF's GIMF model. The September 2016 Economic Review by the National Bank of Belgium discusses an increase in public investment and draws in parts on results from the ECB's EAGLE model calibrated to a representative advanced economy. The Federal Planning Bureau published in 2017 a thorough model analysis on public investment, based on the OECD's QUEST model. A permanent increase in public investment by 0.5 percent of GDP leads to a 2.77 percent increase in output after twenty years. The study differs from this chapter in that it focuses on an investment program that is debt-financed in the short and medium term (the initial debt ratio is only restored in the long run via tax adjustments) instead of a shift from current spending towards public investment.⁵ It also uses a different model⁶ and considers a different policy experiment (we analyze a frontloaded investment boost to reach a capital stock target, whereas FPB (2017) simulates a permanent investment increase leading to comparably slow capital stock growth).

B. Model Details

5. We use the IMF's Global Integrated Monetary and Fiscal Model (GIMF) to simulate an illustrative policy exercise of increasing public investment in transport infrastructure.⁷ The large-scale multi-country dynamic stochastic general equilibrium (DSGE) model GIMF is widely used inside the IMF and at several central banks. Frictions in the form of sticky prices and wages, real adjustment costs, liquidity-constrained households, and households with a finite planning horizon imply an important role for monetary and fiscal policy in economic stabilization. The model also features a financial accelerator, trade in consumption, investment and intermediate goods as well as a public and private capital stock. The public capital stock is an input in the production process (technically, it governs total factor productivity in the production of final goods) and can be interpreted as transport infrastructure. Government expenditure is split between investment in the public capital stock, unproductive consumption, and transfers to households. This analysis uses a three-country variant of GIMF, in which Belgium and the rest of the Eurozone are modelled as two countries in a monetary union, while a third country represents the rest of the world. The model is well suited to analyze an increase in public investment as it accounts for possible short-run demand effects as well as for long-run implications of a higher public capital stock for the supply side. A detailed description of the model is given in Laxton and others (2010).

⁵ FPB (2017) considers a budget-neutral expenditure shift as an alternative funding scenario but does not discuss it in detail.

⁶ While GIMF is more detailed than QUEST III (GIMF features, for example, overlapping-generation households and a financial accelerator mechanism), the basic structure of both models is very similar.

⁷ Transport infrastructure is a main constraint holding back productivity growth (see for example EC, 2017). However, there are also large investment needs in other areas, as for example education and energy infrastructure.

6. The model is calibrated using Belgian macroeconomic data.⁸ Table 1 shows key structural parameters as well as the government's initial fiscal position.

- A crucial parameter for the long-run impact of public investment is the elasticity of total factor productivity (TFP) in the production of final goods with respect to the public capital stock. The used value of 0.1 is a standard parameter at the IMF for advanced economies. The model's long-run elasticity of output with respect to public capital—which is determined in general equilibrium and thus depends on all parameters and the model structure—is 0.14, which is broadly in line with the results of Bom and Ligthart (2014).

<i>Variable</i>	<i>Value</i>
<i>Initial fiscal position:</i>	
Government debt (percent of GDP)	106
Initial government investment (percent of GDP)	2.2
Initial public capital stock (percent of GDP)	36
<i>Structural parameters:</i>	
Weight in Taylor Rule	3.8%
Elasticity of TFP in the production of final goods w.r.t. public capital stock	0.1
Imports (=exports in steady state), % of nominal GDP	81.5
Elasticity of substitution between domestic and foreign goods (in all countries)	1.5
Share of liquidity-constrained households	0.25
Efficiency of public investment	100%
Annual depreciation of rate public capital	4%
Annual population growth rate	0.4%

- In the model's steady state, total imports amount to 81.5 percent of GDP and equal total exports as steady state trade is balanced. Belgium is assumed to import final consumption goods, intermediate goods, and investment goods, and to export universal final goods and intermediate goods. The breakdown of total imports and total exports across those categories reflects data from the U.N. Statistics Division (UNSD) COMTRADE database.
- The empirical literature shows a wide range of estimates for the elasticity of substitution between domestic and foreign goods, which is assumed to be the same across the three countries in the model. Feenstra et al. (2012) find that the micro elasticity (substitution between different import suppliers) between domestic and foreign goods is 3, whereas the macro elasticity (substitution between domestic production and imports) does not significantly differ from unity. The used value of 1.5 is conservative in the sense that it is below the average of both estimates.
- The annual population growth rate of 0.4 percent corresponds to the Belgian average since 1960.
- The remaining parameters are standard values used in the literature.⁹ Paragraph 15 varies the elasticity of TFP in the production of final goods w.r.t. the public capital stock, and the share of liquidity-constrained households.

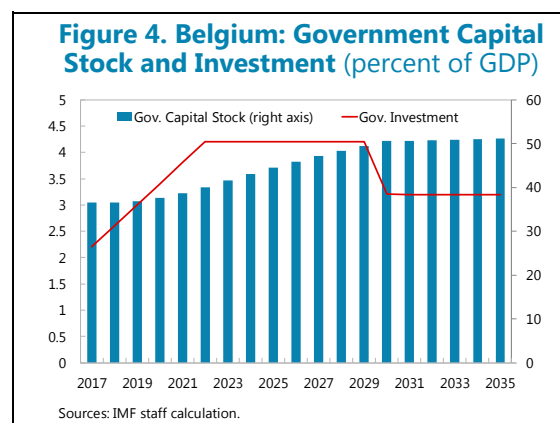
⁸ While the model is comparatively detailed, it remains stylized and does not capture all relevant country-specific factors, including the very high import content of exports in Belgium (and the importance of transit trade). As discussed below, this can have significant implications regarding the magnitude of model-implied effects.

⁹ Simulating the standardized experiment of a two-year, 1 percent of GDP per year debt-financed increase in public investment allows for a comparison with other studies. Under this calibration, the experiment raises output by 0.72 percent after one year (the peak response), and by 0.64 percent after five years (the adjustment is not shown). This is a weaker adjustment than Elekdag and Muir (2014) report for Germany (about 1.1 and 0.72 percent after one and five years respectively, under monetary accommodation). The weaker short-run adjustment can be explained by Germany's significantly smaller import share, which implies weaker import leakages of the stimulus. The medium-term adjustment is broadly in line as it is strongly influenced by the Elasticity of TFP in the production of final goods w.r.t. public capital stock, which is the same as in the calibration at hand.

C. Policy Experiments

7. We simulate a gradual increase in public investment that brings the capital stock back to the levels seen in the 1990s, in line with the average of neighboring countries.

Government investment initially stands at 2.2 percent of GDP and increases by 0.4 percent for 5 subsequent years, reaching 4.2 percent in 2022 (see Figure 4). From 2022 onwards it is kept constant at 4.2 percent of GDP for seven years. Under the assumptions for capital depreciation, population growth and technology growth, this period of high public investment causes the public capital stock to increase gradually from 36 percent of GDP initially to 51 percent by 2029. A public capital stock of 51 percent of GDP is the (unweighted) average in France, Germany and the Netherlands, and corresponds to the size it had in Belgium in 1995. In the long run, public investment of 3.2 percent of GDP stabilizes this level.¹⁰



8. This chapter studies the model-implied dynamic impact over time of the described surge in public investment under three different assumptions on the source of its funding.

The first is a budget-neutral expenditure-shift from public *consumption* to public investment. The underlying assumption is that lower public consumption is achieved through efficiency-oriented spending reforms, such that the scope and quality of public services are not significantly affected. In the model this assumption reflects in the fact that lowering public consumption reduces aggregate demand, but has no direct implications for households. The second policy scenario achieves expenditure-neutrality by cutting *transfers* to households instead of government consumption. The third scenarios abandons budgetary neutrality and assumes that the surge in investment is financed by issuing government *debt*. We do not simulate an increase in taxes to fund additional investment, as taxes are already high in Belgium. Note that the first scenario should be thought of as a stylized benchmark, as it is an extreme assumption that efficiency gains allow for a reduction of government spending by 2 percent of GDP without reducing the wage bill or pensions of civil servants (which would directly affect household income).¹¹ The adjustment to a more realistic expenditure shift away from government consumption *and* transfers would be a convex combination of the results obtained from the first and second scenario, with weights corresponding to the relative size of the consumption and transfer reduction.

9. The simulated boost in public investment exceeds existing or planned investment programs.

On the European level, the Investment Plan for Europe (or “Juncker Plan”) aims at the recovery of investment projects that have been neglected since the financial crisis. The Federal

¹⁰ Higher long-run investment (3.2 instead of 2.2 percent of GDP) is required to offset increased depreciation in absolute terms.

¹¹ While IMF (2016) argues that there is significant room for efficiency improvements in the public sector, government purchases on goods and services stand at 4 percent of GDP in Belgium, which would have to be halved.

Planning Bureau (2017) reckons that annual infrastructure investment will amount to about 0.57 percent of GDP, assuming the completion of all eligible projects will take 15 years. On a national level, the National Pact for Strategic Investment launched by Prime Minister Michel aims to unlock 60 billion euro in investment in key strategic sectors (including energy, security, transport and the digital economy) over 2017 to 2030. The total annual investment volume amounts to about 1.1 percent of GDP. However, not all projects covered by these two investment plans are new and/or count towards the public capital stock as defined by ESA2010 rules. The investment programme outlined in the previous paragraph is significantly more comprehensive, with an increase in public investment reaching 2 percent of GDP at its peak. Scaled-down versions of the policy experiments—which might be more realistic in the face of limited fiscal space—would lead to a proportionally weaker adjustment under the model.¹²

10. The model analysis tries to shed light on the following questions:

- What are the longer-run potential gains from aligning Belgium’s public capital stock with its peer countries, or, conversely, what have been the macroeconomic costs of the past underinvestment?
- How would the Belgian economy adjust to higher public investment in the short- and medium-run? What are the main channels of transmission?
- How does the funding of public investment (expenditure shift versus debt financing) affect dynamic and long-run results?

D. Simulation Results

11. An expenditure-neutral shift from public consumption towards public investment improves the trade balance and increases output, private consumption, and investment (see Figure 5).¹³ The expenditure shift has no immediate impact on aggregate demand (higher investment is compensated by lower consumption), but the induced increase in the public capital stock gradually raises productivity in the private sector.¹⁴ This reduces production costs and leads to a sustained period of declining prices (see Figure 6).¹⁵ Lower prices imply an increase in the real interest rate because the union-wide nominal rate is effectively constant. Private consumption increases from the beginning despite a higher real interest rate as the model assumes that a share of households is forward-looking and anticipates a boost in permanent income, which dominates

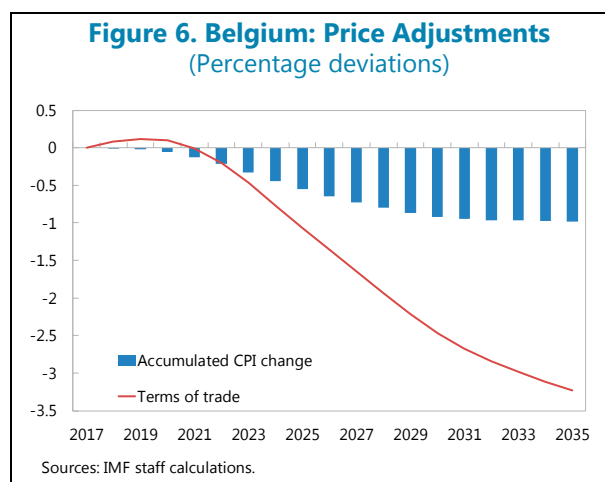
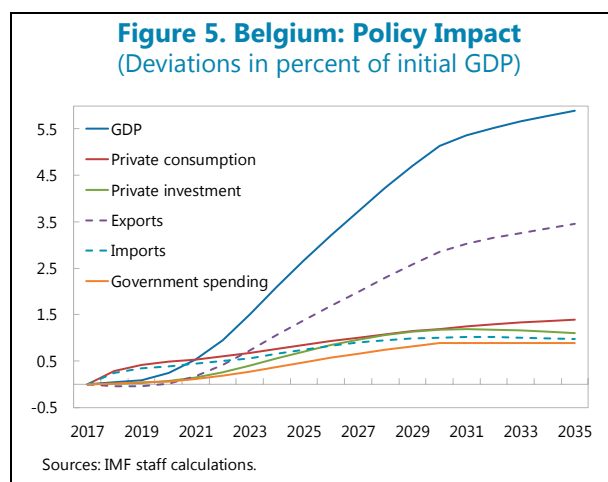
¹² The model is linear in its approximation around the steady state.

¹³ The graph shows rising government spending because it is constant as a share of current GDP and thus increasing as a share of initial GDP.

¹⁴ The public capital stock can be thought of as an input into the production process that is free of charge. An increase thus allows to produce more output for a given amount of labor and capital, or, equivalently, to produce a given output at lower production costs.

¹⁵ Figure 6 shows the average terms of trade of intermediate goods and final goods, weighted by their steady-state share in total exports. The deterioration is particularly strong for final goods, reflecting the model assumption that a higher stock of infrastructure capital increases total factor productivity in the production of final goods (which takes imported intermediate goods as input), implying lower production costs and export prices. The decline in consumer prices is less pronounced because of imported consumer goods.

the substitution effect. Given higher consumption, the trade balance contributes negatively to aggregate demand in the early years, but net exports become an important driver of output growth after 2023. The reason is that the terms of trade deteriorate gradually over the course of the buildup of the capital stock—as each increase in public capital is associated with higher productivity, lower production costs and thereby reduced prices. Investment expands because improved firm profitability resulting from the output expansion reduces their default risk and thereby premiums, which lowers funding costs. Overall, the expenditure shift increases output by 5.9 percent by 2035.¹⁶ This long-run impact is well in line with the results from FPB (2017), who find that increasing public investment by 0.5 percent of GDP in the long run (instead of 1 percent as in this exercise) raises output by 2.77 percent. However, the magnitude of the growth impact should be treated with caution given country-specific characteristics that were not modeled. In particular, the high import content of exports implies that the export channel could be significantly less pronounced in practice than modeled here.¹⁷

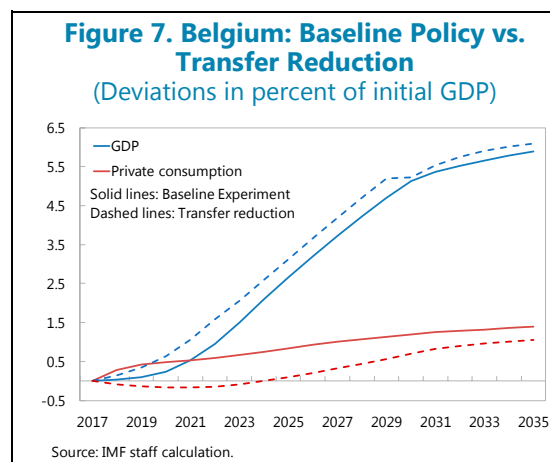


12. An expenditure shift from transfers (instead of public consumption) towards investment causes a somewhat stronger and timelier increase in GDP (see Figure 7). The reason is that the decline of private consumption in response to reduced transfers (in this scenario) has a weaker adverse impact on aggregate demand than the reduction in government consumption in the baseline experiment. A reduction in government consumption directly lowers aggregate demand to its full extent, while a reduction in transfers affects aggregate demand only indirectly via the adjustment of consumption. The transmission of a transfer-reduction into lower consumption, however, is mitigated by consumption smoothing of intertemporally optimizing overlapping-generation households. From a broader perspective the policy reallocates resources from the private sector to the public sector, as tax revenues that were being paid back to households before the expenditure-shift are now being used for public investment. In contrast to the baseline policy in

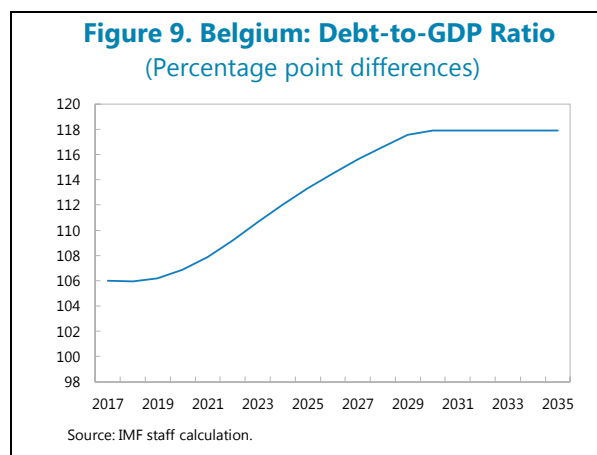
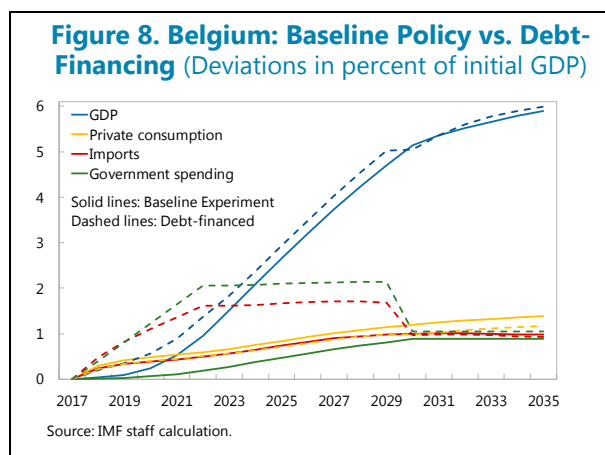
¹⁶ This implies a long-run elasticity of output with respect to public capital of 0.14 (the public capital stock increases by about 41 percent relative to its initial value). Throughout the exercise, additional tax revenues stemming from the growing tax base are paid to households as non-distortionary transfers.

¹⁷ Belgium has a comparatively high share of re-exports and transit trade in total trade.

which government consumption declines to make room for additional investment, it is now private consumption that takes the hit. Without taking a stand on the difference that this makes for household utility, the stronger GDP expansion in this scenario is not sufficient to infer a normative ranking of both policies.¹⁸ The implications of the increased public capital stock are the same in both scenarios and are therefore not discussed in this paragraph.¹⁹ As in the baseline scenario, additional tax revenues are paid out as transfers (mitigating the transfer reduction).



13. A debt-financed increase in public investment leads to a stronger increase in GDP than the baseline experiment. The increase in public investment is now funded by the issuance of government debt.²⁰ Figure 8 compares the adjustment under this scenario (dashed lines) with the adjustment under the baseline scenario (solid lines). Government spending now mimics the path of public investment because there is no offsetting decline in another government spending item. GDP growth is only slightly stronger than in the baseline scenario, which is surprising given that the surge in investment is debt-financed fiscal stimulus. The main reason for the muted impact is that Belgium is a small open economy with a high import share, so additional demand from higher government investment leaks to a considerable extent to foreign countries. Private consumption growth contributes less to GDP growth than in the baseline scenario, mainly because additional government debt increases the present value of interest costs and thereby reduces overlapping generation households' total wealth.



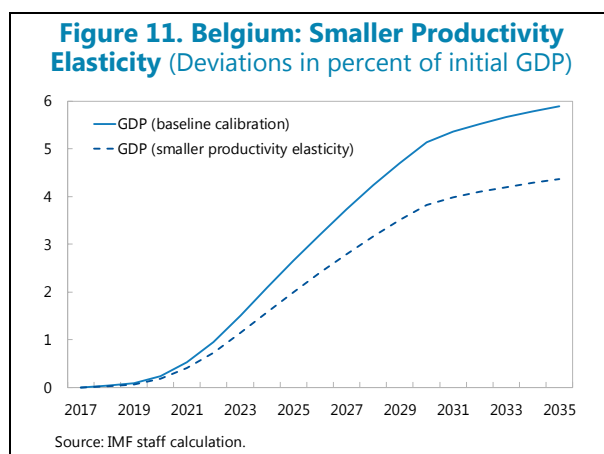
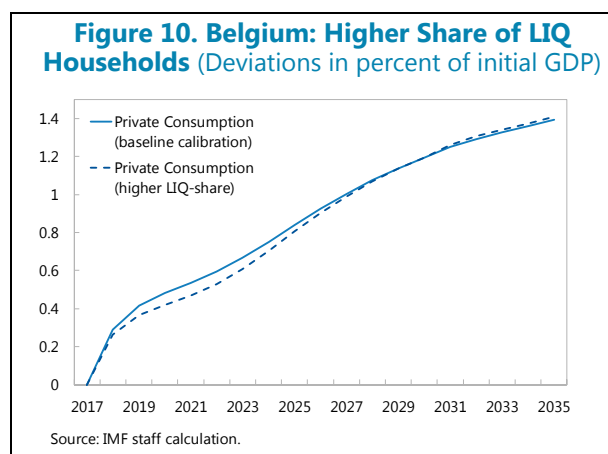
¹⁸ The baseline policy is preferable if the decline in government consumption is achieved via efficiency improvements that do not reduce household utility.

¹⁹ The evolution of the public capital stock is determined by the change in public investment, which is identical across all considered policy scenarios.

²⁰ It is assumed that government bond yields remain constant, which abstracts from possible adverse feedback from higher debt to higher interest rates. However, during the sovereign-debt crisis, government bond spreads proved to be very resilient for a highly indebted country.

14. The growth effect of debt-financed public investment only implies a mild containment in the increase of debt-to-GDP. Figure 9 shows the debt-to-GDP ratio, which increases by 13 percentage points from 106 percent of GDP initially to 118 percent by 2030. The degree of self-financing of the additional investment (in the sense that the induced output expansion partially offsets higher debt in the debt-to-GDP ratio) is very limited: The additional debt burden corresponds to 15 percent of initial GDP, so the triggered output growth reduces debt-to-GDP by only 3 percentage points—which is not surprising for an empirically plausible elasticity of output with respect to public capital.²¹ The reduction in prices caused by the productivity gain contributes to the increasing debt ratio as it elevates the real value of nominal debt. In this scenario, additional tax revenues are used to relax the government surplus required for the given path of public investment.

15. To test the robustness of the results, the expenditure shift from government consumption towards public investment is analyzed under two variations of the calibration. Increasing the share of liquidity-constrained agents from 0.25 to 0.5 has only minor implications for the adjustment of private consumption (see Figure 10). The short-run increase is mildly weaker because it is overlapping-generation households who front-load their consumption response, and these agents now have a smaller weight in the population. The difference in the consumption adjustment is too small to make a noteworthy difference in the overall GDP adjustment. Lowering the elasticity of total factor productivity in the production of final goods with respect to the public capital stock from 0.1 to 0.075 implies a proportional down-scaling of the adjustment of all macroeconomic aggregates (Figure 11 only shows GDP). Since the policy has no direct impact on aggregate demand the adjustment is entirely driven by its impact on productivity, which is muted



²¹ As simplified numerical example, consider public debt and the public per-capita capital stock to stand at 106 and 36 percent of GDP respectively, and abstract from interest costs, population growth and capital depreciation. Holding GDP constant, debt-financed public investment of one percent of GDP would add one percentage point to the long-run debt level, which increases the numerator of the debt-to-GDP ratio by $1\%/106\%=0.94\%$. To take GDP growth into account, note that the additional investment adds one percentage point to the long-run per-capita capital stock, which is an increase of $1\%/36\%=2.8\%$. Assuming a long-run output elasticity w.r.t. public capital of 0.2 (which is above the average estimate reported in Bom and Ligthart, 2014), GDP increases by $2.8\%*0.2=0.56\%$. The debt-to-GDP ratio rises as the numerator grows by more than the denominator. If we accounted for interest costs, population growth and depreciation, debt-to-GDP would increase by more because debt-financed investment would expand long-run debt by more than 1-to-1 while it would increase long-run per-capita capital by less than 1-to-1.

under this alternative calibration. While the overall strength of the adjustment depends mechanically on this key parameter, the purpose of this chapter is to shed light on the policy's transmission channels and its impact on different macroeconomic aggregates.

E. Conclusion

16. The analysis suggests that large output gains can be unlocked by increasing public investment in Belgium. General government fixed assets are significantly smaller as a share of GDP than in peer countries, which is the result of neglecting public investment since the 1980s. This chapter employs the large-scale DSGE model GIMF to study the macroeconomic implications of a shift from current to investment spending at such a scale that rebuilds the public capital stock from 36 percent of GDP to 51 percent (its average size in neighboring countries) over the course of 12 years. Based on this gradual expenditure shift, which peaks at 2 percent of GDP after five years, the model predicts a gradual increase in GDP reaching around 6 percent cumulatively in the long run. At the root of this adjustment is an improvement in productivity, which lowers prices and thereby reduces the terms of trade, leading to a surge in exports. Private consumption and investment pick up as a result of the expansion. The results are broadly similar for financing the boost to public investment through reductions in public consumption or transfers, while a debt-financed investment program would have significant adverse implications for the debt-to-GDP ratio. While the magnitude of the growth impact is broadly in line with similar simulations using DSGE models, it should be interpreted with caution in the Belgian case, given country-specific characteristics that were not modeled.

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