

# Has the crisis altered the Belgian economy's DNA ?

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## Introduction

Owing to the development of information and communication technologies combined with the integration of new economies into global trade, production processes nowadays are fragmented<sup>(2)</sup>. Instead of operating self-sufficiently, managing all the successive production phases themselves, firms make extensive use of outsourcing, obtaining intermediate goods and services from other companies. Typically, some specialise in providing services – such as accounting, transport, marketing, etc. – for third parties while others specialise in producing intermediate goods or components<sup>(3)</sup>. They do not necessarily aim to make a final product for the end user, but instead form a link in the production chain. Today, an economy's production capacity therefore comprises a real network of interlinked firms. That network is not confined within national borders. Firms establish many buying and selling relationships with partners in other countries, especially in a small open economy like Belgium.

Various indicators relevant at the level of the firm can be used to describe this fragmentation of production. Among them, the concept of the *total length* of the production chain to which a firm belongs indicates the number of successive firms involved in making the end product. In addition, each firm is distinguished by its

*position* in a production chain. This second concept gauges whether a firm specialises in the initial production phases or, conversely, in the final stage that delivers the final product. Hitherto, economic analysis had taken very little notice of these dimensions, but they are now beginning to attract attention in the economic world, partly as a result of the recent publication of macroeconomic data linking the output of various branches of activity located in different countries. On the basis of that research, and by applying the principles of input-output analysis<sup>(4)</sup> to an original microeconomic database, this article presents a new way of understanding the operation of the Belgian economy and draws some initial lessons, notably in regard to the recent crisis.

In practice, the analysis reveals that Belgian firms generally form part of relatively long production chains. In addition, the Belgian economy specialises in production segments at a relatively early stage in the production process. On average, the goods and services produced in Belgium are therefore relatively distant from the end user. There are two combined effects here: (i) the branches of activity that tend to be involved in the initial production stages, such as chemicals, metallurgy and certain business services, are relatively predominant in Belgium, and (ii) compared to firms of other European countries belonging to the same branches of activity, Belgian firms generally specialise in the initial production stages, the goods or services produced then undergoing subsequent processing before being sold to the end user.

In regard to economic performance, the econometric analysis presented in this article establishes that, during the period 2002-2011, the fragmentation of the

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(2) See Baldwin (2012) for more information on this subject.

(3) See Kraemer *et al.* (2011), who illustrate the iPhone and iPad production chain.

(4) See Johnson (2014) for a survey of the literature on value added trade, calculated on the basis of the input-output tables, and Duprez (2014) for an illustration of the situation in Belgium.

production processes was beneficial overall to Belgian firms, as the fastest growing firms are the ones which succeeded in securing a place in the longest production chains. However, the ones that benefited the most are those at the end of the chain, i.e. close to the end user. Fragmentation and proximity to the consumer therefore appear to be determinants of economic performance.

However, the fragmentation process came to a halt during the economic crisis. In Belgium, the crisis caused the production network to shrink. Transactions by new firms did not fully offset the destruction of businesses or existing economic links. Within the Belgian network, the most vulnerable firms were essentially small businesses with low productivity, specialising in the initial production phases.

This article is structured as follows. The concepts, data and methodology used are presented in sections 1.1 and 1.2. Sections 1.3 and 1.4 look at the economy from the interconnections angle in order to illustrate the specific characteristics of the Belgian economic fabric and to describe its economic performance. Section 2 describes the economic crisis and its repercussions. The article ends with some concluding remarks.

(1) Possibly after processing.

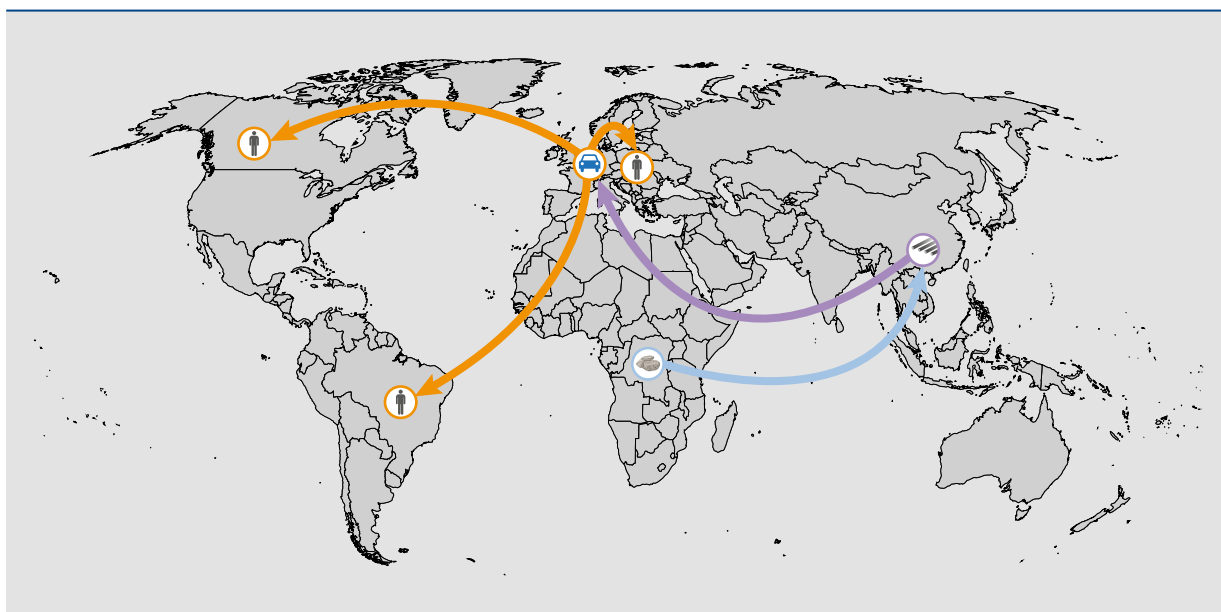
## 1. The Belgian economy's DNA

### 1.1 The Belgian economy as a production network

Like other advanced economies, Belgium has a fragmented production system. The manufacture of an end product involves a number of firms making successive contributions. Here, attention focuses on two of the various indicators relevant at the firm level which can describe this fragmentation of production. The first measures the total length of the production chain, and the second gauges the relative position of a firm in that chain.

Two measures of distance are necessary to construct these two indicators. The first assesses a firm's proximity to the end user, by counting the number of production stages still to be completed before the final product is sold to the consumer<sup>(1)</sup>. The second determines the number of production / processing stages already completed upstream of the firm. The sum of these two distances gives the total length of the production chain to which the firm belongs. The ratio between the two indicates the firm's relative position. To avoid any confusion, it should first be made clear that these distance measures are based solely on the number of different firms involved consecutively in the production and are not based on any geographical criterion concerning the distance in kilometres between these production units.

CHART 1 SIMPLIFIED EXAMPLE OF AN INTERNATIONAL PRODUCTION CHAIN



Source : NBB.

Chart 1 illustrates the concepts with the aid of an imaginary, simplified example of a production chain in the motor vehicle industry. Let us assume that car manufacturing in Belgium uses steel from China which is itself made from iron ore extracted in Congo. In this international car manufacturing chain comprising three links, the Belgian vehicle assembly firm is close to the consumer, the Chinese iron and steel industry occupies an intermediate segment, and mineral extraction in Congo is at the head of the chain. By definition, firms remote from the end user specialise in the initial phases of the production process. At the other end of the chain are firms specialising in product assembly and sales.

In reality, the organisation of production chains is far more complex. Firms are generally involved in more than one chain. For example, a tyre manufacturer may sell part of its output via the motor vehicle industry or the mass marketing sector. It may also sell its products directly to consumers via its website. This firm therefore satisfies final demand via three channels, namely the motor vehicle industry, the retail sector and direct sales. The length of the production chain in which this firm operates and

its relative proximity to the consumer will depend on the relative importance of these three channels<sup>(1)</sup>.

## 1.2 The data

The various indicators presented in section 1.1 are generally calculated at sectoral level on the basis of the input-output matrix data published by statistical institutes (see Antras *et al.*, 2012; Fally, 2012). However, it is also possible to obtain a more detailed assessment at the firm level. For that purpose, three data sources were used.

The main data source consists of the individual firms' declarations to the tax authorities, and in particular the annual declaration of all transactions between firms (the "customer" file). For each VAT declarant, these declarations list all transactions effected with other parties liable for VAT<sup>(2)</sup>. Together, these declarations provide a comprehensive picture of trading between Belgian firms, information which in turn permits the reconstruction of domestic production chains. These data, available for the period 2002-2012, were cross-checked against those from the Central Balance Sheet Office to ensure that the set of VAT declarants comprised only firms for which accounting data were also available. In 2012, the network thus obtained covered 250 000 firms for which almost 8.7 million trade transactions were observed.

(1) Proportionality is therefore the prevailing hypothesis here. While that is probably acceptable at firm level, it is much more debatable at the level of the branch of activity. Nevertheless, it forms the basis of the measures established using the input-output tables.

(2) That database is described by Dhyne, Magerman and Rubinova (2015).

### Box 1 – Measures of the fragmentation of production chains and of the relative position of firms in global value chains

In general, the average length of production chains is measured by the sum of an indicator of distance from the end use, or upstreamness, and an indicator of distance from the initial creation of value added, or downstreamness. Although these measures are presented here at the level of the firm, they apply equally at the level of branches of activity if the only available data are sectoral.

The first measure (upstreamness) is based on the output ( $Y_i$ ) of a firm  $i$  broken down into the total of intermediate supplies to other firms ( $\sum_j F_{ij}$ ) and sales to meet final demand ( $FD_i$ ):

$$Y_i = \sum_{j=1}^n F_{ij} + FD_i \quad \forall i = 1, \dots, n$$

If we express intermediate supplies to other firms as part of the output of those firms, we get the following formula:

$$Y_i = \sum_{j=1}^n d_{ij} Y_j + FD_i \quad \forall i = 1, \dots, n$$



Since the output of firms  $j$  can in turn be sub-divided into intermediate supplies and final demand, firm  $i$  in fact serves final demand directly via its own sales and indirectly by supplying other firms. Antras *et al.* (2012) define the average distance separating firm  $i$  from final demand as the average number of processing operations that goods produced by firm  $i$  undergo before reaching the end user. That distance is designated by the variable  $U_i$  defined as follows:

$$U_i = 1 \times \frac{FD_i}{Y_i} + 2 \times \sum_{j=1}^n d_{ij} \frac{FD_j}{Y_i} + 3 \times \sum_{j=1}^n \sum_{k=1}^n d_{ij} d_{jk} \frac{FD_k}{Y_i} + 4 \times \sum_{j=1}^n \sum_{k=1}^n \sum_{l=1}^n d_{ij} d_{jk} d_{kl} \frac{FD_l}{Y_i} + \dots$$

The first term of this expression represents the share of firm  $i$ 's output destined directly for final demand. The second term expresses the share of  $i$ 's output which goes to meet final demand after only one additional processing by other firms. That share is multiplied by the factor 2 because two transactions are needed for that part of  $i$ 's output to reach final demand, with  $i$  selling to  $j$ , and  $j$  selling to final demand. By the same logic, the third term represents the share of  $i$ 's output that reaches final demand after two additional processing operations. That term is multiplied by a factor 3 because three transactions are needed for  $i$ 's output to reach final demand via that channel. The subsequent terms of the expression represent the share of output that undergoes yet more additional operations.

The second measure (downstreamness) is based on an alternative breakdown of output  $Y_i$  into the sum of purchases of intermediate inputs ( $\sum_j F_{ji}$ ) from other firms plus the creation of value added by the firm itself ( $VA_i$ ):

$$Y_i = \sum_{j=1}^n F_{ji} + VA_i \quad \forall i = 1, \dots, n$$

If purchases of intermediate inputs from other firms are expressed as a share of the output of those firms, we can state that:

$$Y_i = \sum_{j=1}^n \delta_{ji} Y_j + VA_i \quad \forall i = 1, \dots, n$$

This expression reveals the average number of processing operations applied to the various amounts of value added embodied in the output of firm  $i$ . That measure is denoted by the variable  $D_i$  defined as follows:

$$D_i = 1 \times \frac{VA_i}{Y_i} + 2 \times \sum_{j=1}^n \delta_{ji} \frac{VA_j}{Y_i} + 3 \times \sum_{k=1}^n \sum_{j=1}^n \delta_{kj} \delta_{ji} \frac{VA_k}{Y_i} + 4 \times \sum_{l=1}^n \sum_{k=1}^n \sum_{j=1}^n \delta_{lk} \delta_{kj} \delta_{ji} \frac{VA_l}{Y_i} + \dots$$

In this expression, the various amounts of value added, weighted in proportion to their share of the inputs of firm  $i$ , were multiplied by the respective number of processing operations which they have already undergone.

To sum up, the variables  $U_i$  and  $D_i$  represent respectively the average number of processing operations upstream and downstream of firm  $i$ . The average length of the production chains in which firm  $i$  participates is given by:

$$L_i = U_i + D_i - 1$$

Since  $U_i$  and  $D_i$  have a minimum value of 1, by subtracting 1 from the sum of the two variables, we can standardise the shorter length at 1. The relative position of firm  $i$  in the production chains is obtained by:

$$x_i = \frac{D_i - 0.5}{L_i}$$

A value for  $x_i$  close to 0 indicates that the firm is at an initial production stage, while a value close to 1 shows that it is at the end of the production chain.

Individual information on imports and exports was added to this first data source<sup>(1)</sup>. These data identify importers and exporters and the amounts concerned per partner country. Importers and exporters play a particularly significant role in global value chains in that they link the domestic production network to the rest of the world.

Ideally, in order to describe the global production network, we need data on all transactions between firms throughout the world, but such a database is not available. To determine whether a product or service exported by a Belgian firm is consumed directly by a foreign consumer, or whether – conversely – it undergoes additional processing in branches of activity located outside Belgium, and if so, the number of those processing operations, the macroeconomic data from the World Input-Output Database<sup>(2)</sup> (WIOD) were used. Those data provide an annual assessment of all national and international transactions between firms in 40 countries divided into 35 branches of activity. These annual world input-output tables are available for the period 1995-2011. On the basis of the WIOD data and taking account of the branch of activity to which the Belgian exporter belongs and the countries to which that firm exports, the international part of the production chain was estimated and added to its domestic component. A similar exercise was conducted for imports. The number of prior upstream processing operations undergone by imported products was also estimated, and that component was likewise taken into account in measuring the total length of the production chains.

In order to establish complete chains with a domestic component and an international component, the analysis was confined to the period 2002-2011, for which the three data sources are available. That approach permits the most detailed possible assessment of the degree of fragmentation of the production chains at the firm level. In many respects, the data on transactions between Belgian companies can be regarded as an input-output table at the firm level. However, unlike the latter, they cannot distinguish between intermediate inputs and investment goods. In the national accounts, investment goods are a component of final demand, not intermediate consumption. The data on transactions between firms therefore create a downward bias in the value added of firms that invest<sup>(3)</sup>.

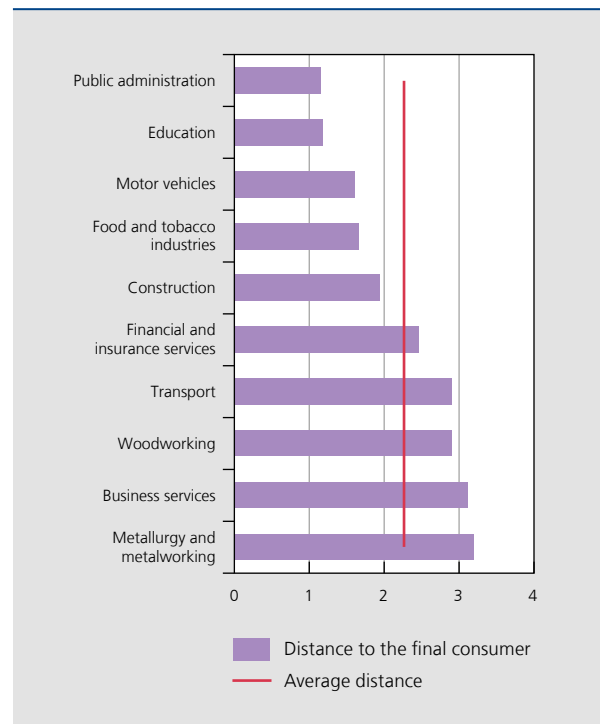
(1) The individual information on foreign trade comes from the Intrastat declarations for intra-EU trade and from the customs declarations for the extra-EU trade.  
 (2) For more information, see Dietzenbacher *et al.* (2013) and Timmer *et al.* (2015). To construct the WIOD data, the national input-output tables were amalgamated in a global matrix. Adjustments were made in order to rectify inconsistencies, notably asymmetries between the exports reported by a country and the corresponding imports reported by the partner country. Those adjustments create discrepancies in relation to the WIOD data and the official national accounts and foreign trade statistics.  
 (3) Another conceptual difference in relation to the input-output tables is that the latter are drawn up per homogenised product whereas the data per branch of activity are heterogeneous by nature.

### 1.3 Fragmentation and positioning of the Belgian economy in global value chains

As well as providing supplementary information to establish the international component of the production chains involving Belgian firms, the WIOD macroeconomic data are also useful for the purposes of an international comparison of production chains.

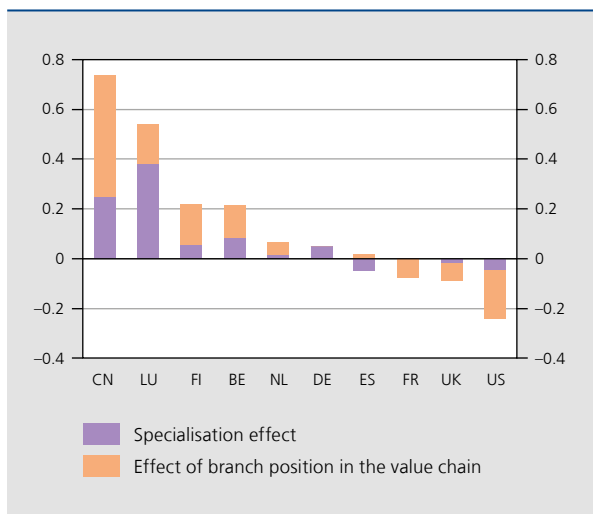
First, it is worth mentioning that the distance from firm to consumer depends partly on the branch of activity to which the firm belongs. Typically, public services are aimed at end users, namely the residents receiving the services. Conversely, some business services such as accounting, engineering and architectural services, are often located upstream of the production chains because most of them are provided for third companies which produce their own goods or services. While industry taken as a whole occupies an intermediate segment, certain specific branches such as iron and steel and woodworking are located further up in the chain. Their products will pass through a number of intermediate stages before being sold to the consumer, often in a different form. By weighting by the relative importance

**CHART 2**      **SECTORAL COMPARISON OF THE DISTANCE TO THE CONSUMER**  
 (average per branch of activity<sup>(1)</sup> in Belgium, 2011)



Source: NBB calculations based on the WIOD.  
 (1) Selection out of 35 branches of activity defined according to the NACE classification 2003.

**CHART 3** INTERNATIONAL COMPARISON OF DISTANCE TO THE CONSUMER<sup>(1)</sup>  
(deviation from the EU15 average)



Source: NBB calculations based on the WIOD.

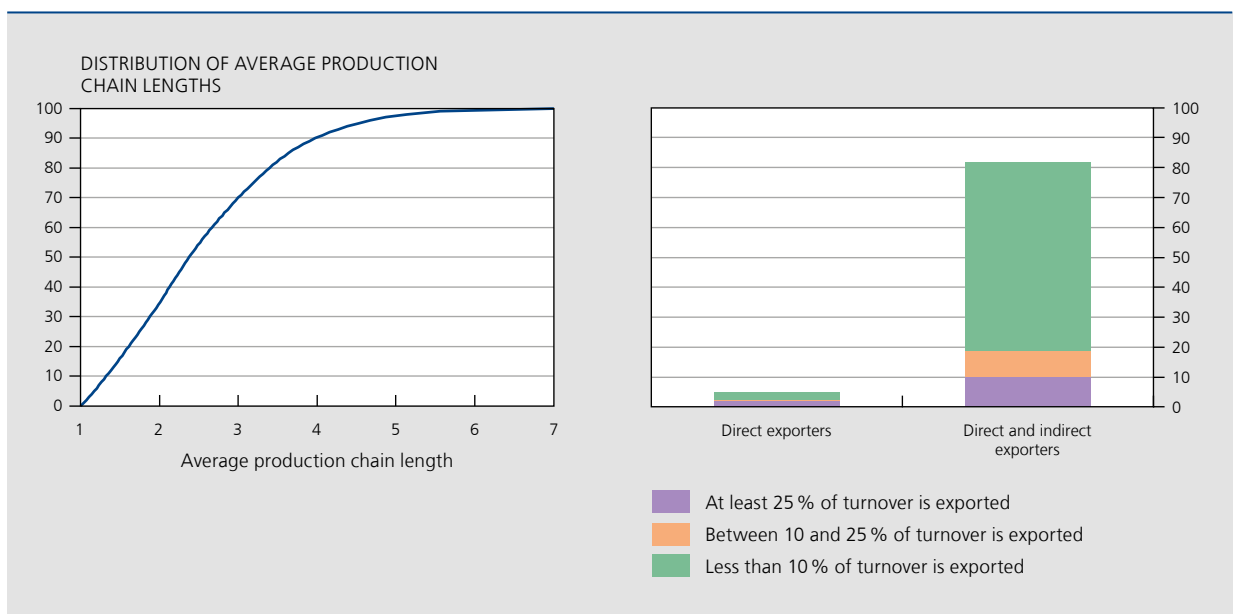
(1) The specialisation effect measures the difference between (a) the distance to the EU15 consumer and (b) an average distance weighted on the basis of the weight of the EU15 branches of activity applied to the distance to the consumer per branch of activity observed in the economy in question. The branch position effect measures the difference between (b) and the average distance to the consumer in the country concerned.

of the branches of activity in the economy, we obtain an average distance to the consumer of 2.3 in Belgium, with an average production chain length of 3.5.

In comparison with the EU15, where the average distance to the consumer is around 2, Belgian production is relatively distant from the end user. Two factors account for this deviation from the EU15 average. First, the economic weight of branches of activity which are typically remote from the consumer, such as chemicals, metallurgy and business services, is greater in Belgium than in the EU15. Second, in comparison with firms of other European countries belonging to the same branch of activity, Belgian firms seem to concentrate more on the initial or intermediate production segments. This apparent tendency to produce intermediate goods and services is consistent with the image of an economy specialising more in semi-finished products (see EC, 2015).

As explained above, the concept of the fragmentation of the production chain can be analysed in more detail by using data on trade transactions between firms. Firms are naturally interlinked via the supply of intermediate goods and services. In 2011, the average firm had a portfolio of 36 domestic business customers. However, some of them, especially in the electricity, gas and water distribution sector, had several thousands of domestic business customers. Moreover, 50 % of firms operated in chains with an average length of 2.4 or more, 30 % of firms formed part of chains averaging more than 3 in length, and for 10 % the average chain length was more than 4.

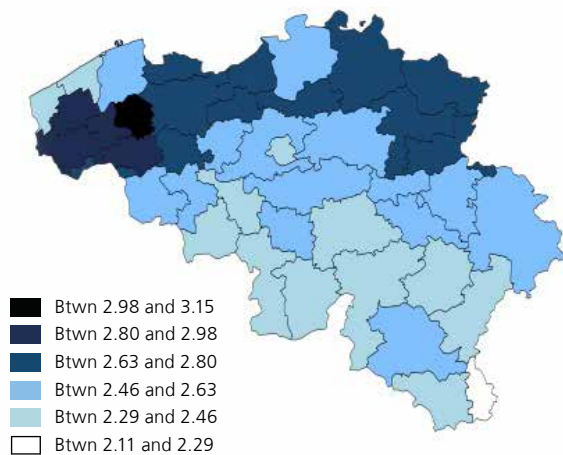
**CHART 4** DISTRIBUTION OF PRODUCTION CHAIN LENGTHS AND PARTICIPATION IN EXPORT ACTIVITIES IN 2011  
(in cumulative %)



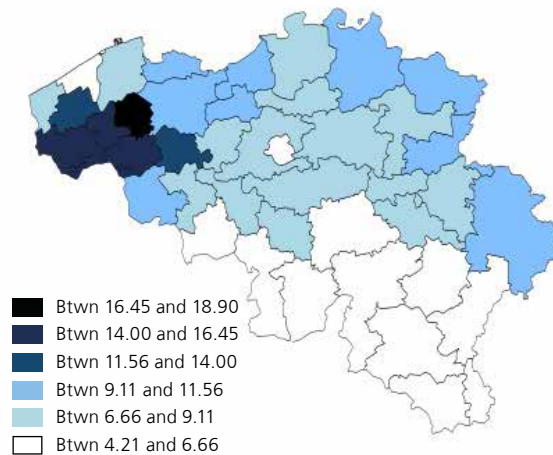
Source: NBB calculations based on VAT data, foreign trade figures and the WIOD.

**CHART 5** FRAGMENTATION OF PRODUCTION CHAINS AND PARTICIPATION IN EXPORTS – AVERAGE<sup>(1)</sup> PER DISTRICT IN 2011

AVERAGE LENGTH OF THE PRODUCTION CHAINS



PERCENTAGE OF TURNOVER EXPORTED (IN %)



Source: NBB calculations based on VAT data, foreign trade figures and the WIOD.  
(1) Unweighted average.

In general, the number of exporting firms is relatively low. In Belgium it is just under 5% of firms, of which almost half export less than 10% of their turnover (see Dhyne and Duprez, 2013). However, as a result of the links between them, a very large proportion of Belgian firms form part of international value chains. Thus, in 2011, almost 82% of the firms observed in the Belgian production network supplied inputs to the rest of the world, either directly or indirectly via third companies. Overall, almost 20% of Belgian firms, on average, ultimately export at least 10% of their output, and almost 10% export at least 25% of their output. Export businesses therefore act as a link in the export process for many domestic firms. The presence on foreign markets is therefore indirectly relevant for many more Belgian firms than the export companies alone. This finding is even more striking in regard to imports. Almost all Belgian firms use foreign inputs, obtaining supplies directly or indirectly from importers, particularly in the case of energy and commodities.

This fragmentation of the production chains and the high degree of integration into global value chains conceal significant regional disparities. As chart 5 illustrates, domestic production chains are more fragmented in Flanders. Flemish firms are also more integrated into global value chains. While it is true that the regional disparities reflect sectoral specialisation, the Flemish economy being more specialised in branches of activity which typically form part

of more fragmented chains, such as chemicals, refining, maritime shipping, rubber and plastic products, etc., the disparities also reflect greater specialisation on the part of Flemish firms, and a denser fabric of small and medium-sized firms specialising in a particular production segment.

#### 1.4 Fragmentation and economic performance

In the economic literature, there are opposing arguments on how fragmentation affects corporate performance. According to a first section of the literature based on the development of outsourcing, firms which specialise in making their flagship product are more efficient. A chain comprising several firms each of which specialised in a particular segment is therefore said to be more efficient than a production chain in which a single firm manages all the production stages.

According to a second section of the literature, mergers or acquisitions indicate that better control of the various production phases can minimise the risks and cut the costs, notably by economies of scale or by the sharing of a number of support functions. According to this theory, concentration, as opposed to fragmentation, improves performance. Overall, these two schools of thought are evidence that the effect of the fragmentation of production chains on corporate performance is basically unknown.

**TABLE 1** GROWTH OF TOTAL FACTOR PRODUCTIVITY (TFP) AND EMPLOYMENT AND FRAGMENTATION OF PRODUCTION – ECONOMETRIC RESULTS<sup>(1)</sup>

Variables	Annual TFP growth ( <i>dlog</i> )			Annual employment growth ( <i>dlog</i> )		
	(1)	(2)	(3)	(4)	(5)	(6)
Chain length .....	0.024*** (0.002)	0.066*** (0.006)	0.054*** (0.006)	0.013*** (0.001)	0.018*** (0.003)	-0.015*** (0.003)
Squared chain length .....		-0.007*** (0.001)	-0.005*** (0.001)		-0.001* (0.001)	-0.001 (0.001)
Relative position .....			0.227*** (0.011)			0.084*** (0.006)
Observations .....	499 558	499 558	499 558	976 902	976 902	976 902
R <sup>2</sup> .....	0.259	0.259	0.260	0.279	0.279	0.279

Source: NBB calculations based on VAT data, foreign trade figures and the WIOD.

(1) Standard deviation in brackets. \*\*\* significant at the 1% threshold, \*\* significant at the 5% threshold, \* significant at the 10% threshold. All explanatory variables refer to the characteristics of firm *i* in period *t* - 1. Each regression comprises a constant, sectoral and time binary variables, and fixed effects specific to the firm. The variable TFP was obtained by estimating production functions at the level of the 2-digit NACE Rev. 2 branches of activity, using the estimation method proposed by Wooldridge (2009).

By incorporating the two indicators of production chain fragmentation, in this case the length and relative position, in an equation for the growth of total factor productivity (TFP) or employment, it is possible to estimate their effect. The assessment of the impact of fragmentation on TFP is based on analysis of the individual data contained in the annual accounts of Belgian firms observed over the period 2002-2011. Those data were used to estimate a Cobb-Douglas production function at the level of the branches of activity defined according to the two-digit NACE Rev. 2 classification. Using these estimates, it was possible to assess TFP growth at firm level and to link that to the fragmentation indicators.

The econometric analysis, which incorporates a range of characteristics (the firm's sector, economic developments, etc.), indicates that firms forming part of long production chains have higher TFP growth rates. Although the effect of fragmentation on efficiency growth is not linear, since it declines with the average length of the production chain, it only becomes negative for lengths in excess of 10, which are not seen in the Belgian network. That suggests that the productive efficiency of Belgian firms could be further improved overall by increased specialisation. Moreover, efficiency gains are not distributed evenly throughout the length of the production chain, as it is firms at the end of the chain that seem to achieve the strongest TFP growth.

Although the econometric analysis also shows that the fragmentation of production has a beneficial impact on employment growth, the effect is smaller than in the case of TFP. It therefore seems that outsourcing is not

generally detrimental to employment in firms that resort to it.

In conclusion, the positive effect of outsourcing exceeds the negative effect of a weaker control of the production chain in the empirical Belgian observations for the period 2002-2011. The results also indicate that the positive effect of production chain fragmentation is not evenly distributed throughout the chain. It is the firms at the end of the production chain that generate the most value added for a given input. In so far as they probably adapt their products to consumer preferences, firms situated at the end of a chain seem to face relatively inelastic demand, which enables them to gain more benefit from the fragmentation process.

## 2. Effects of the economic crisis

The recent economic crisis took its toll on all countries, albeit in various degrees. Europe was particularly hard hit, both in the scale of the initial shock and in the slow pace of the ensuing recovery. In the first quarter of 2015, the volume of GDP in the EU15 had still not regained its early 2008 level. Although Belgium had achieved that by the first quarter of 2011, the average annual growth recorded in the last five years has remained weak, at 0.9%.

### 2.1 Heterogeneous impact on activity at the various stages in the production chains

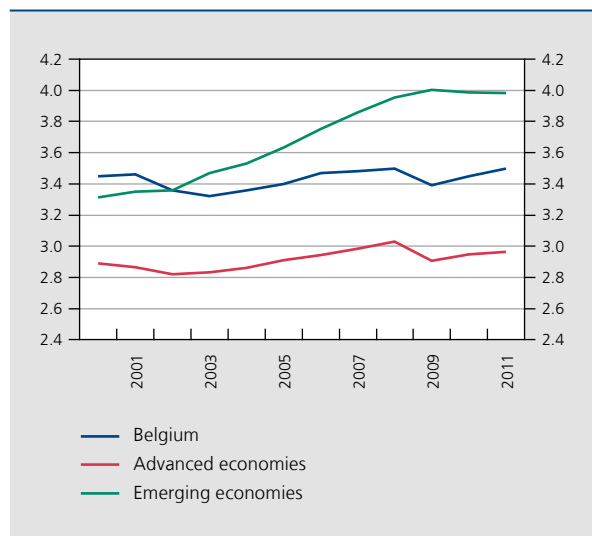
The economic climate influences both production and the way it is organised. Between 2002 and 2008, when



the economic situation was favourable, production chains tended to fragment, as is evident from their increased length. The phenomenon was particularly marked in the case of the emerging economies, as a result of their growing integration into the global economy. In that regard, China's accession to the WTO at the end of December 2001 marked a turning point in that trend. Conversely, during crisis episodes such as those that occurred recently and in 2001-2002, the fragmentation process slows down or even goes into reverse. In a climate of increased uncertainty, firms are probably less likely to establish trading relations with partners. Similarly, firms generally ease back on investment, and that restricts the creation of new, more specialised production units.

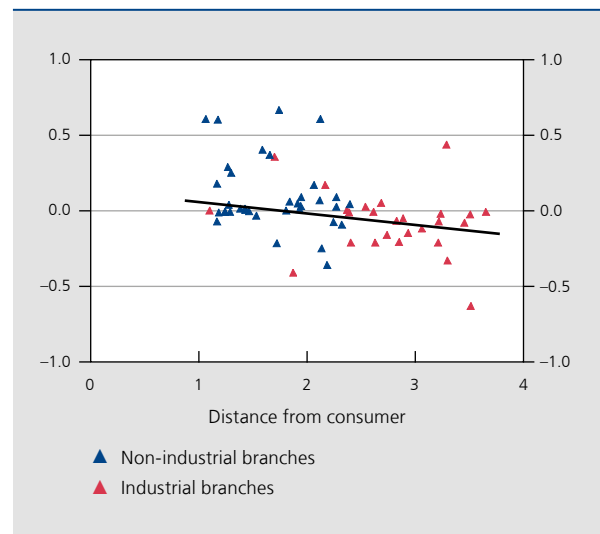
As stated in section 1, proximity to the end user and the fragmentation of production chains had a beneficial effect on economic performance in the period 2002-2011. That was especially true at the time of the economic crisis, as the branches of activity farthest from the end user – whether in the industrial sector or not – were the most affected by the recession. The degree of correlation between the contribution of the branches of activity to GDP from 2007 to 2009 and distance from the consumer is  $-0.41$ . For the years preceding the crisis and for the recent years which followed it, the most distant branches were also the ones which, in general, made the smallest contribution. However, as indicated by the lower correlation rates of  $-0.31$  and  $-0.36$  respectively, the connection is slightly weaker than during the crisis.

**CHART 6** INTERNATIONAL COMPARISON OF THE TREND IN THE LENGTH OF PRODUCTION CHAINS  
(length of the average chains to which economies belong<sup>(1)</sup>)



Source: NBB calculations based on the WIOD.  
(1) The emerging/advanced economies classification is the one used by the United Nations.

**CHART 7** LINK BETWEEN CONTRIBUTION TO GDP DURING THE CRISIS AND DISTANCE FROM THE CONSUMER  
(each triangular symbol represents a branch of activity)



Sources: NAI, NBB calculations based on VAT data, foreign trade figures and the WIOD.

## 2.2 Cleansing of the domestic network

The economic crisis also had an impact on the organisation of the domestic production network. Looking at the overall picture of the economic activity generated by that network, measured by the growth of aggregate turnover, it is possible to identify three sources of growth: (i) an intensive component that depends on trade between firms already observed at the start of the period, (ii) an extensive component which is a function of the number of new or disappearing firms in the production network, and (iii) a second extensive component associated with the establishment of new trading relations or the destruction of trading relations between existing firms.

While these three components made a positive contribution to the growth of the domestic production network during the period 2002-2007, the recent crisis significantly altered the growth dynamics. At the height of the crisis, the network contracted owing to the dual impact of a net destruction of businesses and a reduction in transaction volumes. During the recent period 2009-2012, the extensive component continued to depress the growth of the network, as the activity generated by the creation of new businesses or trading relationships was not enough to offset the activity lost as a result of the exit of a number of firms. Only the rise in the volume of existing transactions made a positive contribution to the recovery of the economic activity of the domestic production network. This strong contribution of the intensive margin to

the growth of the network during the post-crisis period indicates that firms which managed to survive the initial shock saw a significant revival in activity in 2012 compared to 2009. All the same, the number of firms in the network declined steadily.

A detailed econometric analysis of the probability of survival of domestic firms makes it possible to examine more closely the characteristics of the companies which closed down during the crisis period<sup>(1)</sup>. Among the results obtained, the negative links traditionally seen between firms' size or productive efficiency and the risk of exit are confirmed by the analysis of the microeconomic data for Belgium<sup>(2)</sup>.

Moreover, the fragmentation of the production chains and a firm's relative position in those production chains are likewise relevant, because they have a significant influence on the probability of a firm's exit. Firms operating in highly fragmented production chains faced an increased risk of exit. Presumably, in a very fragmented chain, each link can be readily replaced in the event of difficulties, particularly for firms involved in the initial production stages, which are generally more standardised. At the peak of the crisis, firms active at the start of a production chain had to be particularly efficient in order to survive. However, a firm's disappearance did not necessarily imply a shortening of the production chain, as the weak link could be replaced at either local or international level. Conversely, firms active at the end of a chain, producing a differentiated product tailored to the needs of the end

**TABLE 2** PROBABILITY OF EXIT OF FIRMS AND FRAGMENTATION OF PRODUCTION CHAINS<sup>(1)</sup>

(average marginal effects associated with the estimation of a *Probit* equation)

	Baseline effects (no crisis)	Effects during the crisis	Chi <sup>2</sup> test <sup>(2)</sup>
Employment (in <i>log</i> ) . . . . .	-0.010*** (0.001)	-0.003*** (0.001)	73.96***
TFP (in <i>log</i> ) . . . . .	-0.035*** (0.001)	-0.035*** (0.001)	0.00
Length of production chains . .	0.010*** (0.001)	0.007*** (0.001)	4.74**
Relative position in production chains . .	-0.005 (0.005)	-0.032*** (0.005)	19.06***

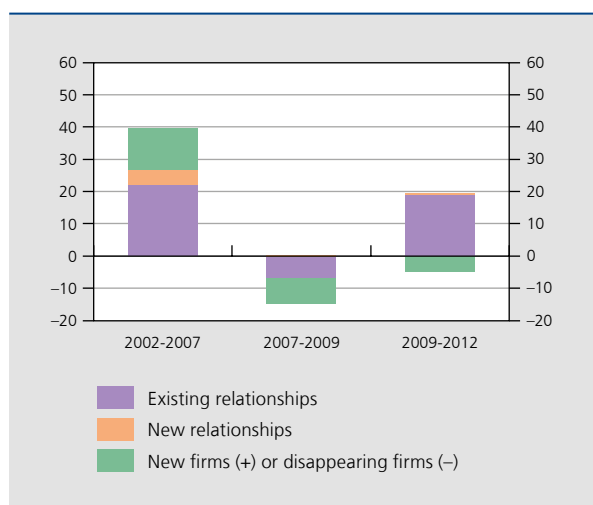
Source: NBB calculations based on VAT data, foreign trade figures and the WIOD.

(1) Standard deviation in brackets. \*\*\* significant at the 1% threshold, \*\* significant at the 5% threshold, \* significant at the 10% threshold. A firm is considered to exit if it is observed in *t* but not in *t* + 2. All the explanatory variables refer to the characteristics of firm *i* in period *t*. Apart from the variables presented in the table (whether or not crossed with an indicator for the crisis period), the estimated *Probit* equation also incorporates sectoral and time binary variables, an indicator of the Belgian firm's membership of a multinational group, and two variables which respectively reflect the share of exports and the share of imports in the firm's turnover. The equation was estimated for four periods: 2003, 2005, 2007 and 2009.

(2) Under the null hypothesis, the crisis did not affect the impact of a variable on the probability of exit. This hypothesis is rejected for employment, length of production chains and relative position in production chains. It is not rejected for TFP.

user, were better equipped to avert the risk of exit during the crisis. These findings therefore seem to indicate that the recent economic crisis had the effect of thinning out the domestic production chains by eliminating the least efficient links, primarily in the initial production phases.

**CHART 8** BREAKDOWN OF THE GROWTH OF THE TOTAL TURNOVER GENERATED BY THE BELGIAN PRODUCTION NETWORK  
(contributions to cumulative growth)



Source: NBB calculations based on VAT data.

## Conclusion

Using a unique and original database which combines information on the organisation of the domestic production network with segments of international production chains, this article aims to present some new findings on the operation of the Belgian economy, notably in regard to the recent crisis situation.

One of the first points to emerge is that Belgian firms have a large number of mutual trading links. The days

(1) The definition of the concept of business closure used for this analysis covers all types of cessation of activity, such as bankruptcy or merger. A firm is deemed to have closed down between *t* and *t*+2 if it was observed in *t* but not in *t*+2. A two-year period is used to avoid counting temporary departures from the sample (firm observed in *t* and in *t*+2 but not in *t*+1).

(2) It should be mentioned that, like Blanchard *et al.* (2015), we find an increased risk of exit for Belgian firms owned by a foreign company. That finding is consistent with the literature on the behaviour of multinationals in the organisation of their production systems. Firms owned by a multinational became particularly vulnerable during the recent crisis. In fact, in that period, numerous Belgian production units that came under large international groups were closed down.

when each business operated on its own, covering the entire production process, are largely gone. Compared to other economies, the Belgian economy appears to feature a relatively high degree of fragmentation of production. In addition, via trading links with import or export firms, the majority of Belgian firms are integrated – albeit indirectly – into global production chains. The question of the economy's external competitiveness is therefore not confined to exporters alone, but extends to a very large number of firms active in a wide variety of branches of activity. It is even less appropriate to restrict this question solely to industrial companies, as service firms make a massive contribution to production chains.

The diagnosis concerning the fragmentation of production in Belgium could be further refined, although that is beyond the scope of this article. Various factors, such as the country's small size or its central location in Europe, could play a role in that diagnosis. Moreover, the analysis of the evolving fragmentation process could be followed up. The fall in commercial transaction costs evident at the start of the millennium, stimulated by such factors as the reduction in transport costs, the emergence of ICT and the lowering of political and economic barriers to trade in emerging countries, undeniably fostered increased international fragmentation. In the absence of further cost reductions, it would be interesting to ascertain whether the fragmentation process has now reached maturity, or whether there is still potential to be exploited.

Apart from showing that production is fragmented, the article highlighted a link between fragmentation and position in production chains, on the one hand, and economic

performance on the other. In general, between 2002 and 2011, it was beneficial to belong to a fragmented production chain. Belgian firms which concentrated on a specific segment in the production chain were thus best able to survive. That specialisation was particularly advantageous for firms at the end of the production chains. Over the period studied, the greatest efficiency gains were achieved close to the consumer.

The economic crisis which had a serious impact on Belgium, as on all economies, brought the fragmentation process to a halt. It also rendered some firms vulnerable. Apart from small size and low productivity, the risk factors include membership of long chains, especially in the case of firms located at the beginning of the chain. Overall, since the crisis the trading links established by firms in the network have not made up for the links destroyed. It is therefore more crucial than ever to create businesses in order to regenerate the domestic production network. However, business creation is relatively weak in Belgium compared to other European countries.

In the end, whether a firm be new or long-established, the productivity gains that it achieves remain crucial to its survival and development. Specialisation in a particular production segment by resorting to outsourcing or spin-offs for production phases in which the firm has less expertise is one way of achieving that objective. Another strategy involves getting closer to the end user, e.g. by offering goods or services directly targeting consumers or by establishing a customer-centred approach. As always, staff training and innovation in design, communication and marketing are crucial to make products attractive to consumers.

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