Single parenthood and educational performance in Belgium

A Community approach

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Abstract

In Belgium, each community has its own schooling system and there is a performance gap between the French and the Flemish Community, in favour of this latest, which remains for some part unexplained. Since being in a single-parent family harms the educational performance and that the proportion of single-parent families is higher in the French Community, we want to assess the relevance of including the family structure in the mitigation of the Community gap, using PISA data from 2003, 2009 and 2012 and applying robust OLS regressions. Our results show that the raw Community gap has a size of around one and a half year of schooling and that only 26% is explained by the variables already highlighted in the literature. We also show that the family structure, both at student and school levels, can further explain 20% of this raw gap. However, our paper cannot identify the channels at stakes as the main one was found to be the Economic, Social and Cultural Status (ESCS) which was already included in the first variables from the literature review. Nonetheless, we see that we cannot disregard the inequality of chances based on the family structure in Belgium anymore.

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1 Chapter 1 – Introduction

Good quality and equitable education is crucial both for the youths' future and development, for the future of the planet and for the economies' prosperity. Indeed, education has a strong effect on individuals wellbeing (UNESCO, 2017; Vandenberghe, 2011), on their occupational possibilities (Vandenberghe, 2011) and on their future incomes (Khamis, Hanoon, & Belarbi, 2010). Moreover, one of the determinants of economic growth is human capital (Vandenberghe, 2011; UNESCO, 2017) which can be enhanced by education (Vandenberghe, 2020). Therefore, we see how important studying education is from an economic point of view.

In Belgium, the schooling system is not uniform across the country. Indeed, education is regulated and financed mostly by communities (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014). In particular, each community has its own schooling system. There are 3 communities, based on language: the Flemish, the French and the German-speaking communities. (Belgian Federal Government, d)

When evaluating the performance of the Flemish and French communities, using results from the Programme for International Student Assessment (PISA), we notice a gap in performance, like other studies already highlighted (Hindriks & Verschelde, 2010; Hindriks & De Witte, 2017; Hindriks & De Witte, 2018; Hindriks & Verschelde, 2011; Hindriks, Verschelde, Rayp, & Schoors, 2009). The Flemish community is performing better than the French community and the gap can reach a raw size of up to one year of education (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014). Moreover, the gap is noticeable in each survey and does not seem to close up (Hindriks & Verschelde, 2011).

Some studies have been conducted on this performance gap, but the literature is not extensive. According to those studies, the gap is mainly explained by differences in socioeconomic background, immigrant status, school autonomy and school identity (Hindriks, Verschelde, Rayp, & Schoors, 2010; Hindriks & Verschelde, 2011; Perelman, Pestieau, & Santin, 2011). However, the family structure, and especially the single parenthood framework, does not seem to have been included when looking at the sources of performance variation. Even though single parenthood seems to be an important indicator of socioeconomic inequalities it could also have an effect because of the family structure and the emotional effect on the child (de Lange & Dronkers, 2018; Considine & Zappalà, 2002).

Studies on the effect of single parenthood on children's educational performance have shown that there is a significant variation of performance due to the family structure. In particular, there is a negative relationship between single parenthood and educational performance. (Pong S.-L. , 1997; de Lange & Dronkers, 2018; de Lange, Dronkers, & Wolbers, 2014)

Furthermore, single parenthood seems to have an effect both at the individual level, affecting the child directly, and at the school level, affecting all the children through the peer effect (de Lange & Dronkers, 2018; de Lange, Dronkers, & Wolbers, 2014). Moreover, it has been shown that the peer effect is stronger in the French than in the Flemish community (Hindriks, Verschelde, Rayp, & Schoors, 2009).

If we look at some statistics about the type of households where there are children, we see that Belgium had about 9.98% of single-parent households in 2011 (Belgian Federal Government, 2016) and about 11.9% in 2016 (Steinbach, Kuhnt, & Knüll, 2016). It was 10% in 2019 (Statbel, 2020). Even though single parenthood in Belgium does not appear to be large, it still leads to large achievement disparities (Woessmann, 2015).

If we take the regions as a proxy for the communities in 2011, we observe that the Flemish community had a proportion of single-parent households of 8.3% and 11.7% for the French community (Belgian Federal Government, 2016). Looking at the same proxy for 2019, we see that the French community proportion of single-parent households increased to 12% and that it decreased to 8% for the Flemish Community (Statbel, 2020) Therefore, since the Flemish and French communities do not have the same proportion of single-parent households, the proportion is larger in the French than in the Flemish community, we wonder if it could be another source of performance variation across the communities.

In this paper, we will assess the relevance of including the family structure in the analysis of the Belgian Community gap as well as the channels through which it might be at stakes. We will conduct a robust OLS analysis in 3 parts using PISA data from 2003, 2009 and 2012. A first part to see how large is the Community gap and how much can be explained by the factors already highlighted in the literature. A second part to see the channels through which the individual and the concentration effects take place. And a third part to see how much more the family structure can explain in the Community gap. Since we cannot assume that the effect on Mathematics would be the same on Reading and Science, we conduct the analysis with each of the three literacies as independent variables. Moreover, as we use multiple surveys, we conduct the analysis on both the merged database and on each year independently. Therefore, we present the main results using Mathematics and the merged database in the core of the paper but we put the other results, with Reading and Science as well as for 2003, 2009 and 2012, in the Appendix.

We expect the Community gap not to be fully explained by the factors already highlighted in the literature, the single parenthood to negatively affect students both at the individual and at the school levels, this to be explained up to some level by the Economic, Social and Cultural Status (ESCS) and to explain another part of the Community gap.

Our main findings are that the Community gap is still there and we managed to explain up to one-third of this raw gap. There is also a gap based on the family structure in Belgium, both at the individual and at the school levels, and its size is about one year of schooling for the individual one, which is important. We could explain around 50% of the raw gap, mainly through the ESCS index but not only. Finally, we found that adding the individual family structure and the concentration of single-parent families into the Community gap analysis decreased further this latest by 20% of its raw size. This is, the initial gap was around 44 points for Mathematics, it was 32 points when we controlled for the variables from the literature and it reached a size of 24 points once we added the family structure.

As the family structure has its own effect on top of its major channel, the ESCS, it means that further research must be conducted to understand the channels through which the family structure can further explain the Community gap. However, it has already been shown that

policies equalising resources (financial, social, etc.) between single-parent and two-parents families were effective in reducing the disadvantage children from single-parent families suffer from. That should be considered as a policy intervention if the governments or the schools want to have a system giving equal chances to every child, no matter the type of family he is coming from.

The structure of the paper is the following: Chapter 2 summarises the relevant literature, the main hypotheses we have as well as the conceptual framework, Chapter 3 describes the data we use, its source and the variables of interest, we conduct our analysis in Chapter 4 and discuss the results, state some limits of our data and some policy implications in Chapter 5.

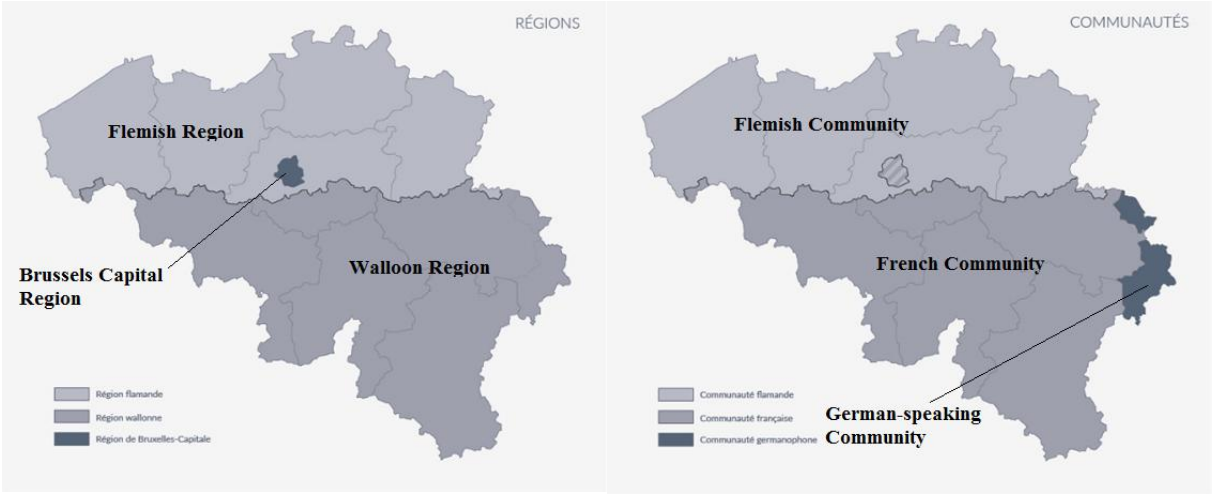
2 Chapter 2 – Literature Review and Conceptual Framework

2.1 Communities and educational performance

2.1.1 Existence of a gap

Belgium is an independent federal state since 1830 which is composed of one federal state, three regions and three communities, as stated in the Constitution (Belgian Federal Government, a). While the regions come from a territory approach, the communities are based on the language and the culture and each of them has its own decision power on the domains which have been assigned to the entity (Belgian Federal Government, a). On *Figure 1L*, we show two maps. The first one, on the left-hand side, pictures the Flemish Region, the Brussels Capital Region and the Walloon Region and the second one, on the right-hand side, pictures the Flemish Community, the French Community and the German-speaking Community. Even if both tend to overlap, in particular for the Flemish Region and the Flemish Community which have been institutionally merged in 1980 (since their creation) (Vlaams Parlement, 2005; Belgian Federal Government, c) and have only one parliament and one government for both (Belgian Federal Government, b), it is not fully the case and their competencies are different.

Figure 1L – Belgian regions and communities



Source: Belgium.be, completed by us

In Belgium, the schooling system was uniform across the country for a long time since education was a state competency, but it is not the case anymore. In 1989, a reform gave to the three Belgian communities the education competence (Hindriks & De Witte, 2018; Hindriks, Verschelde, Rayp, & Schoors, 2010; Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014). Since then, education is regulated and financed mostly by the communities (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014) which prevent us to assume that the distribution of educational performance will be the same across the different communities of the country since they are separated deciding entities which means that we are facing independent schooling systems like we would when comparing countries.

Actually, studies on educational performance in Belgium have shown that there is a gap between the Flemish Community and the French Community[1]. According to Vandenberghe (2011), the gap is not new and could have started in the mid-1950s. In particular, while the Flemish Community is in the top of the OECD results regarding PISA, which is the Programme for International Student Assessment, the French Community is below the OECD average (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014; Hindriks & De Witte, 2017; Hindriks & De Witte, 2018). It means that the Flemish Community is outperforming the French Community, and the gap can reach a raw size (when we do not control for anything) of 50 points which represent more than one year of schooling[2] (Perelman, Pestieau, & Santin, 2011; Vandenberghe, 2011; Hindriks & Verschelde, 2011; Hirtt, 2008).

Figure 2L – Belgium raw scores by Community, OECD average raw scores and the raw gaps between the Belgian Communities, using PISA data from 2000 to 2018

Source: Data from OECD Reports

Moreover, it seems that this gap, even if it is slowly decreasing, has not been closing, as we can see in *Figure 2L*. On those graphs, we see the evolution of the raw scores (without any control) for both communities and the OECD average, and of the gap between 2000 and 2018. The left-hand axis is measuring the raw score while the right-hand axis is measuring the gap in score-points. It seems that the gap is now reaching a size of 20 points for every subject, which is, therefore, corresponding to more than half a year of schooling. It means that even if Hindriks and Verschelde wrote in 2011 that the gap "seems to keep on growing"[3], we fail to see it on

[1] Studies usually do not focus on the 3rd community in Belgium which is the German-speaking Community because it represents less than 1% of the Belgian population (Statbel, 2019).
[2] Indeed, one year of schooling is around 34 points, which is 0.34 standard deviation of the scores as the mean is set at 500 and the standard deviation at 100 (OECD, b)
[3] Hindriks, J., & Verschelde, M. (2011). Examining the educational gap between Flemish and French-speaking. In V. Vandenberghe, S. Perelman, P. Pestieau, D. Santin, J. Hindriks, M. Verschelde, . . . P. Van Parijs, *Educational*

those graphs. One last thing we can highlight from those results is that overall the performance is worse in 2018 than in 2000 for the Flemish Community and the OECD on average, while the French Community seems to slightly improve its performance.

Hypothesis 1 – The Flemish Community is performing better than the French Community when looking at raw scores in mathematics, reading and science.

2.1.2 Determinants of the community gap

The literature about the determinants of the performance gap has not been extensive. Overall, the studies are not able to completely explain this gap and there is a lot of inconclusive researches about it. What we can take out is that the socio-economic status, the immigrant status, the school autonomy, the school identity and the peer effect are part of the explanation for the difference in performance across communities, but some of this gap remains unexplained (Hindriks & Verschelde, 2011; Hindriks, Verschelde, Rayp, & Schoors, 2009).

The socio-economic status

First, it is well-known that the socio-economic status (SES), which has a variety of (good and less good) measures (O'Connell, 2019; Thompson, 2018; Sirin, 2005), is a good predictor of the educational performance (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014; O'Connell, 2019; Glick & Hohmann-Marriott, 2007). Especially, it seems that the lower this status, the worse the performance, even if it is not a general rule since we could experience some social mobility (O'Connell, 2019; Glick & Hohmann-Marriott, 2007; Ali, Zubair, Fahad, Hamid, & Awais, 2013; Considine & Zappalà, 2002).

The index of Economic, Social and Cultural Status (ESCS) computed in PISA is one of the multiple existing measures of the SES. It is an index based on the parents' occupational status, the highest level of parents' education, the family wealth, the home educational resources and the classical possessions[4] (Thompson, 2018; OECD, 2019b). Overall, it seems that studies are unclear about the way the SES impacts educational attainment (Thompson, 2018), even if they agree that the socio-economic background influences the opportunities and the educational attainment (O'Connell, 2019). Nevertheless, some studies do provide insights regarding each of the components of the ESCS.

It appears that home possessions, such as books, are a proxy for the cultural and financial possessions of the households (O'Connell, 2019; Evans, Kelley, Sikora, & Treiman, 2010). Living in a home with books provides an environment that endows the children with useful learning tools such as the vocabulary, the comprehension skills, etc. (Evans, Kelley, Sikora, & Treiman, 2010). Moreover, the parental education level and occupational status are good indicators of the economic status of the households which then reflects the potential of social and economic resources the child has access for learning (Sirin, 2005; Thompson, 2018). Finally, it seems that more educated parents are more able to provide a stimulating environment

Divergence: Why do pupils do better in Flanders than in the French community? (Vol. 8, pp. 36-40). Brussels: Re-Bel initiative.

[4] Such as books, computer, car, etc.

to their children, because of the scholarly culture, as well as greater psychological support (Evans, Kelley, Sikora, & Treiman, 2010; Thompson, 2018).

Besides, the Flemish Community is richer and has a greater ESCS than the French Community (Hindriks & Verschelde, 2011; Hirtt, 2008). Therefore, the literature highlighted that the ESCS explains some part of the Belgian Community gap.

At this stage, it is already worthy noticing that some of the literature used the family structure as a measure of the SES (Thompson, 2018; Krein & Beller, 1988; Boggess, 1998). In the next section, we will focus on a deeper understanding of the family structure and its role in mitigating the educational performance.

The immigrant status

Second, it seems that, in OECD countries and in Belgium as well, immigrants are performing worse than natives. In particular, both immigrants from the first and second generation are outperformed by native students (Vandenberghe, 2011; Hindriks & Verschelde, 2011; OECD, 2019b; Marks, 2005). Even though the immigrant status is somehow related to the socio-economic status, it seems that immigrants tend to have a low socio-economic index (Hindriks, Verschelde, Rayp, & Schoors, 2009; Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014; OECD, 2019b; Marks, 2005), it is not the only channel at stake (Hirtt, 2008; OECD, 2019b).

Some of the reasons behind their lagging positions are the same as the ones highlighted above with the SES: the lack of resources because the parents are less educated, they have a lower job status, a lower income and they have less wealth (OECD, 2019b; Marks, 2005). Regarding the wealth, it is explained by the fact that immigrants come with barely anything (Marks, 2005). In particular, in the European Union, it seems that they are running away from war when they arrive and therefore do not have much with them (OECD, 2019b).

On top of that, there is the language proficiency which is a problem for immigrants (OECD, 2019b; Glick & Hohmann-Marriott, 2007; Hindriks, Verschelde, Rayp, & Schoors, 2009). Indeed, immigrants who are not speaking the national language have a disadvantage since they must first learn the language before being able to learn at school.

Overall, the two main reasons of the lagging performance of children from immigrant families are the SES, which explains in the OECD up to 50% of the difference (OECD, 2019b), and the language, but it cannot explain the entire gap in performance. It means that the immigrant status has its own effect on top of the SES and language even if the literature cannot identify the other channels (Hindriks, Verschelde, Rayp, & Schoors, 2009). Moreover, it has been found that this could not be explained by cultural elements such as the aspirations, the attitude towards schooling or the behaviour (Marks, 2005). It has been confirmed by Hindriks & al. (2009), they show that controlling for the immigrant status does not change the ESCS coefficient (Hindriks, Verschelde, Rayp, & Schoors, 2009).

Looking deeper at Marks' study on the immigrant status effect on education and his results for Belgium in particular, we see that the second generation of immigrant speaking another language than Flemish, or French has, on average, 117 points less than native children.

Controlling for the SES (the income and occupational status), the gap is 56 points and using the ESCS (SES plus some cultural factors), it is 54 points. (Marks, 2005)

Since there are more immigrants in the French Community than in the Flemish one, Belgian studies conclude that the immigrant status is explaining some of the Belgian educational performance gap (Hindriks & Verschelde, 2011; Hirtt, 2008).

The school autonomy

Third, it seems that schools' systems with high performance are also the one with higher school autonomy (OECD, 2013c; Hindriks & Verschelde, 2011; Hindriks, Verschelde, Rayp, & Schoors, 2010; Hindriks & Verschelde, 2010; Hindriks, Verschelde, Rayp, & Schoors, 2009; OECD, 2018). However, the relation is not as easy. Indeed, school autonomy leads to an increase in educational performance only if there is the right accountability system (OECD, 2013c; Hindriks, Verschelde, Rayp, & Schoors, 2010).

The concept of autonomy in this context refers to the autonomy of the curriculum, the allocation and the management of the resources (OECD, 2013c). In particular, when it is defined as "the operational empowerment of the principals and teachers"[5], school autonomy is beneficial for both the low and the high performers in Belgium (Hindriks, Verschelde, Rayp, & Schoors, 2010).

Since the 80s', OECD schools have experienced an increase in autonomy because governments agreed that schools were better judges regarding the needs they have (OECD, 2013c). The implicit goal of this was to increase the responsiveness of schools, students and even sometimes teachers (OECD, 2013c). It seems that the increase in school autonomy will have an effect because it eliminates some administrative burden, helps to overcome the bureaucratic rigidity and makes closer agents more responsible (Hindriks, Verschelde, Rayp, & Schoors, 2010). However, if the governments and the schools' interests are not aligned, it can backfire and school autonomy can lead to lower educational performance (Hindriks, Verschelde, Rayp, & Schoors, 2010).

In Belgium, as explained at the beginning of this chapter, the government decided in 1989 to give the power of educational decisions to the Communities (Hindriks & De Witte, 2018; Hindriks, Verschelde, Rayp, & Schoors, 2010). On top of that, the Belgian Constitution says that the government must give the financial resources to the schools as soon as they meet the minimum requirements which basically are to explain how they plan to reach the end goals[6] (Hindriks, Verschelde, Rayp, & Schoors, 2010). In Belgium, the schools have some autonomy on the teaching methods, the textbooks, the evaluation methods, etc. but not on the end goals nor on the salaries (Hindriks, Verschelde, Rayp, & Schoors, 2010; Hindriks & Verschelde, 2011).

It seems that the Flemish Community has a higher school autonomy and its accountability system appears to be one of the most effective systems (Hindriks, Verschelde, Rayp, & Schoors,

[5] Hindriks, J., Verschelde, M., Rayp, G., & Schoors, K. (2010). *School autonomy and educational performance: within-country evidence.* Louvain-la-Neuve: Center for Operations Research and Econometrics.

[6] It is the tasks a student must be able to do at the end of the year, in the French Community it is called "*Socles de compétences*" and in the Flemish Community, it is "*Eindtermen*" (Hirtt, 2008)

2010; Hirtt, 2008). Therefore, school autonomy has been highlighted as a determinant of the Belgian educational performance gap (Hindriks & Verschelde, 2011; Hindriks, Verschelde, Rayp, & Schoors, 2010).

The school identity

Fourth, regarding the school identity, according to Hindriks and Verschelde (2011), it is the missing link in the previous studies about the gap. They define school identity by the fact that the student, the parent and the teacher identify to the school. For the student, it means that he feels like he must be at school or that he has to perform well. It is kind of expectations he believes he has to fulfil because of norms and values (Burke, 1989; Hindriks & Verschelde, 2011). For the parent, it is related to the implication he will have in his child's school and for the teacher, it will be his implication as well. Overall, it has been shown that people tend to choose behaviours which are consistent with how they picture themselves through norms and values (Burke, 1989). It is what we call identity economics.

From other studies, we see that the gender identity has a great effect on choices, capacities and opportunities students have (Collins, Kenway, & McLeod, 2000; Burke, 1989). In particular, gender identity can limit children regarding education and employment (Collins, Kenway, & McLeod, 2000). The identity is of course not limited to the gender, even if this one has been more studied than others (Collins, Kenway, & McLeod, 2000; Burke, 1989). Indeed, the identity can be related to the SES, the immigrant status, etc. (Collins, Kenway, & McLeod, 2000). Dannette & al. (2008) have shown that, in New Zealand, the cultural identity can decrease the student performance and it is mostly due to their low SES. Moreover, it seems that peer culture can also influence educational performance because it will impact the self-identity (Collins, Kenway, & McLeod, 2000).

However, studies on Belgium do not clearly explain how school identity is related to the Belgian performance gap, nor how both Communities differ regarding it.

The peer effects

Finally, on top of the individual effect of the socio-economic and the immigrant status, there is a peer effect (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014; Hindriks, Verschelde, Rayp, & Schoors, 2009). The peer effect is that the school composition matters and that a student from a school with a lower average ESCS or a larger share of immigrants should have a lower performance than if he was in a school with a higher average ESCS or a lower share of immigrants (Belfi, Gielen, De Fraine, Verschueren, & Meredith, 2015; Hindriks & Verschelde, 2011; Mostafa, 2010; Schmidt, Burroughs, Zoido, & Houang, 2015; Belfi, Haelermans, & De Fraine, 2016; Masci, De Witte, & Agasisti, 2018).

At the school level, the concentration of lower SES students means that the school has lower physical and educational resources (Thompson, 2018; Mostafa, 2010), as well as lower expectations regarding student performance (Thompson, 2018; Mostafa, 2010; Belfi, Gielen, De Fraine, Verschueren, & Meredith, 2015). It also appears that, in schools with low SES, the teachers have less confidence in their abilities to make a difference for the children, partially because of the lack of social relationship between teachers, parents and students (Belfi, Gielen, De Fraine, Verschueren, & Meredith, 2015). Moreover, it seems that concentration will

exacerbate the inequality because weaker educational content is likely to be given to low SES schools (Schmidt, Burroughs, Zoido, & Houang, 2015; Thompson, 2018). The idea is that students with similar characteristics, such as SES, immigrant status, etc., will be gathered in the same school (Schmidt, Burroughs, Zoido, & Houang, 2015). In particular, less privileged households are likely to be stratified into relatively poor communities (Mostafa, 2010). It has been shown that there is a large segregation based on the ESCS in Belgium (Belfi, Gielen, De Fraine, Verschueren, & Meredith, 2015; Hindriks, Verschelde, Rayp, & Schoors, 2009; Belfi, Haelermans, & De Fraine, 2016) and that it is stronger in the French community than in the Flemish one (Hindriks, Verschelde, Rayp, & Schoors, 2009).

Regarding the immigrant status, Danhier & al. (2014) show evidence of segregation in schools as well. It seems that across countries, there is a concentration of first-generation immigrants into schools offering a lower set of academic courses which means that they are gathered into a less academic part of the schooling system which is likely to increase the inequalities (Marks, 2005). In particular, this concentration brings new difficulties to schools such the fact that they are likely to struggle to attract and keep good teachers and that parents are likely to allocate less time and resources to contribute to the school (Marks, 2005).

The segregation of similar students into schools according to the abilities is called tracking. In Belgium, students are tracked in 3 schooling types: general, pre-vocational and vocational (Schmidt, Burroughs, Zoido, & Houang, 2015). Belfi & al. (2012) studied the effect of segregation by ability, as it is done in Belgium, and by gender on the well-being and the academic self-concept. They showed that both types of segregation have an important impact on the students and can therefore not be ignored.

Moreover, the peer effect has been estimated to be larger in the French Community (Hindriks, Verschelde, Rayp, & Schoors, 2009) which means that the same student going to the same school (same share of immigrants and same average ESCS) will perform less well if the school is located in French Community than if it is in the Flemish community. It means that the peer effect can also explain some part of the gap, on top of the socio-economic and immigrant's status.

Hypothesis 1 bis – Even when controlling for the socioeconomic status, the immigrant status, the school autonomy and the school identity, the Flemish Community is performing better than the French Community in mathematics, reading and science.

2.1.3 Conclusion

To briefly conclude on this section, we have seen that we have a gap in favour of the Flemish Community when we look at the average performance of the communities over time. Moreover, we should mention that the dispersion of the results is large in Belgium, but even when we look at the quintile, taking the ESCS index, for example, we systematically have this gap (Hirtt, 2008). It means that it is not an average effect. We also highlighted the identified determinants of the Community gap (the ESCS, the immigrant status, the school autonomy, the school identity and the peer effect) and the fact that no study has been able to fully explain this gap.

2.2 Parenthood and educational performance

As we explained in Section 1, the family structure can be a component of the SES index (Thompson, 2018; Krein & Beller, 1988; Boggess, 1998). In this section, we will focus on deepening our understanding of the mechanisms through which the family structure affects the educational performance.

There has been an increasing interest in the relation between the family structure and the educational performance. Researchers agree that the family structure is an important determinant of the performance at school (Azumah, Krampah, & Nachinaab, 2018; Dronkers, 1994; Glick & Hohmann-Marriott, 2007). It seems that the number of single-parent families is increasing faster than the two-parents' families (de Lange, Dronkers, & Wolbers, 2014) and since the future of the children mostly depends on the households (de Lange, Dronkers, & Wolbers, 2014), it might be useful to quantify this effect and to know how to counteract it, if necessary.

Conducted studies all confirm that there is a negative association between the single parenthood and the child's educational performance (Bankston & Caldas, 1998; Downey, 1994; Frisco, Muller, & Frank, 2007; Dronkers, 1994; Mulkey, Crain, & Harrington, 1992; Pong, Dronkers, & Hampden-Thompson, 2003; Dronkers, 1999; de Lange & Dronkers, 2018). This effect has been estimated to be of around 1 year of schooling (Mulkey, Crain, & Harrington, 1992; de Lange & Dronkers, 2018). Moreover, it appears that it is working at the individual level but also at the school level, through the concentration of single-parent families (Pong, Dronkers, & Hampden-Thompson, 2003; de Lange & Dronkers, 2018; de Lange, Dronkers, & Wolbers, 2014; Pong S.-L. , 1997).

Hypothesis 2 – Children from single-parent families are outperformed by students from two-parents' families when looking at raw scores in mathematics, reading and science.

Hypothesis 3 – Children attending a school with a larger concentration of single-parent families are performing less well than the same children in a school with a lower concentration of such families when looking at raw scores in mathematics, reading and science.

2.2.1 Communities and family structure

At our best knowledge, there are limited studies on the effect of the family structure in Belgium and those looking at it are considering Belgium as a uniform country within international studies and are therefore not making use of the different Communities (Woessmann, 2015; de Lange, Dronkers, & Wolbers, 2014; de Lange & Dronkers, 2018). From de Lange and Dronkers (2018), we do not learn a lot about Belgium because they used OECD countries to have more observations and not to make a difference across countries.

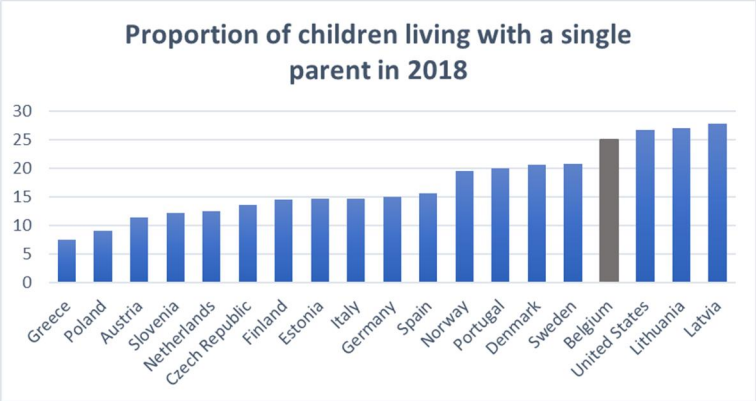
Nevertheless, in Woessmann (2015), we can read that Belgium is a country with a relatively low prevalence of single parenthood (13.7% in 2016) in comparison to other countries, but it has one of the largest disparities of performance by family structure. While, in de Lange & al. (2014), they show that Belgium has a lower concentration effect (schools' share of single-

parents families) than other countries because of the higher share of single-parent of families of the country. They seem to disagree on the perception of the size of the prevalence of single parenthood but not on the absolute size nor on the existence of the negative effect.

From census data, we find that the share of single-parent families in Belgium was of 10% in 2019. But the share is not uniform across Communities: the prevalence is higher in the French Community (12%) than in the Flemish Community (8%). Moreover, when we look at the 10 municipalities with the largest share of single parents, none of them is a Flemish municipality. (Statbel, 2020)

If we look at the relative prevalence across OECD countries, we see on *Figure 3L* that Belgium was one of the countries with the highest prevalence for 2018 (OECD, 2020), which is the opposite of what Woessmann (2015) was saying. Even if the percentage is higher than the national census data, we assume that it is due to a different definition and since it is applied to all countries, we can hope that the relative ranking in not less relevant.

Figure 3L – Proportion of children living with a single parent in the OECD countries



Source: OECD Database

Hypothesis 4 – The proportion of single-parent families is higher in the French Community than in the Flemish Community.

2.2.2 The type of single-parent families

In the following sub-section, we will, as the literature did, focus on single parenthood due to divorce (or separation if not married at first) and on lone parenthood. However, there is a large heterogeneity among those families and the reasons behind (Pong, Dronkers, & Hampden-Thompson, 2003; Dronkers, 1994; Pong S.-L. , 1997). Over time, we experienced a shift in those reasons and the share of single parenthood due to out-of-wedlock childbearing has increased even though divorce is still the main reason (Pong, Dronkers, & Hampden-Thompson, 2003). It would, therefore, be sensible to assume different effects depending on the reasons and on the length of single parenthood, but most studies have been enabled to analyse it due to the lack of data.

On top of the reasons and the length of single parenthood, there is also the gender of the lone parent that could matter. On this subject, evidence are mixed. While some studies have found that children living in lone father families are more disadvantaged than their counterpart living

in lone mother families (Pong, Dronkers, & Hampden-Thompson, 2003; Dronkers, 1999; Mulkey, Crain, & Harrington, 1992), some other did not find any significant difference (Downey, 1994). The main reason why single mothers and single fathers lead to different performances is that children will experience different types of deprivation according to the gender of the remaining parent because mothers and fathers provide for different things. Overall, single-parent families have a lower income than two-parents' families, but lone mothers have an even lower income than lone fathers because of lower educational level (Dronkers, 1994). On top of this income argument, since mothers appear to care more about the children's well-being, while fathers are financial resources provider, children from lone-mothers' families are economically deprived, while children from lone-fathers' families suffer from a lack of interpersonal resources (Downey, 1994). Of course, this is not a general rule and things tend to change.

Hypothesis 5 – Children from lone-mothers' families perform better than those from lone-fathers' families in mathematics, reading and science.

2.2.3 The direct effect of the family structure on the child

Concerning the individual level, the 3 common explanations for the lower achievement of children from single-parent families are the lower financial, parental and social resources (Pong, Dronkers, & Hampden-Thompson, 2003; de Lange & Dronkers, 2018; de Lange, Dronkers, & Wolbers, 2014; Woessmann, 2015).

The reasons behind the lower financial resources are first that there is only one wage-earner left in the household (Azumah, Krampah, & Nachinaab, 2018; Pong, Dronkers, & Hampden-Thompson, 2003; Bankston & Caldas, 1998; Downey, 1994; Dronkers, 1994), which means that they have lower financial resources (de Lange & Dronkers, 2018), and second that people divorcing are a selective group of already less educated people, which means that they usually already have a lower level of financial resources before-hand (Dronkers, 1994; Frisco, Muller, & Frank, 2007; Dronkers, 1999; de Lange & Dronkers, 2018). However, there is no empirical evidence of this second point (de Lange, Dronkers, & Wolbers, 2014). Moreover, it seems that the economic deprivation is the main explanation of the lower achievement (Pong, Dronkers, & Hampden-Thompson, 2003) and could account up to half of the performance gap due to the family structure (Downey, 1994; Pong S.-L. , 1997).

Regarding the lack of parental control and support, single parents have less time and of lower quality to allocate to their children because they are alone to deal with the household and therefore tend to be less involved in their children's education (Pong, Dronkers, & Hampden-Thompson, 2003; de Lange, Dronkers, & Wolbers, 2014). This lower involvement means that they tend to help less for the homework, to have a lower interest and to be less in contact with the school (Azumah, Krampah, & Nachinaab, 2018).

Finally, the lack of social resources concerns both the lack of interaction and communication of parent with their children, and the fewer social interactions of parents with networks and community (Pong, Dronkers, & Hampden-Thompson, 2003). It might be caused by depression and stress of the divorce, combined with a possible moving in a new neighbourhood, which means that they are likely to lose the relations they had before (de Lange & Dronkers, 2018).

Moreover, parents do not see their children all the time if they share custody and therefore have fewer interactions with them. Overall, it will negatively affect children well-being and development (de Lange & Dronkers, 2018; de Lange, Dronkers, & Wolbers, 2014).

However, Woessmann (2015) found that the immigrant status and the language spoken at home could hardly contribute to the explanation of the lower performance of children from single-parent families.

Overall, those 3 factors are important, but they cannot explain the entire gap (Pong, Dronkers, & Hampden-Thompson, 2003). It is hard to identify precisely the channels because we cannot always measure them (Azumah, Krampah, & Nachinaab, 2018; Mulkey, Crain, & Harrington, 1992; Frisco, Muller, & Frank, 2007; de Lange, Dronkers, & Wolbers, 2014). Moreover, on top of those factors, the children from single-parent families tend to have a worse behaviour than children from two-parents' families because the single-parent families have less authority over the children (Azumah, Krampah, & Nachinaab, 2018; Mulkey, Crain, & Harrington, 1992; Downey, 1994; de Lange, Dronkers, & Wolbers, 2014; Pong S.-L. , 1997). In particular, it seems that the remaining effects disappear when we control for the children behaviour such as school lateness or not doing homework (Mulkey, Crain, & Harrington, 1992).

Hypothesis 2 bis – Most of the individual performance gap due to the family structure is explained by the lack of financial, parental and social resources.

2.2.4 The peer level mechanisms of single parenthood

Turning now to the school-level effect, it seems that in general the composition of the school body matters, and it is also true when we look at the family structure (Bankston & Caldas, 1998; Masci, De Witte, & Agasisti, 2018). The literature has identified 2 main channels through which the family structure harms the school quality. It seems to lower the quality because of fewer financial and social resources and because of lower teaching time (de Lange, Dronkers, & Wolbers, 2014; de Lange & Dronkers, 2018; Pong S.-L. , 1997).

The main idea behind the lack of financial and social resources of school with a large concentration of single-parent families is that the parents are characterized by lower economic, social and cultural status (ESCS) (de Lange, Dronkers, & Wolbers, 2014; de Lange & Dronkers, 2018). Firstly, it means that schools with low average ESCS will tend to be poorly financed (Pong S.-L. , 1997). If schools are less financed, it is likely that they will lack resources such as teachers (de Lange, Dronkers, & Wolbers, 2014) and that they will not be able to do as many activities as a school composed with parents who have money to invest in those activities (de Lange & Dronkers, 2018). Secondly, it also means the schools with a higher concentration of single-parent families will tend to receive less social support since single parents have less time to invest in the school (de Lange & Dronkers, 2018). Moreover, parents will invest less in social relations, as we saw at the individual level, which means that the higher the concentration, the fewer social interactions the families will have and the lower the community network (de Lange, Dronkers, & Wolbers, 2014; Pong S.-L. , 1997).

Regarding the teaching time, as already highlighted at the individual level, there are more behavioural problems in single-parent families than in two-parents' families because of the

parent weakened authority (Azumah, Krampah, & Nachinaab, 2018; Mulkey, Crain, & Harrington, 1992; Downey, 1994; de Lange, Dronkers, & Wolbers, 2014; Pong S.-L. , 1997). The teachers will have to spend more time dealing with behavioural issues which means that the teaching time is decreased and that the children have less time to ask questions when something is not clear to them. It has also been found that the teachers have lower expectations regarding the children and therefore put less effort into the educational outcome (de Lange, Dronkers, & Wolbers, 2014; de Lange & Dronkers, 2018). On top of that, fewer qualified teachers are willing to work in such schools because of the lower attractiveness (McKenna, 2018; de Lange & Dronkers, 2018).

Hypothesis 3 bis – The negative single-parent families school concentration effect is explained by fewer socio-economic resources and by the lower quality of teaching time of the school.

Finally, it appears that children from single-parent families suffer more from the concentration effect than children from two-parents' families. It means that the children with lone parents are twice at disadvantaged in comparison to their counterpart living with both of their parents because of the lack of resources both at home and at school. (de Lange, Dronkers, & Wolbers, 2014)

Hypothesis 6 – Children from lone-parent families are more affected by the negative effect of the concentration of single-parent families.

2.2.5 Conclusion

In this section, we have seen evidence that the family structure matters when assessing educational performance and, in particular, that single parenthood is associated with lower performance. We have also highlighted that the effect was working at two different levels: the individual and the schools. Finally, it appeared that being from a single-mother or a single-father family was not giving similar performance because of the different deprivations, linked with the parents' gender, children might experience.

2.3 Parenthood in the communities and educational performance

As we have seen in Section 1, there is an educational performance gap between the communities in Belgium. We also see that the studies cannot entirely explain the reasons behind. In Section 2, we have seen that the family structure can explain the lower performance of some children, those in single-parent families. Therefore, we are wondering whether the family structure could be a forgotten determinant of the Community gap.

In particular, in Section 2.1, we have seen that the proportion of single-parent families is not the same in both communities and is higher in the lagging community, the French one. To be able to state the two last hypotheses, we need to make again the difference between the individual effect and the concentration effect.

On the one hand, the average results in the French Community could be lower both because the individual effect of the family structure is larger, and the share of single-parent families is higher in the French Community. On the other hand, it could be only due to the higher

proportion of single-parent families in the French Community. In this case, more children have a lower performance which decreases more the average performance of the French Community without having a larger individual effect.

Hypothesis 7 – The individual performance gap due to the family structure effect is larger in the French Community than in the Flemish Community.

Second, as highlighted in Section 1.1, the peer effect appears to be overall stronger in the French Community, therefore we expect the concentration effect to be larger in the French Community as well.

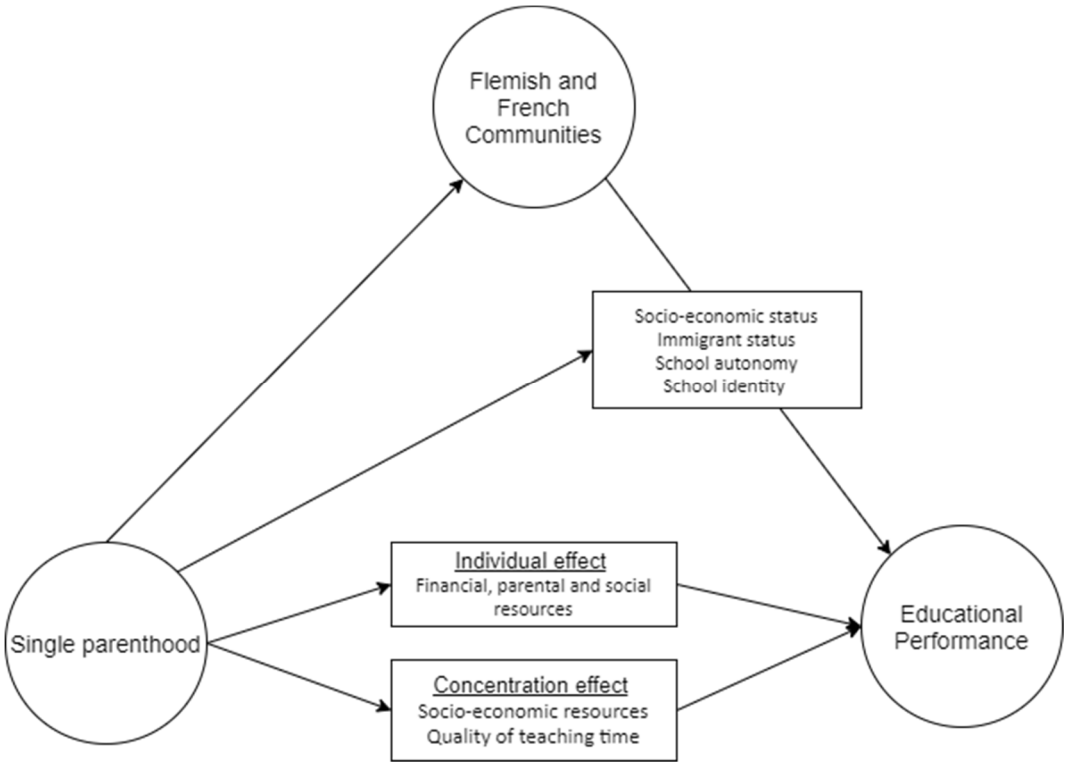
Hypothesis 8 – The single-parent families school concentration effect is larger in the French Community than in the Flemish Community.

Finally, based on the results, we would like to see if the family structure is helping to mitigate the Community gap, on top of the determinants already highlighted in the literature and stated in Section 1.1.

Hypothesis 9 – The family structure, individual and concentration effect, is a determinant of the performance gap between the French and the Flemish communities.

To summarize the conceptual framework developed in the 4 sections above, *Figure 4L* makes visual the core components, relations and variables of our study. We have a bubble for each broad component: the communities, the family structure and the educational performance. Then we have one arrow for each relation (2 for the family structure because of the 2 distinct channels): the communities and the performance, the family structure and the performance, the communities and the family structure, and the effect of the family structure on the performance applied to the communities. Finally, the boxes are stating the variables that should explain those relations, when it was possible.

Figure 4L – Conceptual framework



3 Chapter 3 – Data description

3.1 PISA data

The Programme for International Student Assessment (PISA) is an attempt to improve comparison of educational outcomes across the OECD countries as the number of years of schooling, which was the measure used up to then, is not reliable (OECD, 2019a). Indeed, depending on the country, the schooling system is likely to be different and so are the number of years to reach the same level.

Who?

PISA is an OECD initiative that tests the skills of a representative sample of 15-years-old students in each country under the evaluation through an agreed metric (OECD, 2019a). Doing so allows the OECD to give valuable feedback about the effectiveness of countries schooling systems and to try determining what are the factors of education's effectiveness (OECD, b). In 2018, educational experts from 93 countries and economies (which is 80% of the world) participated in the elaboration of PISA (OECD, 2019a; OECD, 2018).

Timing and purpose

Every 3 years, a representative sample of schools and students take the 2-hour test and the scores are then aggregated at the country's level to determine what is the mean score as well as its dispersion and to rank countries based on that score. The purpose is not purely to rank countries to tell which one is above the other, the idea is more to evaluate the efficiency of the schooling systems, to show what works and what does not work to improve efficiency such that all countries can learn from each other and that we can design the "perfect" school which would be efficient and inclusive such that anyone could attend to and would have the same chances. (OECD, b)

What is tested?

In the test, they assess whether children can apply what they have learned in class to real-life situations, covering mathematics, reading and science literacies, but also collaborative problem solving and financial literacy (OECD, b). They also have background questionnaires for students, parents and schools' principals to gather information about themselves and their environment (OECD, 2019a).

Two-stage stratified sample design

To select a representative sample, they use a two-stage stratified sample design. The first stage is to select schools having 15-year-old students and the second stage is to randomly select students within those schools. (OECD, 2017a; OECD, b)

All of the schools, from the country which is willing to participate in PISA[7], are first assigned to exclusive groups based on their characteristics to ensure the representativeness of the sample. In Belgium, in 2015, the stratification variables used to group similar schools in excludable

[7] When the country does not want to or cannot, but some regions do or are able to, they can join PISA on their own (OECD, b).

groups are the community (Flemish, French or German), the form of education (*réseaux*[8]), the funding (private or public), the ISCED[9] level (2 or 3) and the educational tracks (general, vocational or pre-vocational) (OECD, 2017a). Second, they are sampled with probabilities that are proportional to a function of their estimated number of eligible students (OECD, 2017a). It is worthy to know that schools could be excluded if they are inaccessible or too small (OECD, 2019a).

Then, students are sampled within schools. All 15-year-old students are eligible[10], and each country has to set a target cluster size which will determine the number of students to be randomly selected from each of the schools, usually, it is set to 35 (OECD, 2017a).

Test design and scores inference

The test design is based on using different sets of items to be able to evaluate a larger set of questions without making the assessment lasting more than 2 hours. To be comparable, different groups of students will have to answer different but overlapping[11] sets of items. Moreover, each test form is composed of four clusters of 30-minute questions. (OECD, 2019a)

To put all scores into one dimension while accounting for differences between both student's ability and question's difficulty levels, the Item Response Theory (IRT) is used (OECD, 2017a). This enables country comparisons, which is the main purpose of PISA. It generates a common scale that makes children comparable on all of the items even though they did not answer all the questions. Then, thanks to this IRT, they infer 5 plausible values for each literacy. The plausible values are scores that the students could have realised if he had to answer to all of the items and not only to a subset of those, as it is done. The purpose is to be able to draw a continuous distribution around the reported values that are discontinuous to have the dispersion of the actual abilities of the students based on the observed one (the test). (OECD, 2017a)

In our paper, we focus on Belgium and on the years of survey that had background data on the family structure as well as enough data to be able to split the observations across in the 2 communities we are interested in: The Flemish and the French Communities. This is, we used 2003, 2009 and 2012 as 2006, 2015 and 2018 had no data about the family structure and 2000 did not allow to compare the communities.

3.2 Database description

In this section we will describe the data we will use to test for the 9 hypotheses we stated in our Literature Review Chapter. As explained above, this is cross-sectional data from 2003, 2009 and 2012 survey in Belgium, downloaded from the PISA website (OECD, a) and their overall descriptive statistics are shown in *Appendix 1D*. Once we keep the observations that had data on the family structure and in particular children that were either in a two-parents family or in

[8] There are mainly 3 types, the Community schools, the Subsidized public schools and the Subsidized private schools, but there are also the Fee-paying private schools (Miller, 2020).
[9] International Standard Classification of Education
[10] If they are between 15 years 3 months and 16 years and 3 months at the time of the test and are in the schooling system since at least 6 years. Moreover, students with intellectual disability or limited proficiency in the language of the test could be excluded if the total rate of exclusions (school- and student-level) is below 5% (OECD, 2019a).
[11] Because we cannot assume that the difficulty of one set is the same of the one of another, overlapping sets allow to control for the variation in difficulty (OECD, 2019a).

a single-parent family, we are left with 21,233 observations (6,895 in 2003, 7,183 in 2009 and 7,155 in 2012). 13,244[12] out of those are children in the Flemish Community and the 7,989[13] observations left are in the French Community. This pool of students is split across 808 schools, but we cannot assume that they are 808 different schools as there is no possibility to link the schools from one survey to another since it is a basic numbering ID (from 1 to 265 in 2003, from 1 to 267 in 2009 and from 1 to 276 in 2012) with no further identification possible. The yearly descriptive statistics can be found in *Appendix 2D* for 2003, *Appendix 3D* for 2009 and *Appendix 4D* for 2012.

To verify our hypotheses, we will use the 3 literacies (Mathematics, Reading and Science) as dependent variables to avoid any bias since there is no reason to assume that a student performing high in Mathematics would perform the same in Reading even if the correlation is quite strong, for example. Indeed, as shown in *Appendix 5D*, the linear correlations are 0.87 for Mathematics and Reading, 0.92 for Mathematics and Science, and 0.91 for Science and Reading. This is a strong correlation, but not a perfect correlation and especially for Mathematics and Reading which means that it makes sense to test our hypotheses for all of the literacies.

We will use 6 student-level independent variables (Family Structure, ESCS index, Gender, Language, Immigrant Status and Sense of Belonging to School), 9 school-level variables (Share of Single-Parent Families, Average ESCS Index, Share of Immigrants, Urbanisation, School Autonomy, Teacher Participation, Teacher Shortage, Student-Teacher Ratio and Quality of Educational Resources) as well as community (as a measure of the Community performance gap) and year dummies (as a control). The descriptive statistics of all of those variables are shown in *Appendix 1D* for the merged database.

3.2.1 Dependent variables

Mathematics, Reading and Science Literacy

The literacy is the score students have at the PISA survey. The overall scale is done such that the mean is set at 500 and that the standard deviation is 100 across countries. It means that 500 will be the average achievement of respondents (OECD, 2014). The scores reported in the table are an average of the 5 plausible values, which "*are a representation of the range of abilities that a student might reasonably have*"[14]. Indeed, in PISA, students do not receive all items, but only a sub-sample, as explained in the first section of this chapter. However, those subsamples must overlap to allow a comparison between students who do not have the same questionnaire.

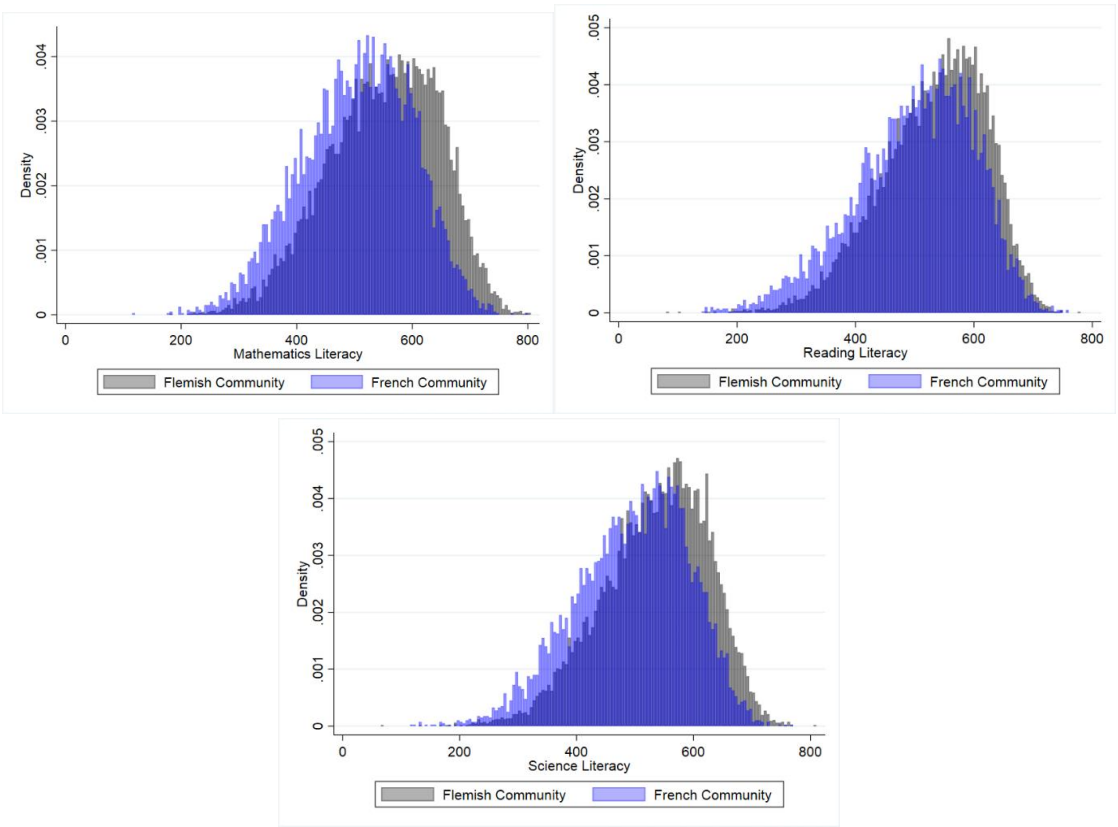
From the table, we see that, on average, the Belgian performance is higher than the OECD average for all the fields since all overall averages are above 500, which is the OECD average. However, the standard deviation is large. Moreover, we can already notice that the average performance is higher in the Flemish than in the French Community. The raw gap, for the

[12] 4,399 in 2003, 4,317 in 2009 and 4,528 in 2012.
[13] 2,496 in 2003, 2,866 in 2009 and 2,627 in 2012.
[14] OECD. (2009). *PISA Data Analysis Manual - SPSS Second Edition.* PISA. Paris: OECD Publishing. P.43

overall database, is around 46 points for Mathematics, 31 points for Reading and 38 points for Science which are all statistically significant at a 1% level[15].

We can also notice the difference in the scores' distribution in *Figure 1D*. The grey area, which represents the Flemish Community, is on the right-hand side of the blue area, which represents the French Community, no matter the literacy we use. It means that the Flemish Community tend to score higher than the French Community. Indeed, while the median score of the Flemish Community is 557.88 for Mathematics, 542.51 for Reading and 543.58 for Science, it is respectively 510.31, 510.57 and 504.69 for the French Community.

Figure 1D – Scores, distribution by community



3.2.2 Student-level independent variables

Family Structure

The family structure is initially a categorical variable which can take 4 different values: single parent (natural or otherwise), two parents (natural or otherwise), other or missing. For the aim of this paper, we keep it as a dummy variable equal to 1 when this is a single-parent family and is equal to 0 when it is a classical family form, this is two-parents family[16]. To construct this variable, the following question was asked to children: "*Who usually lives at <home> with you?*"[17]. They had to tick the yes or no boxes for mother, father, brother(s), sister(s), grandparents and others (OECD, 2013b). The main limitation here is that under the 4 first boxes

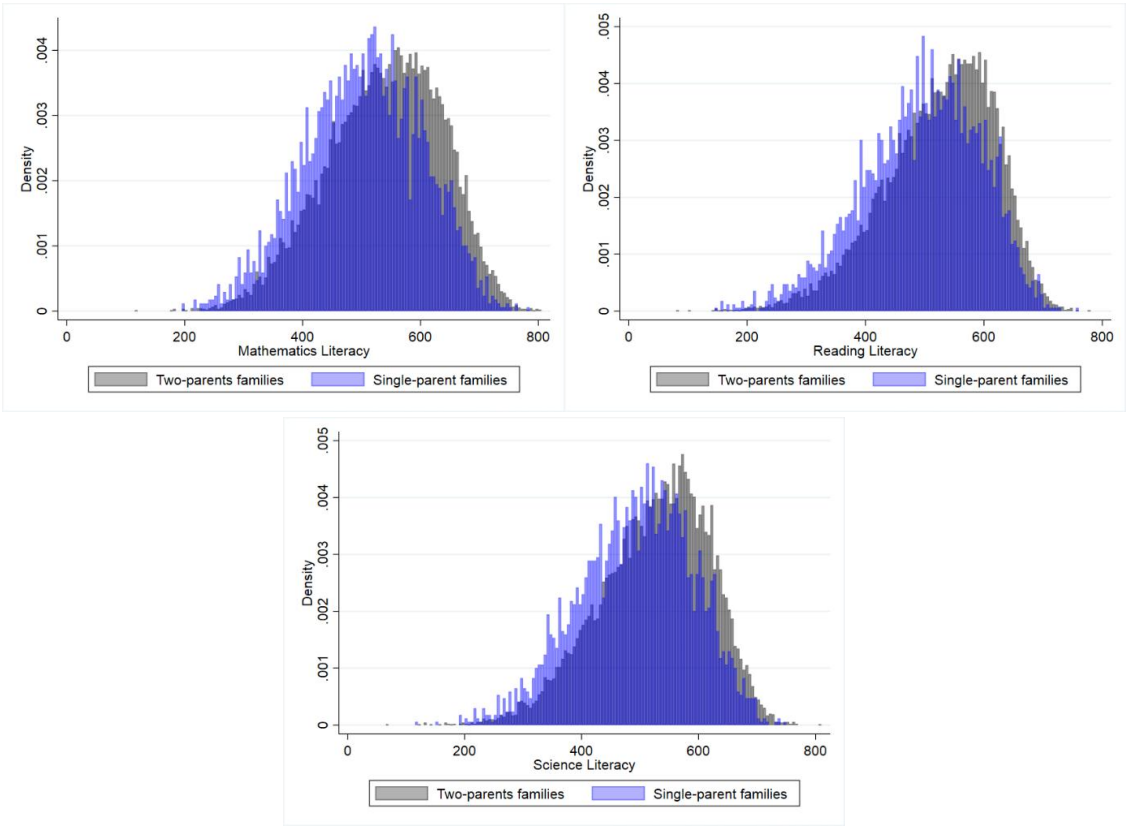
[15] A 1% level of confidence means that the chance to be wrong, that the coefficient is actually equal to 0 while we say it is not, is 1%.
[16] It is leaving aside 412 in 2003, 469 in 2009 and 595 observations in 2012.
[17] OECD. (2013). *Database - PISA 2012 - Student Questionnaire Form A*. Retrieved from OECD Programme for International Student Assessment: https://www.oecd.org/pisa/pisaproducts/PISA12_StQ_FORM_A_ENG.pdf. P.9

it includes step- and foster family, which means that living with the mother and the stepfather is assumed to be the same as living with the mother and the father. Using the same question, we also have the division of single-parent families according to the gender of the sole parent[18].

In the data, on average, 84% of children from the sample is living in a classic family and that 16% is in a single-parent family. The proportion varies by community as we see that the French Community has a higher proportion of children living with a single parent, 21% against 13% for the Flemish Community. This difference of 8% is statistically significant at a 1% level. It means that we can confirm Hypothesis 4, which stated that the proportion of single-parent families is higher is the French Community than in the Flemish Community.

We also see the distribution of single-parent families between single-mother and single-father families. The majority of single-parent families are headed by the mother, 13% out of the 16% which is a ratio of approximately 8 over 10. Regarding the difference of proportion across communities, there is a lower proportion which is female headed in the Flemish than in the French Community (84% versus 86%) and it is statistically significant at a 1% level of confidence.

Figure 2D – Scores, distribution by family structure



What is interesting is to already have a look at the distribution of scores by family structure, it is depicted in *Figure 2D*. We can see that the scores distribution of children from two-parents' families, the grey area, is on the right-hand side on the one of children from single-parent families, the blue area. It means that children from single-parent families tend to score lower

[18] For some years the sum of those proportions is not equal the single-parent proportion because sometimes data on the single-parent gender was missing.

than those from two-parents' families. Moreover, looking at the median scores for Mathematics, Reading and Science, for children from two-parents' families it is respectively 545.69, 536.47 and 534.70 while it is 505.30, 500.92 and 500.21 for those from single-parent families.

Gender

It is a dummy variable which takes the value 1 when it is a girl and the value 0 when it is a boy. This index was constructed by asking the following question to children: "*Are you female or male?*"[19].

In the table, we see that there is not a gender more represented than the other, as we would expect since the population in Belgium is well balanced regarding gender (Statbel, 2019) and education up to 16 years old is compulsory (Miller, 2020). Indeed, the proportions are 51% of boys and 49% of girls. Moreover, it is stable across Communities and the difference between them is not statistically significant.

ESCS Index

The Economic, Social and Cultural Status is a continuous SES index constructed by PISA. The variables composing it are the parental education, the highest parental occupation and the home possession, as an indirect indicator of family wealth (OECD, 2017a). The index has been standardised to all OECD countries such that its mean is equal to 0 and its standard deviation to 1, as for any standardised PISA index (OECD, 2017a). Since the mean of the index is 0, we will consider that students with an index above 0 have an advantage, while students with an index below 0 have a disadvantage with respect to the financial, social and cultural background.

In the table, we see that overall, the index ranges from -5.05 to 2.71 with an overall average of 0.21, which means that Belgium is above the OECD average by 0.21 standard deviation. We also see that the Flemish and the French Communities have similar indices, respectively 0.22 and 0.19, even if we could say that the French Community appears to be a bit less advantaged, by 0.03, which statistically significant at a 5% level.

Language

This variable indicates what language is usually spoken at home (OECD, 2014). It is a categorical variable which can take the following values: language of the test, other language or unknown. The unknown answer was assumed when the child did not answer the question.

From the data, we have that 78% of children often speaks the language of the test at home, while 15% speaks another language and it is unknown for 7% of them. It seems that more children are speaking the language of the test at home in the French than in the Flemish Community and this difference of 8% is statistically significant at a 1% level.

Immigrant Status

The immigrant status is a categorical variable having the following values: native, first-generation, second-generation or unknown. A native student is a child who is born in Belgium and at least one of his parents as well. A second-generation immigrant is a student who is born

[19] OECD. (2013). *Database - PISA 2012 - Student Questionnaire Form A*. Retrieved from OECD Programme for International Student Assessment: https://www.oecd.org/pisa/pisaproducts/PISA12_StQ_FORM_A_ENG.pdf. P.5

in Belgium, but both of his parents are born abroad, while for a first-generation immigrant, the child and his parents are all born abroad. (OECD, 2019b)

Since we have created dummies for each of the categories, the number in the table shows the proportion of students in each category. We see that, overall, 86% of the sample is native, 7% is second-generation, 6% is first-generation and 1% is unknown regarding the immigrant status. We can also notice that the proportion of native students is higher in the Flemish than in the French Community, with respectively 91% and 79% of their students' population, which is what Hirtt (2008) found with 2006 PISA data and what National statistics showed in 2011 (Petrovic, 2012). This statistically significant difference shows a higher share of children from either first- or second-generation of immigrants in the French Community.

Sense of Belonging to School

The sense of belonging to school is an index derived from statements the children had to answer on a strongly disagree – strongly agree scale (OECD, 2017a). One example of statements is "*I feel like an outsider at school*"[20]. As for the ESCS index and any other PISA index, it has been standardised at the OECD level with its mean set at 0 and its standard deviation at 1 (OECD, 2009; OECD, 2017a).

From *Appendix 1D*, we see that it ranges from -3.69 to 2.63 and that the Belgium average is -0.18. It means that Belgian students are below the OECD average by 0.18 standard deviation. It seems that in Belgium children have a lower feeling of belonging at school, but it is stable across communities as it is shown by the non-statistically significant difference between the Flemish and French Communities. We can compare it to similar neighbouring countries: France, Germany and The Netherlands. In those countries, this index is respectively around -0.04, -0.15 and 0.26. We see that Belgium is not an exception at being below the OECD average even though we do not know why. It is worth also to say that, in 2015, Belgium was doing better in terms of the sense of belonging as the difference with the OECD was not statistically significant anymore. For France, it was -0.06, Germany 0.29 and the Netherlands 0.17 (OECD, 2017b).

3.2.3 School-level independent variables

Share of Single-Parent Families

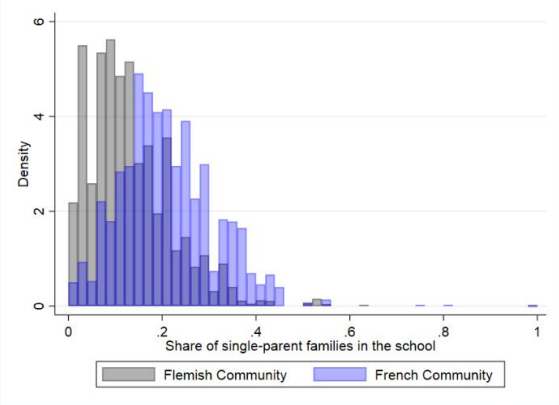
It has been created by computing the proportion of single-parent families in each school. It is simply the mean of the family structure dummy we created, taken at the school level.

The average proportion of single-parent families in schools is 16% in Belgium, but it is larger in the French Community, which has a proportion of 21%, while the Flemish Community only has a proportion of 13%. The 8% difference is statistically significant at a 1% level.

On *Figure 3D*, we see the distribution of this variable by community. It shows that the share of single-parent families in the school tends to be lower in the Flemish Community than in the French one. Indeed, the median proportion for the Flemish Community is 11.76% while it is 19.35% for the French Community.

[20] OECD. (2019). *PISA 2018 Results (Volume II): Where All Students Can Succeed.* PISA. Paris: OECD Publishing. Retrieved from https://doi.org/10.1787/b5fd1b8f-en. P.192

Figure 3D – Share of single-parent families in the school, distribution by community



Average ESCS Index

This variable has been generated by computing an average of the individual ESCS for each school. Therefore, it has the same interpretation than the individual one. This is, a positive number tells us that the school is socio-economically advantaged with respect to the OECD, while a negative number stands for disadvantaged.

From the data, the average school ESCS is 0.20, similar to the individual one. Regarding the communities, we can say that the Flemish Community has a slightly higher average than the French Community which is statistically significant at a 1% level.

Share of Immigrants

The share of immigrants is a share computed at the school level as well. We first generated a dummy variable for the immigrant status which is equal to 1 when the student is either from the first or the second generation of immigrants and equal to 0 when he is native or when it is unknown. Then, for each school of the sample, we computed the mean of this new dummy variable.

In the table, we see that it ranges from 0 to 1, 1 being 100% of the children are from immigration and 0 being all of them are either native or unknown. The overall average is 0.13, meaning that an average school has 13% of its population coming from immigration. We can notice that the share is larger in the French Community (20%), probably because there are already more children from immigration, as we stated above and that it is statistically significant at a 1% level.

Urbanisation

The urbanisation is a categorical variable taking one of the 5 following values: village, small town, town, city or large city (OECD, 2009). The question was asked to principals through the school questionnaire and the threshold used to split the categories is the number of people living in the location.

In the table, we see that, in Belgium, 3% of the sample goes to a school located in a village, 23% in a small town, 53% in a town, 13% in a city and 8% in a big city. Those proportions are not stable across communities except for the city. It seems that, in the French Community, more children are from a school located in a village or a big city and less in a small town or a city than in the Flemish Community, which is statistically significant at a 1% level.

School Autonomy & Teacher Participation

School autonomy is composed of two different indices: school autonomy and teacher participation (OECD, 2014). Both indices are constructed with the same set of questions asked to the school principal. They had a set of propositions such as "*Selecting teachers for hire*" and "*Choosing which textbooks are used*"[21] and they had to tick the boxes of who is doing that at school, either principal, teachers, school governing board, regional or local education authority or national education authority (OECD, 2013a). When they ticked principal, teachers or school governing board, it was used to compute the school autonomy and when it was only teachers, it was used to compute the teacher participation (OECD, 2014). It is again standardised at the OECD level which means that a higher number represents a higher degree of autonomy (OECD, 2017a).

In the data, we notice that Belgium has an overall index for school autonomy which is in the OECD average (0.00), while it is above the OECD average for teacher participation (0.24). We can also notice large differences across the Flemish and the French Communities. In particular, the Flemish Community is above the OECD average by, respectively, 0.19 and 0.46 standard deviation and the French Community is below the OECD average by 0.35 and 0.13 standard deviation. Therefore, it seems that the Flemish Community has more autonomy than the French one which is confirmed by the difference across communities which is statistically significant at a 1% level.

Teacher Shortage

This index is derived from the following question: "*Is your school's capacity to provide instruction hindered by any of the following issues?*"[22]. They had to answer some statements on a scale ranging from *Not at all* to *A lo*t (OECD, 2013a). The ones of interest to assess the teacher shortage are the ones about the lack of qualified teachers. The index based on this statement was also standardised, which means that its mean is set at 0 and its standard deviation at 1 (OECD, 2009; OECD, 2017a; OECD, 2014). We will, therefore, consider that a positive index shows a larger lack of qualified teacher than the OECD average while a negative index will picture the opposite.

The average index for Belgium is 0.28, which means that Belgium has a higher teacher shortage than the OECD average. Regarding the communities, it appears that the shortage is almost equal to the OECD average (0.01) in the Flemish Community while it is equal to 0.76 for the French Community. It means that this latest is experiencing a larger shortage than the Flemish Community and it is statistically significant at a 1% level.

Student-Teacher Ratio

The ratio is simply obtained by dividing the number of students, which is the school size, by the number of teachers. Since teachers can either work part- or full-time, they are weighted such that a part-time teacher has a weight of 0.5 and a full-time teacher has one of 1.0. (OECD, 2014)

[21] OECD. (2014). *PISA 2012 - Technical Report.* PISA. Paris: OECD Publishing. P.347

[22] OECD. (2013). *Database - PISA 2012 - School Questionnaire*. Retrieved from OECD Programme for International Student Assessment: https://www.oecd.org/pisa/pisaproducts/PISA12_ScQ_ENG.pdf. P.12

The Belgium average of students per teacher is 9.43. It means that they have 1 full-time teacher for more than 9 children. This ratio is larger in the French than in the Flemish Community and the difference of 1.11 students is statistically significant at a 1% level.

Quality of Educational Resources

Based on the same question than the one used to assess the teacher shortage but using the statement related to the equipment, the index about educational resources was built using the same standardisation as before. It means that its mean is set at 0 and its standard deviation at 1 (OECD, 2009; OECD, 2017a; OECD, 2014). Therefore, a negative index is supposed to be a proof of lower quality of educational resources while a positive one a proof of better quality than the OECD average.

In the table, we see that the average for Belgium is 0.24 which means that the quality of educational resources is better in Belgium than the OECD average. However, we see large differences behind when we consider the communities. Indeed, while the Flemish Community is above the OECD average by 0.51 standard deviation, the French Community is below this average by 0.21 standard deviation. This difference is statistically significant at a 1% level which seems to mean that the better quality of educational resources in Belgium is driven by a much higher one in the Flemish Community.

In this paper, the Teacher Shortage, the Student-Teacher Ratio and the Quality of Educational Resources variables are used as measures of the school resources, the teaching time and its ability to offer an education of good quality.

3.3 Brief correlation analysis

We check the correlations of the independent variables of interest (the communities and the family structure) with the literacies, in *Appendix 6D*, to already have an idea about the potential link even if a correlation does not imply causality. We see that while the scores tend to be positively correlated with the Flemish Community, it is negatively correlated with the family structure and the concentration of single-parent families.

We also look at the correlations between the family structure and other variables to prevent creating multicollinearity problems in our analysis by putting strongly correlated variables together. The linear correlations are shown in *Appendix 7D* for the student-level and school-level variables. From this table, we see that all of the correlations are below 0.4 which makes us believe that multicollinearity will not be such a strong problem.

3.4 Conclusion

The first section of this chapter briefly explained PISA and how it works, in general. Then we detailed for each of the variables their respective construction and descriptive statistics, in the second section. We already confirmed Hypothesis 4 and have a feeling about some of the other hypotheses. The following chapter will mobilise those data to formally analyse the 8 other hypotheses we want to verify.

4 Chapter 4 – Data Analysis

In this chapter, we will present the results of our analysis of Mathematics with the overall database. The other results, for Reading and Science as well as by year, can be found in the Appendix. Since most of the results found for Reading and Science are consistent with those for Mathematics, we will only refer to them for the size of the raw gaps and of the mitigated ones. If the results differ, we will spend a bit more time on those, in particular when 2012 results, the latest one, are different from the overall ones.

In this paper, the tools we use are robust Ordinary Least Squares (OLS) regressions and test of equality of coefficients. A regression is an econometric tool that allows measuring the relationship between the variable of interest, the dependent variable, and a set of potential determinants, the independent variables (Gelade, 2019). The method we use to estimate those regressions are the OLS which aims to minimize the sum of the squared residuals (a residual being what is not explained by the model) to find the line that best fits the data (Gelade, 2019). If we use robust regressions it is due to the potential heteroscedasticity in our data, therefore we correct the standard errors to avoid drawing biased conclusions. The test of equality will tell us whether 2 coefficients are statistically different at an imposed level of confidence.

The chapter has the following structure. There are 4 sections, one for the initial Community gap, one for the individual effect of the family structure, one for the concentration effect and one for the role the family structure can play in the Community gap. Each section will be subdivided is 3 parts, a brief data description of the variables used, the analysis of the results and a conclusion regarding the hypotheses tested.

4.1 Communities and educational performance

The purpose of this section is to test the Hypotheses 1 and 1 bis. They are, respectively, the existence of the Belgian Community gap and the mitigation of this gap by the highlighted variables from our literature review, being the socio-economic status, the immigrant status, the school autonomy and the school identity.

In this section we will use data from 2003 and 2012 only since some of the variables are not available in 2009: the school autonomy and the children sense of belonging to school. It restricts our sample to 11,275 observations once we keep only those with data on all of those 4 variables[23].

First, we would like to present some descriptive statistics for the variables which will be used in the regressions we conduct below and their respective expected relation with educational performance. For their expected effect on the Community gap, the explanations are developed in the first section of the Literature Review Chapter. In *Table 1A*, you can find this summary table, which is slightly different from the one in the Data Description Chapter since we describe only the data we will use in this section, as explained above. We will briefly describe each variable and add its expected link with educational performance, one by one. Then, we will conduct 7 regressions to test both hypotheses and analyse the results.

[23] On top of the 7,183 observation from 2009 that were not used, 159 observations in 2003 and 2,616 observations in 2012 did not have data for all the variables.

4.1.1 Data description

Table 1A – Descriptive statistics of variables used to test hypotheses 1 and 1 bis

	Overall		By community		Difference Flemish and French
			Flemish Community N = 7,250	French Community N = 4,025	
	Range	Mean (SD)			
Dependent Variables					
Mathematics Literacy	180.51 – 804.99	539.07 (97.64)	554.82 (95.25)	510.69 (95.46)	44.13***
Reading Literacy	83.22 – 756.35	522.75 (91.79)	535.18 (86.62)	500.36 (96.49)	34.82***
Science Literacy	67.28 – 765.61	522.09 (92.38)	534.54 (89.31)	499.65 (93.58)	34.89***
Student-Level Independent Variables (N = 11,275)					
ESCS Index	-4.13 – 2.71	0.20 (0.91)	0.22 (0.90)	0.16 (0.94)	0.06***
Immigrant Status					
Native	0 – 1	0.88	0.92	0.81	0.11***
Second Generation	0 – 1	0.06	0.04	0.10	-0.06***
First Generation	0 – 1	0.05	0.03	0.08	-0.05***
Unknow	0 – 1	0.01	0.01	0.01	0.00**
Sense of Belonging to School	-3.69 – 2.63	-0.19	-0.19	-0.19	0.00
School-level Independent Variables (N = 542)					
Average ESCS Index	-1.52 – 1.31	0.19 (0.50)	0.20 (0.48)	0.17 (0.54)	0.03***
Share of Immigrants	0 – 1	0.12 (0.16)	0.08 (0.12)	0.18 (0.20)	-0.10***
School Autonomy	-2.87 – 1.60	-0.01 (0.55)	0.19 (0.38)	-0.35 (0.62)	0.54***
Teacher Participation	-1.85 – 2.33	0.26 (0.83)	0.47 (0.78)	-0.12 (0.77)	0.59***

*p < 0.1, **p < 0.05, ***p < 0.01

Mathematics, Reading and Science Literacy

From the Table, we see that the mean Belgian performance is higher than the OECD average for all fields since all overall means are above 500 which is the OECD average. However, the standard deviations are large, between 91.79 and 97.64. Moreover, we can already notice that the average performance is higher in the Flemish than in the French Community. The raw gap, for the overall database, is around 44 points for Mathematics, 35 points for Reading and for Science which are all statistically significant at a 1% level.

ESCS Index

In the Table, we see that overall, the student-level index ranges from -4.13 to 2.71 with an overall average of 0.20, which means that Belgium is above the OECD average by 0.20 standard deviation. We also see that the Flemish and the French Community have slightly different indices even though they are both above the OECD average, respectively 0.22 and 0.16. We can say that the French Community appears to be a bit less advantaged than the Flemish Community, which is statistically significant at a 1% level.

From the literature, we can expect the scores of students to be positively related to their socio-economic and cultural status (O'Connell, 2019; Glick & Hohmann-Marriott, 2007; Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014; Considine & Zappalà, 2002; Ali, Zubair, Fahad, Hamid, & Awais, 2013). However, O'Connell put some nuances in the causal interpretation of the socio-economic status (SES) that some could infer from the results. He said that the causal direction is not clear and that the relation between the SES and the scores needs to be carefully taken into account for policy purposes (O'Connell, 2019).

For the average school ESCS index, we have in the data that it is 0.19, similar to the individual one. Regarding the communities, we can say that the Flemish Community has a slightly higher average than the French Community which is statistically significant at a 1% level.

According to the literature, a higher average ESCS index at the school level is associated with higher results, no matter the individual ESCS (O'Connell, 2019; Masci, De Witte, & Agasisti, 2018). Therefore, we expect a positive relationship between the school average ESCS and the scores.

Immigrant Status

Since we have created dummy-variables for each category, the number in the table shows the proportion of students in the sample from each category. We see that, overall, 88% of the sample is native, 6% is second-generation, 5% is first-generation and 1% is unknown regarding the immigrant status. We can also notice that the proportion of native students is higher in the Flemish than in the French Community, with respectively 92% and 81% of their sample, which is what Hirtt (2008) found with 2006 PISA data and what National statistics showed in 2011 (Petrovic, 2012). This difference is then reflected in the statistically significant higher share of children from either first- or second-generation of immigrants in the French Community.

Regarding the immigrant status, we expect ethnic minorities to perform less well than native students (Glick & Hohmann-Marriott, 2007), in particular, it has been shown that non-native students perform less well at school in Belgium (Hindriks & Verschelde, 2011). It means that we expect both first and second generation of immigrants to have a lower score than their native counterpart. However, it is interesting to notice that, in the United States, some groups of immigrants outperform native students (Kao & Tienda, 1995), which makes unclear the relationship between the immigrant status and the school performance (Pong, Dronkers, & Hampden-Thompson, 2003).

Sense of Belonging to School

From *Table 1A*, we see that it ranges from -3.69 to 2.63 and that the Belgium average is -0.19. It means that Belgian students are below the OECD average by 0.19 standard deviation. It seems that in Belgium children have a lower feeling of belonging at school, but it is stable across Communities as it is shown by the statistically non-significant difference between Flemish and French Communities. We can compare it to similar neighbouring countries: France, Germany and The Netherlands. In those countries, this index is respectively around -0.04, -0.15 and 0.26. We see that Belgium is not an exception at being below the OECD average even though we do not know why. It is worth also to say that, in 2015, Belgium was doing better in terms of the sense of belonging as the difference with the OECD was not statistically significant anymore. For France, it was -0.06, Germany 0.29 and the Netherlands 0.17 (OECD, 2017b).

Since we use the children's sense of belonging to school as a proxy for the school identity, we expect a greater sense of belonging to be associated with a higher score as having high grade is consistent with norms and social expectations about school, as the school identity is supposed to work (Burke, 1989; Hindriks & Verschelde, 2011). Moreover, it has been shown that sense of belonging was a good predictor of academic outcomes (Sánchez, Colón, & Esparza, 2005).

Share of Immigrants

In the table, we see that it ranges from 0 to 1, 1 being 100% of the children in the school are from immigration and 0 being all of them are either native or unknown. The overall average is 0.12, meaning that an average school has 12% of its population coming from immigration. We can notice that the share is larger in the French Community (18%), probably because there are already more children from immigration, as we stated above and that it is statistically significant at a 1% level.

It seems that the scores of students are linked to the school composition regarding the immigrant status (Masci, De Witte, & Agasisti, 2018). In particular, since there is a concentration of first-generation immigrants into schools offering a lower set of academic courses (Marks, 2005; Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014), we expect schools with a higher concentration of immigrants to perform less well.

School Autonomy & Teacher Participation

In the data, we notice that Belgium has an overall index for school autonomy slightly below the OECD average (-0.01), while it is above the OECD average for teacher participation (0.26). We can also notice large differences across the Flemish and the French Communities. In particular, the Flemish Community is above average by, respectively, 0.19 and 0.47 standard deviation and the French Community is below the average by 0.35 and 0.12 standard deviation. Therefore, it seems that the Flemish Community has more autonomy than the French one which is confirmed by the difference across communities which is statistically significant at a 1% level.

It seems that school autonomy enables reaching higher achievement on average results (Schütz, West, & Wöbmann, 2007; Hindriks & Verschelde, 2011; Hindriks, Verschelde, Rayp, & Schoors, 2010; Clark, 2009; King & Özler, 2005). Therefore, we expect a positive relationship between school autonomy (defined by both school autonomy and teacher participation) and the scores.

4.1.2 Results analysis

In the following pages, we present the results of the regressions testing Hypotheses 1 and 1 bis which are summarized in *Table 2A* for the overall database using Mathematics scores as the dependent variable. The other results can be found in *Appendix 1A* which reports all the Flemish Community coefficients.

We use a step-by-step approach starting from the basic model to compute the raw Community gap and then add one by one[24] the 5 highlighted determinants of this gap from Section 1.2 of the literature review.

Model 1 is the simplest model identifying the raw Community gap. It simply consists of regressing the literacy on the Community dummy and controlling for the year of the survey. We see that for Mathematics the raw gap is 44 points and, in *Appendix 1A*, for Reading and Science it is 34 points. It means that students from the Flemish Community perform on average

[24] Of course, the order of addition might affect the results we find, therefore when a variable showed no effect, we tested its sole effect in the Appendix.

better than those from the French Community as we expected. In particular, they seem to have the equivalent of one extra year of schooling regarding their abilities. Therefore, we can confirm Hypothesis 1.

Since this Model 1 explains only 5% of the Mathematics Literacy and we want to verify (or not) Hypothesis 1 bis, we conduct 6 other regressions to add the determinants one by one. Model 2 shows that controlling for the ESCS index decreases the gap by 3 points, which is relatively small. It also increases the explanatory power of the model to 26%, which means that as expected, the ESCS index is a major determinant of the educational performance. Moreover, we can see from the ESCS index coefficient that being 1 standard deviation above the OECD average, this is being socio-economically advantaged, increases the score by 50 points, which is the equivalent of more than one year of schooling or 0.5 scores' standard deviation. It shows that the system is not equitable and that the social background is an important determinant of the performance.

Table 2A – Test of hypotheses 1 and 1 bis using Mathematics literacy

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Flemish	44.23***	41.53***	36.60***	28.58***	28.60***	32.64***	32.71***
Community	(1.873)	(1.639)	(1.630)	(1.886)	(1.885)	(1.721)	(1.774)
Student ESCS		49.39***	45.30***	44.76***	44.57***	19.86***	19.85***
		(0.856)	(0.879)	(0.882)	(0.885)	(0.978)	(0.982)
Immig. status							
1st gen.			-56.19***	-56.27***	-56.17***	-43.20***	-43.40***
			(3.873)	(3.849)	(3.842)	(3.485)	(3.707)
2nd gen.			-40.66***	-40.12***	-40.42***	-31.36***	-31.54***
			(3.618)	(3.591)	(3.595)	(3.187)	(3.346)
Unknown			-86.31***	-85.67***	-85.61***	-68.25***	-68.33***
			(8.850)	(8.923)	(8.917)	(7.646)	(7.661)
School autonomy				13.64***	13.61***	6.628***	6.629***
				(1.713)	(1.714)	(1.587)	(1.587)
Teacher				1.208	1.203	-0.424	-0.421
participation				(1.061)	(1.060)	(0.941)	(0.941)
Sense of Belonging					2.479***	1.452*	1.452*
to School					(0.876)	(0.788)	(0.788)
School average						85.77***	85.88***
ESCS						(1.749)	(1.855)
School share of							0.924
Immigrants							(6.032)
Year 2012	-13.13***	-13.94***	-12.77***	-13.36***	-13.94***	-14.40***	-14.42***
	(1.813)	(1.605)	(1.575)	(1.575)	(1.586)	(1.426)	(1.435)
Constant	515.9***	508.1***	517.7***	522.9***	523.7***	508.6***	508.5***
	(1.710)	(1.499)	(1.547)	(1.664)	(1.677)	(1.576)	(1.805)
Observations	11,275	11,275	11,275	11,275	11,275	11,275	11,275
R-squared	0.051	0.265	0.293	0.298	0.298	0.431	0.431
Test of equality Flemish Community coefficients Model 1 and Model 7: chi2 = 54.35, Prob > chi2 = 0.000							

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

Controlling for the immigrant status, in Model 3, we see that the gap further (on top of the ESCS index) decreases by almost 5 points and that the model explains 29% of the score. We

can also see that being from the first or second generation of immigrants decreases the score respectively by 56 points and 40 points which are around 0.6 and 0.4 standard deviations.

Model 4 adds the school autonomy measured by both the school autonomy and teacher participation indices. The teacher participation index is not statistically significant for Mathematics, but it is significant at a 5% level for Reading and 1% level for Science. Regarding the school autonomy, we see that a school which is 1 standard deviation above the OECD average will increase the average performance of its students by 13 points. Adding those variables decreases the Community gap to 28 points. As the explanatory power of the model is 29.8%, it seems that the school autonomy is not adding much explanation to the scores even if the school autonomy index coefficient is statistically significant at a 1% level.

Adding the children sense of belonging to school, as an imperfect proxy for the school identity, we see that it does not add any explanatory power to the model even if it is statistically significant at a 1% level. Moreover, it does not change the size of the Community gap, as we can see in Model 5.

Model 6 is controlling for the average ESCS index at the school level. It is an indicator of social concentration which seems to help to explain the scores since it is statistically significant, and it increases the explanatory power of the model to 43%. In particular, being in a school which seems to be socially advantaged increases the score. However, regarding the gap, adding this variable increases the Community gap by 4 points. It now has a size of 32 points.

Finally, adding the school share of students' population from immigration does not help explaining anything more. Its coefficient is small and insignificant, and the measure of the Community gap remains at 32 points for Mathematics, 23 points for Reading and 22 points for Science. However, when we use only this variable and compare the gap to the initial one, we see that it explains a large share of the raw gap as the Community coefficient decreases to 24 points for Mathematics[25]. It means that the share of immigrants in the school is capturing some of the effects already explained by the variables we included earlier, such as the ESCS index and the immigrant status.

When we look only at 2012 results, which are the most recent ones given our data requirement (having information about the family structure), we have slightly different results as we show in *Table 3A*. The performance gaps are all lower in levels in 2012 than in our previous table, of about 10 points for Mathematics, 17 points for Reading and 5 points for Science. It seems that the initial variables are more able to explain the performance gap in 2012 than what we concluded above, indeed it explains 34% for Mathematics, 62% for Reading and 59% for Science, while above we had around 68% of the gap was unexplained.

Therefore, we can confirm Hypothesis 1 bis since the gap is mitigated by some, not all, of the chosen variables. It seems that between 22 and 32 points, between 65% and 72% of the raw gap, are still not explained by our models. However, it is worth saying that when we restrict ourselves to 2012 data only, the remaining Community gap, once controls are added, is 23 points for Mathematics, 6 points for Reading and 28 points for Science. As you can see in

[25] See *Appendix 6A*

Appendix 1A, the Community gap for reading in 2012 is statistically significant at a 5% level (and not 1%) and is relatively low once the controls are added. However, it was already a low raw gap of 17 points, which means that the variables explain up to 62% and that even if its level is lower, some part of the Community gap remains.

Table 3A – Test of hypotheses 1 and 1 bis for 2012

	Mathematics		**Reading**		**Science**	
	Model 1	**Model 7**	**Model 1**	**Model 7**	**Model 1**	**Model 7**
Flemish Community	35.82***	23.61***	17.27***	6.489**	29.59***	15.65***
	(2.834)	(2.643)	(2.775)	(2.601)	(2.706)	(2.601)
Observations	4,539	4,539	4,539	4,539	4,539	4,539
R-squared	0.033	0.414	0.009	0.419	0.025	0.390

Test of equality Flemish Community coefficients Model 1 and Model 7:
Mathematics: chi2 = 27.38, Prob > chi2 = 0.000
Reading: chi2 = 22.37, Prob > chi2 = 0.000
Science: chi2 = 24.29, Prob > chi2 = 0.000

Note: Model 7 includes the initial determinants of the Belgian Community gap: the student ESCS index, the immigrant status, the school autonomy, the teacher participation, the children sense of belonging to school, the school average ESCS and the school share of immigrants.

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

4.1.3 Conclusion

Overall, we can conclude that there is a Community gap and that this gap is partly mitigated by some of the highlighted variables, mainly the ESCS index, but also the immigrant status, the school autonomy and the average school ESCS index. We can see that the difference between the Flemish Community coefficients in Model 1 and in Model 7 from *Table 2A* is 11.52 for Mathematics and this difference is statistically significant at a 1% level.

It means that Hypotheses 1 and 1 bis can be confirmed; there is a Community performance gap and this gap does not entirely disappear when we control for the identified variables, no matter the literacy used.

4.2 Parenthood and educational performance, the direct effect

This section aims to test the Hypotheses 2, 2 bis and 5. They are, respectively, the existence of a performance gap between children from single-parent families and those from classic families, the moderation of this gap by the lack of financial, parental and social resources as highlighted in our literature review, and the better performance of children from lone-mothers' families than those from lone-fathers' families.

In this section, we use the entire database. As for the previous section, we first briefly present some descriptive statistics of the variables used in the regressions and add their expected effect on the performance score. We also add the details on single-parent families to allow the comparison between lone-mothers and lone-fathers families, which is our Hypothesis 5. Regarding their link with the family structure, the explanations can be found in the second section of the Literature Review Chapter. Then we will run 6 regressions to test those 3 hypotheses.

4.2.1 Data description

Table 4A – Descriptive statistics of variables used to test hypotheses 2, 2 bis and 5

	Overall		By community		Difference Flemish and French
			Flemish Community N = 13,244	French Community N = 7,989	
	Range	Mean (SD)			
Dependent Variables					
Mathematics Literacy	117.47 – 804.99	532.90 (98.07)	550.27 (95.36)	504.11 (95.71)	46.15***
Reading Literacy	83.22 – 775.14	519.73 (94.26)	531.72 (88.41)	499.85 (100.11)	31.87***
Science Literacy	67.28 – 806.08	519.81 (95.45)	534.30 (90.60)	495.77 (95.80)	38.53***
Student-Level Independent Variables (N = 21,233)					
Family Structure					
Two parents	0 – 1	0.84	0.87	0.79	0.08***
Single parent	0 – 1	0.16	0.13	0.21	-0.08***
Single mother	0 – 1	0.13	0.11	0.18	-0.07***
Single father	0 – 1	0.03	0.02	0.03	-0.01***
Gender					
Boy	0 – 1	0.51	0.50	0.51	-0.01
Girl	0 – 1	0.49	0.50	0.49	0.01
ESCS Index	-5.05 – 2.71	0.21 (0.92)	0.22 (0.91)	0.19 (0.94)	0.03**
Language					
Test	0 – 1	0.78	0.75	0.83	-0.08***
Other	0 – 1	0.15	0.18	0.11	0.07***
Missing	0 – 1	0.07	0.07	0.06	0.01***
Immigrant Status					
Native	0 – 1	0.86	0.91	0.79	0.12***
Second Generation	0 – 1	0.07	0.04	0.10	-0.06***
First Generation	0 – 1	0.06	0.04	0.09	-0.05***
Unknow	0 – 1	0.01	0.01	0.02	-0.01***

*p < 0.1, **p < 0.05, ***p < 0.01

Family Structure

In the data, on average, 84% of children from the sample is living in a classic family and that 16% is in a single-parent family. The proportion varies by community as we see that the French Community has a higher proportion of children living with a single parent, 21% against 13% for the Flemish Community. This difference of 8% is statistically significant at a 1% level.

As explained in the literature review, the family structure is an important predictor of academic performance with the socioeconomic status (Glick & Hohmann-Marriott, 2007). We expect children from single-parent families to perform lower than those from classical families as it has been agreed in the literature (Downey, 1994; Considine & Zappalà, 2002; Glick & Hohmann-Marriott, 2007; Woessmann, 2015).

We also see the distribution of single-parent families between single-mother and single-father families. The majority of single-parent families are headed by the mother, 13% out of the 16% which is a ratio of approximately 8 over 10. Regarding the difference of proportion across communities, there is a lower proportion which is female-headed in the Flemish than in the French Community (84% versus 86%) and it is statistically significant at a 1% level of confidence.

For the gender of the sole parent, it seems that the literature does not agree on the expected effect on educational performance. Indeed, while some state no difference (Downey, 1994), others argue that children with a single mother will perform better than those with a single

father (Pong, Dronkers, & Hampden-Thompson, 2003; Dronkers, 1999; Mulkey, Crain, & Harrington, 1992).

Gender

In *Table 4A*, we see that there is not a gender more represented than the other, as we would expect since the population in Belgium is well balanced regarding gender (Statbel, 2019) and education up to 16 years old is compulsory (Miller, 2020). Indeed, the proportions are 51% of boys and 49% of girls. Moreover, it is stable across Communities and the difference between them is not statistically significant.

As for the gender of the sole parent, the evidence regarding the effect of the gender of the child on the educational performance are mixed. Indeed, some argue that boys are outperformed by girls except for Science (Deary, Strand, Smith, & Fernandes, 2007), some found that girls perform better than boys no matter the subject (Pomerantz, Altermatt, & Saxon, 2002; Considine & Zappalà, 2002) and some explained that boys perform better than girls on mathematical tasks (Frost, Hyde, & Fennema, 1994; Glick & Hohmann-Marriott, 2007; Masci, De Witte, & Agasisti, 2018).

Language

From the data, we have that 78% of children often speaks the language of the test at home, while 15% speaks another language and it is unknown for 7% of them. It seems that more children are speaking the language of the test at home in the French than in the Flemish community and this difference of 8% is statistically significant at a 1% level.

As the test is in the Community language, Flemish or French, if the child does not speak this language fluently, it will score lower (Glick & Hohmann-Marriott, 2007; Kola Aina, Gbenga Ogundele, & Sunday Olanipekun, 2013) since he might take more time to understand the questions, for example. For this reason, we expect children speaking mainly the test language at home to perform better than those speaking another one.

4.2.2 Results analysis

In the following pages, we will present the results of the regressions testing Hypotheses 2, 2 bis and 5 which are summarized in *Table 5A* for the overall database using Mathematics scores as the dependent variable. The other results can be found in *Appendix 2A* which reports all the single parent coefficients of the tests of Hypotheses 2 and 2 bis and in *Appendix 4A* which displays the sole parent's gender coefficients of the tests of Hypothesis 5 in the 1st column.

We use again a step-by-step approach starting from the basic model to compute to raw individual family structure gap and then add one by one some potential channels explaining this gap, from Section 2.3 of the Literature Review Chapter. To mitigate the individual family structure gap, we will use the ESCS index, the immigrant status, the language and the gender of the child. We will also use Model 2 to test for the effect of the gender of the sole parent and to see if indeed children from lone-mother perform better than those from lone-father.

Model 1 is the simplest model identifying the raw gap. It simply consists of regressing the literacy on the single-parent dummy and controlling for the year of the survey. We see that, overall, for Mathematics, the raw gap is 37 points, and, it is 31 points for Reading and 32 points

for Science, from *Appendix 2A*. It means that students from lone-parent families perform lower than their counterparts living in two-parents' families, in particular, they have the equivalent of one year less of schooling regarding their abilities or 0.4 score's standard deviation. However, the individual family structure is only explaining 2.5% of the educational performance. From that model, we can confirm Hypothesis 2 and conclude that, indeed, being in a single-parent family gives an educational disadvantage to children.

In Model 2, we test Hypothesis 5 and see no statistically significant difference in performance regarding the gender of the single parent. Moreover, even if there is no significant effect, we can notice that the coefficient is slightly negative indicating a lower performance of children from single mothers if any. It means that we cannot confirm our hypothesis regarding the gender of the sole parent, which stated that children from single-mother families would outperform those from single-father families.

Table 5A – Test of hypotheses 2, 2 bis and 5 using Mathematics literacy

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Single parent	-37.14***	-36.43***	-21.59***	-20.86***	-20.82***	-20.71***
	(1.840)	(2.487)	(1.682)	(1.644)	(1.634)	(1.631)
Single mother		-0.740				
		(1.704)				
Student ESCS			48.24***	43.63***	42.72***	42.44***
			(0.639)	(0.653)	(0.659)	(0.656)
Immig. status						
1st gen.				-58.73***	-53.14***	-53.54***
				(2.632)	(2.672)	(2.665)
2nd gen.				-47.12***	-40.21***	-39.95***
				(2.455)	(2.502)	(2.494)
Unknown				-86.34***	-81.74***	-84.11***
				(5.710)	(5.795)	(5.779)
Language						
Other than test					-8.567***	-9.501***
					(1.827)	(1.822)
Unknown					-35.68***	-36.57***
					(2.312)	(2.303)
Girl						-15.45***
						(1.146)
Year 2009	-15.30***	-15.26***	-18.06***	-15.78***	-15.64***	-15.16***
	(1.632)	(1.635)	(1.451)	(1.421)	(1.436)	(1.428)
Year 2012	-18.28***	-18.28***	-17.47***	-15.82***	-15.81***	-15.29***
	(1.656)	(1.656)	(1.468)	(1.432)	(1.448)	(1.445)
Constant	550.2***	550.2***	538.3***	545.3***	548.3***	555.9***
	(1.232)	(1.232)	(1.108)	(1.102)	(1.114)	(1.266)
Observations	21,233	21,233	21,233	21,233	21,233	21,233
R-squared	0.025	0.025	0.226	0.263	0.271	0.277
Test of equality Single Parent coefficients Model 1 and Model 6: chi2 = 296.43, Prob > chi2 = 0.000						

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

We start testing Hypothesis 2 bis with Model 3 by adding the student ESCS index to the single parent dummy. The explanatory power of the model increasing from 2.5% to 22.6% which means that as expected, the ESCS index is a major determinant of the educational performance.

Moreover, it decreases the individual family structure performance gap by a bit more than 15 points, which is 41.8% of the gap. It means that, as explained by the literature, a large part of the difference of performance might be due to the lack of financial, cultural and social resources that we capture by the ESCS index. We also notice from the ESCS coefficient that being 1 standard deviation above the OECD level, this is being socio-economically advantaged, increases the score by 48 points, which is close to what we found in *Table 2A*.

In the following models, we add some other variables such as the immigrant status (Model 4), the language (Model 5) and the gender of the child (Model 6) but their abilities to further mitigate the raw gap seems limited and the gap stays around 20 points. Moreover, we notice that the immigrant status seems to explain 3.7% more the performance, the language adds 0.8% and the gender 0.6%. As expected, children from immigration or speaking another language than the test score lower than the others. Regarding the gender, we see that girls are outperformed by boys by around 15 points in Mathematics and by 6 points in Science, but they outperform boys by 30 points in Reading.

For Model 4 and Model 5, we tested the sole effect of those variables on the individual family structure gap and find that the immigrant status explains 3 points, and the language 1 point for Mathematics overall[26]. It means that those variables are probably capturing some effect of other variables added earlier even if alone they are capturing only a small share of the gap.

Therefore, we see that as stated in Hypothesis 2 bis, the individual performance gap due to the family structure can be mitigated by the lack of financial, cultural and social resources. The gap in the last model is, overall, about 20 points for Mathematics, 15 points for Reading and 16 points for Science.

4.2.3 Conclusion

Overall, we can confirm that there is an individual gap due to the family structure and that this gap is explained at 41.8% for Mathematics, 47.7% for Reading and 46.9% for Science, by the ESCS. We see that the difference between the single parent coefficients in Model 1 and in Model 6 is 16.43 points for Mathematics and that it is statistically significant at a 1% level.

It means that Hypotheses 2 and 2 bis can be confirmed; there is an individual performance gap due to the family structure and this gap is mostly explained by the ESCS index even if more than half of it remains unexplained, no matter the literacy used.

However, as shown by Model 2, we have no difference in educational performance based on the single parent gender. Therefore, we cannot confirm Hypothesis 5; children from lone-mothers' families do not perform better than those from lone-fathers' families, no matter the literacy used.

4.3 Parenthood and educational performance, the school concentration effect

The goal of this section is to test the Hypotheses 3, 3 bis and 6. They are, respectively, the lower educational performance of children in a school with a higher concentration of single-parent

[26] See *Appendix 7A* and *Appendix 8A*

families than those with a lower one, some explanations of this gap are the fewer socio-economic resources and the lower quality of teaching time, and the even larger negative effect of the school concentration on children in single-parent families themselves.

In this section, we will use the entire database. As for the previous section, we will first briefly present some descriptive statistics of the variables used in the regressions and add their expected effects on the performance score. Regarding their link with the single-parent families' school concentration, the explanations can be found in Section 2.4 of the Literature Review Chapter. Then we will run and analyse 5 regressions to test those 3 hypotheses.

4.3.1 Data description

Share of Single-Parent Families

In *Table 6A*, the average proportion of single-parent families in schools is 16% but it is larger in the French Community, which has a proportion of 21%, while the Flemish Community only has a proportion of 13%. The 8% difference is statistically significant at a 1% level.

We have seen in the literature review that the school composition from the family structure point of view matters when assessing the educational performance (Masci, De Witte, & Agasisti, 2018; Bankston & Caldas, 1998; de Lange, Dronkers, & Wolbers, 2014; de Lange & Dronkers, 2018; Pong S.-L. , 1997). In particular, we expect children from schools with a higher concentration to be outperformed by those from schools with a lower one.

Urbanisation

In the Table, we see that, in Belgium, 3% of the sample goes to a school located in a village, 23% in a small town, 53% in a town, 13% in a city and 8% in a big city. Those proportions are not stable across communities except for the city. It seems that, in the French Community, more children are from a school located in a village or a big city and less in a small town or a city than in the Flemish Community, which is statistically significant at a 1% level.

As a greener environment seems to be associated to higher academic performance because of its positive effect on the physical and mental health through increased physical activity, lower stress and lower pollution, to cite only a few, (Masci, De Witte, & Agasisti, 2018), we expect higher scores in villages, small towns and towns than in cities and big cities.

Teacher Shortage

The average index for Belgium is 0.28, which means that Belgium has a higher teacher shortage than the OECD average. Regarding the communities comparison, it appears that the shortage is almost equal to the OECD average in the Flemish Community (0.01) while it is equal to 0.76 for the French Community. It means that this latest is experiencing a larger shortage than the Flemish Community and it is statistically significant at a 1% level.

It seems to be a consensus on the fact that the teacher shortage harms the educational performance as it seems to be decreasing the competences requirement on the staff to be recruited (Ingersoll, 2003; McKenna, 2018). Therefore, we expect the teacher shortage to decrease the scores.

Table 6A – Descriptive statistics of variables used to test hypotheses 3, 3 bis and 6

	Overall		By community		Difference Flemish and French
			Flemish Community N = 13,244	French Community N = 7,989	
	Range	Mean (SD)			
Dependent Variables					
Mathematics Literacy	117.47 – 804.99	532.90 (98.07)	550.27 (95.36)	504.11 (95.71)	46.15***
Reading Literacy	83.22 – 775.14	519.73 (94.26)	531.72 (88.41)	499.85 (100.11)	31.87***
Science Literacy	67.28 – 806.08	519.81 (95.45)	534.30 (90.60)	495.77 (95.80)	38.53***
Student-Level Independent Variables (N = 21,233)					
Family Structure					
Two parents	0 – 1	0.84	0.87	0.79	0.08***
Single parent	0 – 1	0.16	0.13	0.21	-0.08***
ESCS Index	-5.05 – 2.71	0.21 (0.92)	0.22 (0.91)	0.19 (0.94)	0.03**
School-level Independent Variables (N = 808)					
Share of Single-Parent Families	0 – 1	0.16 (0.10)	0.13 (0.09)	0.21 (0.10)	-0.08***
Average ESCS Index	-2.35 – 1.60	0.20 (0.51)	0.21 (0.49)	0.18 (0.55)	0.03***
Urbanisation					
Village	0 – 1	0.03	0.01	0.05	-0.04***
Small Town	0 – 1	0.23	0.28	0.16	0.12***
Town	0 – 1	0.53	0.56	0.47	0.09***
City	0 – 1	0.13	0.13	0.13	0.00
Big City	0 – 1	0.08	0.02	0.18	-0.16***
Teacher Shortage	-1.20 – 3.19	0.28 (0.97)	0.01 (0.94)	0.73 (0.82)	-0.72***
Student-Teacher Ratio	1.33 – 44.33	9.43 (2.97)	9.03 (2.95)	10.14 (2.87)	-1.11***
Quality of Educational Resources	-3.59 – 2.20	0.24 (0.98)	0.51 (0.87)	-0.21 (0.98)	0.72***

*p < 0.1, **p < 0.05, ***p < 0.01

Student-Teacher Ratio

The Belgium average of students per teacher is 9.43. It means that they have 1 full-time teacher for more than 9 children. This ratio is larger in the French than in the Flemish Community and the difference of 1.11 students is statistically significant at a 1% level.

The higher this ratio, the higher the number of students per teacher and therefore the more his time has to be spread across the pool of students. A bit similar to the idea of teacher shortage, we expect that the higher this ratio, the lower the performance due to the lower teacher availability to students (Thurlow, Ysseldyke, Wotruba, & Algozzine, 1993; Koc & Celik, 2015).

Quality of Educational Resources

In the table, we see that the average for Belgium is 0.24 which means that the quality of educational resources is better in Belgium than the average of the OECD. However, we see large differences behind when we consider the Communities. Indeed, while the Flemish Community is above the OECD average by 0.51 standard deviation, the French Community is below this average by 0.21 standard deviation. This difference is statistically significant at a 1% level which seems to mean that the better quality of educational resources in Belgium is driven by much higher one in the Flemish Community.

We expect a higher quality of educational resources to be associated with higher scores, as it has been shown in the literature (Savasci & Tomul, 2013; Murillo & Román, 2011).

4.3.2 Results analysis

In the following pages, we will present the results of the regressions testing Hypotheses 3, 3 bis and 6 which are summarized in *Table 7A* for the overall database using Mathematics scores as the dependent variable. The other results can be found in *Appendix 3A* which reports all the share of single-parent families' coefficients of the tests of Hypotheses 3 and 3 bis and in *Appendix 4A* which displays the interaction coefficients of the tests of Hypothesis 6 in the 2nd column.

We again use a step-by-step approach starting from the basic model to compute the educational gap due to the concentration of single-parent families while controlling for the individual effect. Then we add the potential channels explaining this gap, from Section 2.4 of the Literature Review Chapter. To mitigate the concentration effect on the educational performance, we will use the school average ESCS index as a proxy for its socio-economic resources, and the quality of educational resources, the teacher shortage and the student-teacher ratio as a proxy for the quality of teaching time. In Model 2, we will test the interaction effect to see if indeed children from single-parent families are more affected by the concentration effect than those in classic families.

Model 1 is, therefore, the simplest model to test for the concentration effect. We notice that controlling for the share of single-parent families in the school decreases the individual effect of the family structure from -20.71 to -10.78, for Mathematics, this is a reduction of about half of the effect. Looking at the concentration coefficient, we see that it is statistically significant at a 1% level and that if the entire school is composed of children from single-parent families, which would represent perfect segregation, the score of those children would be 369 points lower for Mathematics and it would be 333 points for Reading and 331 points for Science. Of course, those numbers are large and have to be interpreted carefully. Indeed, this variable is likely to be correlated with other variables and we need to control for those, which is what we do in Model 3, Model 4 and Model 5. However, from this first model, which seems to explain 15.1% of the performance, we can confirm Hypothesis 3 and conclude that, indeed, the school concentration of children from single-parent families is associated with lower scores.

In Model 2, we test the effect of the concentration on children from single-parent families, which is Hypothesis 6. As shown by the interaction coefficient, even if it seems that the effect is positive, meaning that the concentration effect is a bit lower for those children than for others, this is not statistically significant as the standard error is large. Moreover, it does not increase at all the explanatory power of the model. From this, we cannot confirm Hypothesis 6 which predicted a stronger concentration effect (this is a negative interaction coefficient) for children from single-parent families.

To see how the average ESCS index of the school can help to mitigate the gap created by the concentration of single-parent families, we need to control for the individual ESCS index as well. It is done in Model 3. With this model, we see that the ESCS, individual and school, indices increase the explanatory power of the model to 41.6%, which is logical since a large

part of the difference of performance might be due to the lack of financial, cultural and social resources that we captured by the ESCS index, as already highlighted earlier in this chapter. Furthermore, it seems to explain 53.1% of the concentration effect for Mathematics, as it decreases the concentration coefficient to -173.1. It means that after controlling for the ESCS index of the school and of the child, with perfect segregation, schools with only classical families will score 173 points higher, which is 1.73 standard deviations, than those with only single-parent families.

Table 7A – Test of hypotheses 3, 3 bis and 6 using Mathematics literacy

	Model 1	Model 2	Model 3	Model 4	Model 5
Single parent	-10.78***	-15.62***	-7.215***	-7.455***	-7.478***
	(1.779)	(3.826)	(1.498)	(1.536)	(1.530)
School share of single-parent families	-369.3***	-374.0***	-173.1***	-159.0***	-140.0***
	(6.584)	(7.306)	(5.892)	(6.169)	(6.323)
Single parent and share of single-parent interaction		23.26			
		(16.45)			
Student ESCS			19.64***	19.57***	19.57***
			(0.705)	(0.722)	(0.720)
School average ESCS			82.16***	72.94***	74.13***
			(1.342)	(1.587)	(1.607)
School quality of educ. resources				5.269***	4.248***
				(0.590)	(0.591)
School teacher shortage				-6.688***	-6.624***
				(0.587)	(0.584)
School student-teacher ratio				2.726***	3.020***
				(0.240)	(0.242)
Urbanisation					
Small Town					19.64***
					(3.134)
Town					15.78***
					(3.035)
City					9.504***
					(3.255)
Big City					-10.11***
					(3.504)
Year 2009	-18.57***	-18.50***	-23.04***	-19.92***	-19.52***
	(1.525)	(1.526)	(1.263)	(1.304)	(1.297)
Year 2012	-34.96***	-34.97***	-25.00***	-23.75***	-23.31***
	(1.556)	(1.556)	(1.304)	(1.337)	(1.339)
Constant	612.0***	612.6***	557.4***	530.6***	511.1***
	(1.553)	(1.610)	(1.448)	(2.612)	(3.855)
Observations	21,233	21,233	21,233	19,883	19,883
R-squared	0.151	0.151	0.416	0.432	0.438
Test of equality Share of single-parent coefficients Model 1 and Model 5: chi2 = 2,023.71, Prob > chi2 = 0.000					

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

In Model 4, we add the variables supposed to capture the quality of teaching time and see that it does not help to explain much more. Indeed, it increases the explanatory power of the model by less than 2% and explains only 4% more the concentration gap which is however statistically significant at a 1% level. Testing for the equality of the concentration coefficient, we have that

the difference between Model 3 and Model 4 is statistically significant at a 1% level[27]. What is surprising when we look at the coefficients of those variables, is that while the quality of educational resources and the teacher shortage are aligned on our expectations, it is not the case for the student-teacher ratio. It seems that the larger this ratio the higher the score. In particular, having 1 extra student per teacher should increase the score by 2.7 points. Our intuition on this strange result is that it could be explained by the non-alignment of the class size on the student-teacher ratio (Koc & Celik, 2015; OECD, 2019c). Indeed, the student-teacher ratio could capture the size of the courses' offer of the school and not the time each teacher has to allocate individually to children.

Finally, in Model 5, we controlled for the school surrounding greenness using the urbanisation variable. As for Model 4, its extra explanatory power is limited to 0.6% and it decreases the gap by 19 points, which is 5% of the initial gap. Testing for the equality of the concentration coefficient, we have that the difference between Model 4 and Model 5 is statistically significant at a 1% level[28]. What is also interesting to notice is that even if we predicted a decreasing enhancing effect on the performance between villages and big cities, it does not seem to be as clear. Indeed, small towns, towns and cities seem to perform better than villages. One possible explanation would be that villages are too small and have other characteristics counteracting the positive effect of the surrounding greenness.

We also tested the sole effect of the quality of teaching time on the peer family structure gap and find that it is explaining 25% of the raw gap (almost 100 points)[29]. It means that the quality of teaching time is capturing the effect of some variables we added earlier, probably the school average ESCS.

Therefore, we see that as stated in Hypothesis 3 bis, the concentration of single-parent families' effect can be mitigated by the socio-economic resources and the quality of teaching time. The gap in the last model is about 140 points for Mathematics, 104 points for Reading and 111 points for Science, as shown in *Table 7A* and *Appendix 3A*.

4.3.3 Conclusion

Overall, we can confirm that there is a gap created by the concentration of single-parent families and that this gap is explained at 53.1% for Mathematics, 60.7% for Reading and 57.5% for Science, by the ESCS. We also see that the difference between the concentration of single-parent families' coefficients in Model 1 and in Model 5 is 229.3 points for Mathematics and that it is statistically significant at a 1% level.

It means that Hypotheses 3 and 3 bis can be confirmed; there is a performance gap due to the concentration of single-parent families, on top of the individual gap[30], which still exists when we add the concentration of single-parent families at the school level, and this gap is mostly

[27] chi2 = 44.16 and prob > chi2 = 0.000
[28] chi2 = 146.76 and prob > chi2 = 0.000
[29] See *Appendix 9A*
[30] However, when we restrict our analysis to 2012, the individual effect becomes statistically non-significant as soon as we start mitigating the concentration effect. It can be found in *Appendix 3A*.

explained by the ESCS even if a bit more than 40% of it remains unexplained, no matter the literacy used.

However, as shown by Model 2, we do not have a different concentration effect on children from single-parent families than the one on those from classical families. Therefore, we cannot confirm Hypothesis 6; children from single-parent families are not more affected by the concentration effect than those from two-parents' families, no matter the literacy used.

4.4 Parenthood in the communities and educational performance

The purpose of this section is to test the Hypotheses 7, 8 and 9. They are, respectively, the larger individual effect of the family structure on the French Community, the larger concentration effect of single-parent families on the French Community and the contribution of the family structure, both individual and school levels, to the mitigation of the Belgian Community gap.

Table 8A – Descriptive statistics of variables used to test hypotheses 7, 8 and 9

	Overall		**By community**		**Difference Flemish and French**
			Flemish Community N = 13,244	French Community N = 7,989	
	Range	Mean (SD)			
Dependent Variables					
Mathematics Literacy	117.47 – 804.99	532.90 (98.07)	550.27 (95.36)	504.11 (95.71)	46.15***
Reading Literacy	83.22 – 775.14	519.73 (94.26)	531.72 (88.41)	499.85 (100.11)	31.87***
Science Literacy	67.28 – 806.08	519.81 (95.45)	534.30 (90.60)	495.77 (95.80)	38.53***
Student-Level Independent Variables (N = 21,233)					
Family Structure					
Two parents	0 – 1	0.84	0.87	0.79	0.08***
Single parent	0 – 1	0.16	0.13	0.21	-0.08***
ESCS Index	-5.05 – 2.71	0.21 (0.92)	0.22 (0.91)	0.19 (0.94)	0.03**
Immigrant Status					
Native	0 – 1	0.86	0.91	0.79	0.12***
Second Generation	0 – 1	0.07	0.04	0.10	-0.06***
First Generation	0 – 1	0.06	0.04	0.09	-0.05***
Unknow	0 – 1	0.01	0.01	0.02	-0.01***
Sense of Belonging to School	-3.69 – 2.63	-0.18 (0.90)	-0.19 (0.86)	-0.18 (0.98)	0.01
School-level Independent Variables (N = 808)					
Share of Single-Parent Families	0 – 1	0.16 (0.10)	0.13 (0.09)	0.21 (0.10)	-0.08***
Average ESCS Index	-2.35 – 1.60	0.20 (0.51)	0.21 (0.49)	0.18 (0.55)	0.03***
Share of Immigrants	0 – 1	0.13 (0.17)	0.09 (0.14)	0.20 (0.20)	-0.11***
School Autonomy	-2.87 – 1.60	0.00 (0.55)	0.19 (0.38)	-0.35 (0.63)	0.53***
Teacher Participation	-2.07 – 2.81	0.24 (0.84)	0.46 (0.77)	-0.13 (0.83)	0.59***

*p < 0.1, **p < 0.05, ***p < 0.01

In this section, we will use the entire database to test Hypothesis 7 and 8 but we will have to restrict ourselves to the observations used in the first section of this chapter to test Hypothesis 9. It was the ones from 2003 and 2012 since some of the variables are not available in 2009. It restricts our sample to 11,275 observations once we keep only those with data on all of those 4 variables initially mitigating the gap.

Since all the data we will mobilise in this section have already been described a second time in this chapter (and a first time in the Data Description Chapter), we will not do it again. We will only place the table summarizing the variables we will use, without any restriction of the sample, which is *Table 8A*.

4.4.1 Results analysis

In the following pages, we will present the results of the regressions testing Hypotheses 7, 8 and 9 which are summarized in *Table 9A* for the overall database using Mathematics scores as the dependent variable. The other results can be found in *Appendix 4A* which displays the coefficients of the tests of Hypotheses 7 and 8 in respectively, the 3rd and 4th columns and in *Appendix 5A* which reports all the Flemish Community coefficients for the tests of Hypothesis 9. There is also another table, *Table 10A*, which summarises the results of Hypothesis 9 for 2012 regarding Mathematics, Reading and Science as they slightly differ from the overall results shown in *Table 9A* and that the most recent survey might be more accurate to draw recommendations for policy interventions.

We used Model 1 and 2 to test Hypotheses 7 and 8 by adding the interactions of the community dummy with the single parent dummy and with the share of single-parent families. Model 3 of *Table 9A* is Model 7 of *Table 2A*, the mitigated Community gap and Model 4 and 5 will add to it the single parent dummy and the share of single-parent families to see how the Community gap is affected by the family structure.

From Model 1, we cannot confirm Hypothesis 7 as the coefficient of the interaction of the Community with the single parent dummy is negative and statistically significant at a 1% level for Mathematics. It is the opposite of our hypothesis as it means that the Flemish Community appears to suffer more from the negative individual effect of single parenthood. For Science, it is also negative but statistically significant at a 10% level only, while for Reading it is negative and statistically non-significant. However, from *Table 9A*, it seems that children from single-parent families in the Flemish Community still score 9 points higher than those in the French Community because of the overall Community gap.

To test for Hypothesis 8, we use Model 2 which adds the concentration effect of the family structure as well as the interaction of the community dummy with the share of single-parent families, on top of the community dummy and on top of the individual effect. The interaction coefficient is negative and statistically significant at a 1% level which is, as for Hypothesis 7, the opposite of Hypothesis 8's prediction. The coefficient is -106 for Mathematics, -40 for Reading and -62 for Science. From those results, we cannot confirm Hypothesis 8.

At this stage, what is left to us is testing the contribution of the family structure to the explanation of the Community gap, both through the individual and the concentration effects. Model 3 of *Table 9A* is Model 7 of *Table 2A*, we will not comment on it, but we will use it as the benchmark to see the contribution. In Model 4, we add the single parent dummy which captures the individual effect and can see that the gap does not change much, it decreases by 0.19 for Mathematics and it corresponds to almost 3% of the raw gap[31]. The figures for Reading and Science are around 0.8% and 2%.

Adding the share of single-parent families to capture the concentration effect of the family structure, we find that the gap decreases further to 24 points for Mathematics and to 17 points for Reading and Science. It means that the concentration of single-parent families explains 16%

[31] Testing for the equality of the Community coefficient, we have that the difference between Model 3 and Model 4 is statistically significant at a 1% level: chi2 = 33.54 and Prob > chi2 = 0.000

of the raw gap for Mathematics, 18% for Reading and 15% for Science[32]. It means that we can confirm Hypothesis 9 and conclude that the family structure does contribute to the mitigation of the Belgian Community gap, in particular, it can explain up to 19% of the gap, which is around 3 times the ESCS effect.

Table 9A – Test of hypotheses 7, 8 and 9 using Mathematics literacy

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Flemish Community	45.59***	37.92***	32.71***	31.52***	24.43***
	(1.481)	(2.801)	(1.774)	(1.775)	(1.900)
Single parent	-24.74***	-10.78***		-15.31***	-10.32***
	(2.637)	(1.773)		(1.959)	(2.010)
Single parent and Flemish Com. interaction	-12.13***				
	(3.647)				
School share of single-parent families		-271.3***			-91.08***
		(10.84)			(8.723)
Share of single-parent and Flemish Com. interaction		-106.5***			
		(13.87)			
Year 2009	-13.49***	-16.19***			
	(1.586)	(1.532)			
Year 2012	-17.65***	-31.74***	-14.42***	-15.16***	-19.44***
	(1.623)	(1.576)	(1.435)	(1.435)	(1.492)
Constant	519.9***	579.4***	508.5***	512.0***	532.3***
	(1.577)	(2.795)	(1.805)	(1.850)	(2.667)
Observations	21,233	21,233	11,275	11,275	11,275
R-squared	0.071	0.161	0.431	0.434	0.440
Test of equality Flemish Community coefficients Model 3 and Model 5: chi2 = 124.69, Prob > chi2 = 0.000					

Note: Models 3 to 5 include the initial determinants of the Belgian Community gap: the student ESCS index, the immigrant status, the school autonomy, the teacher participation, the children sense of belonging to school, the school average ESCS and the school share of immigrants.

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

However, we cannot stop the analysis here. Indeed, when looking at yearly results, we found that the results for 2012 were not always the same as those we just explained. Therefore, we decided to add *Table 10A* which summarises Models 4 and 5 of Hypothesis 9's results for 2012.

In the table, we see that while some gap remains after controlling for the initial variables and for the family structure for Mathematics and Science, the gap is not statistically significant for Reading anymore. For the 3 different literacies, we have that the family structure accounts for 13%, 20% and 10% of the initial gap of 2012, which was shown in *Table 3A*. Moreover, it seems that the gap for Reading disappears once we add the family structure.

[32] Testing for the equality of the Community coefficient, we have that the difference between Model 4 and Model 5 is statistically significant at a 1% level: chi2 = 98.97 and Prob > chi2 = 0.000

Table 10A – Test of hypothesis 9 for 2012

	Mathematics		Reading		Science	
	Model 4	**Model 5**	**Model 4**	**Model 5**	**Model 4**	**Model 5**
Flemish Community	23.33***	18.80***	6.412**	2.938	15.36***	11.94***
	(2.645)	(2.717)	(2.605)	(2.681)	(2.602)	(2.680)
Single parent	-8.215**	-2.620	-2.336	1.956	-8.800***	-4.567
	(3.213)	(3.268)	(2.977)	(3.039)	(3.108)	(3.160)
School share of single-parent families		-109.7***		-84.14***		-82.99***
		(15.33)		(14.60)		(15.49)
Observations	4,539	4,539	4,539	4,539	4,539	4,539
R-squared	0.415	0.422	0.419	0.423	0.391	0.396

Test of equality Flemish Community coefficients Model 4 and Model 5:

Mathematics: chi2 = 42.26, Prob > chi2 = 0.000

Reading: chi2 = 29.67, Prob > chi2 = 0.000

Science: chi2 = 26.02, Prob > chi2 = 0.000

Note: Models 4 and 5 include the initial determinants of the Belgian Community gap: the student ESCS index, the immigrant status, the school autonomy, the teacher participation, the children sense of belonging to school, the school average ESCS and the school share of immigrants.

Robust standard errors in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01

4.4.2 Conclusion

We have seen that we cannot confirm Hypotheses 7 and 8, as the coefficient indicates a larger effect for the Flemish Community and not for the French Community as we expected.

However, we can confirm Hypothesis 9 which states that the family structure helps to mitigate the Community gap. Indeed, as we have seen from *Table 9A* and *Table 10A*, the family structure can explain up to 20% of the raw performance gap.

5 Chapter 5 – Discussion and Conclusion

5.1 General comments

As we have seen, this paper is an attempt to assess the relevance of considering the family structure as an explanation of the Belgian Community gap. Our paper was structured in 3 main chapters: the literature review and conceptual framework, the data description and the data analysis. Each of those chapters was then split into sections to follow the conceptual framework presented at the end of the literature review, *Figure 4L*. This is, looking at the Belgian Community gap and its channels, the gap based on family structure and its channels as well and the contribution of the family structure to the Community gap analysis.

First, we have seen, in the Literature Review Chapter, that since education was a community competence since 1989 in Belgium, it was interesting to look at the evolution of the educational performance of its main communities: the French and the Flemish Community. Studies on educational performance by community showed that there was a gap in favour of the Flemish Community which could reach the equivalence of around one and a half year of schooling and that this gap could have appeared before education has been made a community competence, in the mid-1970s. Those studies also tried to find the determinants of this gap and concluded that the ESCS, the immigrant status, the school identity, the school autonomy and the peer effect could explain some part of the gap. This leads to our first hypotheses, 1 and 1 bis, that we then confirmed in the Data Analysis Chapter.

Indeed, from this analysis, we have seen that our data confirm the well-known Belgian Community gap highlighted in the literature and that some, not all, of the stated determinants seem to explain around one-third of the initial raw gap, with the overall database. This is, there is a raw performance gap between the French and the Flemish Community, in favour of this latest, which is around the equivalent of 1 year of schooling for Mathematics in 2012 (Hypothesis 1). Moreover, we have seen that we can explain between 35% (if overall data) and 62% (if only 2012 data) of this gap with the variables already highlighted in the literature, but not the entire gap (Hypothesis 1 bis). Our results are generally aligned on previous studies, as we will explain in Section 3 of this chapter.

Second, since a part of the Community gap was systematically left unexplained and that the family structure has been found to harm the educational performance, both at the individual and peer levels, we wanted to confirm this effect in Belgium to then see whether it could further explain the Community gap. We find that children in single-parent families tend to perform 37 points lower, the equivalent of one year of schooling, than their counterparts living in two-parents' families and that the school share of single-parent families harms children attending that school. This leads to our second and third hypotheses, 2 and 3, that we then confirmed in the Data Analysis Chapter.

Regarding the channels behind the effect of the family structure, we could not test all of those highlighted in the literature review, being the lack of financial, parental and social resources at the individual level and being the fewer socio-economic resources as well as the lower quality of teaching time of the school at the school level. Indeed, PISA data does not allow to test for the parental or social support other than through the ESCS proxy and similarly for the quality

of teaching time of the school which was proxied by the school quality of educational resources, the teacher shortage and the student-teacher ratio. We find that at both levels the main channel was the ESCS even if some other variables are also playing a (smaller) role. This leads to the explanation of our second and third hypotheses, 2 bis and 3 bis, that we then confirmed in the Data Analysis Chapter.

Indeed, from our data analysis, it seems that the ESCS index plays an important role in this even if is not the only factor as it explains only 40% of the individual effect and 53.1% of the concentration effect. At the individual level, even when we control for the ESCS index, the immigrant status, the language and the gender of the child, 56% of the gap remains (Hypothesis 2 bis). At the school level, 38% is left unexplained after controlling for the ESCS index, the school quality of teaching time and urbanisation (Hypothesis 3 bis). Our results are mostly aligned on previous studies as it will be explained below, in Section 4.

Third, we wanted to include the family structure into the Community gap analysis as we find that the proportion of single-parent families is larger in the French Community than in the Flemish Community, which was our hypothesis 4. Doing so decreases the gap further, to 24 points which means that the family structure can further explain 19% of the raw gap, on top of the ESCS index. Unfortunately, it means that the main channel we identify in the second part is not the one at stake regarding the Community gap. This is, the part of the family structure effect that we could not explain with our data is affecting somehow the Community gap. Therefore, we cannot say that it is the family structure *per se* which is affecting the Community gap as it could be something else behind that we did not identify, but it is still giving us clue on what is going on as it is at least a correlation.

In parallel of those 5 main hypotheses, we analysed other patterns such as the effect of the gender of the sole parent (Hypothesis 5), the larger concentration effect on children from single-parent families (Hypothesis 6), as well as the stronger individual and concentration effects of the family structure on children from the French Community (Hypotheses 7 and 8). All of those hypotheses have not been confirmed by our data though. It means that even though Hindriks & al. (2009) found that the peer effect was stronger in the French than in the Flemish Community, it is not the case for the peer effect of the family structure. Indeed, as we have seen the peer effect is stronger in the Flemish Community.

The raw gaps we found in our overall data appear every year even if it seems to decrease over time. For example, the raw Community gap was around 50 points in 2003 and 2009, and around 35 points in 2012 for Mathematics. Indeed, as shown in Figure 2L[33], all the raw gaps seem to decrease over time, which is a good sign for equality but not necessarily for the overall performance in Belgium, as both communities' performance seems to be decreasing.

Finally, we can conclude that despite the limits of the data, as we will explain in Section 2 of this chapter, we find a relationship between the Community gap and the family structure that was still unexplored so far, at our best knowledge. More studies should be carried out on that specific relationship and maybe other data could be used to answer the limits of PISA data.

[33] Belgium raw scores by Community, OECD average raw scores and the raw gaps between the Belgian Communities, using PISA data from 2000 to 2018

Moreover, as our conclusions are drawn from 2012 data which means that it has been 8 years since then, maybe the relationships changed.

In the following sections, we will state some of the limits of our data. Then we will compare our results with previous studies, in particular those of Hindriks & Verschelde (2011), of Danhier & al. (2014) and of Hirtt (2008) on the Belgian Community gap and those of de Lange, Dronkers, & Wolbers (2014) and of Woessmann (2015) on the gap due to the family structure. Finally, we will try to find some potential extensions of this paper as well as its policy implications.

5.2 Limits of PISA data

Even if PISA data has some big advantages for such an analysis we conducted in the previous chapter, it also has some non-negligible limits. In the following paragraphs, we state some of those advantages and limits at stake when we study the link between the family structure and the performance, in particular.

5.2.1 Advantages

The first advantage is that PISA provides for a large range of background data which is useful to study the performance and its relationship with the students' background or with the schools' types, resources, etc. (Woessmann, 2015).

The second advantage is that asking the question of who is living at home directly to children gives the real family form and not the formal situation which is a more accurate answer in a world where marriage is not so common anymore[34] and where we have a lot of out of wedlock births (de Lange, Dronkers, & Wolbers, 2014).

5.2.2 Limits

Regarding the limits, the first one is that PISA does not allow for a causality analysis, it is rather a correlation. However, it still allows to see some patterns and it is therefore not less relevant to study the relationships between the background variables and the performance. Indeed, as explained by Woessmann (2015), the analysis gives descriptive patterns since single-parent family is likely to hinder some other characteristics as decisions to get divorced, to go through a separation, etc. might be linked to other background information. Therefore, the link between the performance and the family structure is a correlation which might capture its relationship with other related factors that are important for child development.

Second, as PISA asks children to self-report their family structure there is a risk (but relatively small in a developed country such as Belgium) to consider a parent working abroad for a long period as a separation (de Lange, Dronkers, & Wolbers, 2014) while it is not a single-parent family as we defined it in this paper. Another limit is that this question has not been asked since the 2012 survey, which limits our analysis to the results founds using data from 8 years ago.

Third, the data does not allow to split foster and biological families, which means that a child with one biological and one stepparent will be considered in the same kind of family than a

[34] In 1990, Belgium registered 64,554 marriages while in 2012 it was 42,198. For the Flemish Region it goes from 38,257 to 25,522 and for the Walloon Region it is respectively 20,265 and 12,228 (Statbel, 2012). Moreover, the crude wedding rate in Belgium was 7.1% in 1960 and 3.9% in 2017 (Statbel, 2017).

child with his two biological parents. It is likely to give understated results as shown by Woessmann (2015) when he made the comparison with 2000 PISA data.

The fourth limit is related to the structure of the data which is cross-sectional data and not longitudinal. Indeed, cross-sectional data do not allow to know for how long the family structure is such as recorded in the data as it is a one moment picture (Dronkers & Robert, 2003) and we do not know the causes of separation (de Lange, Dronkers, & Wolbers, 2014). It is likely that being in a single-parent family structure for 1 year or 10 years does not have the same effect. Additionally, due to this structure of data, each school in each survey is considered as a different school even though they might be the same for some of them (de Lange, Dronkers, & Wolbers, 2014). Furthermore, cross-sectional data appears to be more vulnerable to unobserved differences between children from different family structures and schools with different shares of single-parent families (de Lange, Dronkers, & Wolbers, 2014). However, it seems that PISA data is the best data available so far as such longitudinal data does not exist in our best knowledge.

Lastly, as we have seen in the analysis, we could not test exactly the channels through which the family structure has an effect on the performance as we lack data to test for the lack of parental and social resources and for the lower quantity of teaching time in schools with a higher share of single-parent families which had to be imperfectly proxied.

5.3 Community gap in the literature

In Hindriks & Verschelde (2011), they stated that the raw Community gap measured around 50 points. Our results are aligned on theirs as our estimation is 44 points when we used repeated cross-sectional data (2003 and 2012) to assess the raw gap in Mathematics performance. Our lower estimate of the gap is simply because we use the 2012 database which show a lower gap that previous years. Indeed, it measures up to 36 points while it was up to 54 points in 2003 and 49 points in 2009. It is also confirmed by Danhier & al. (2014) who used Mathematics 2012 data only and found a raw gap of 34.1 points.

Regarding the possible determinants of the gap, Hindriks & Verschelde (2011) stated that what could explain some of the gap are the socio-economic status, the immigrant status, the school autonomy, the school identity and the peer effect. In our analysis, we used the ESCS index, the immigrant status, the school autonomy and the teacher participation, the sense of belonging to school as well as the school average ESCS index and the school share of immigrant to account for all of those potential explanations. On the contrary of what Danhier & al. (2014) have concluded in their report and in line with what Hirtt (2008) found, in our analysis the SES of the student and the immigrant status does play a role in mitigating respectively 6% and 11% of the raw gap which is not so much but not negligible either. Also, we have seen that the sense of belonging to school and the school share of immigrants do not seem to play an additional role in mitigating the gap. It could be because the sense of belonging to school is an endogenous variable which is not a really good proxy for the school identity, even though it is the best proxy we could think of based on the data we have. Regarding the school share of immigrants, it might be that most of the immigrant difference highlighted by Hindriks & Verschelde (2011) are explained by the school average ESCS index that we included earlier in our analysis.

Moreover, in previous researches, they could explain up to half of the gap, as in Danhier & al. since their initial gap was of 34 points and the final one was 20 points. In our case, we did not explain as much with the overall database, but we reach a final gap of 23 points for Mathematics, 6 points for Reading and 15 points for Science once we restrict ourselves to 2012 data, as they did in their paper. Our estimation of the "final" gap is then close to what they found even though we did not use all the variables they used. Indeed, in their paper they conducted a multi-level analysis including the immigrant status, the gender, the SES, the language, the backwardness and the orientation at the individual level and the SES and academic composition[35] at the school level as well as interactions between the communities and the two measures of school composition. It means that both their paper and our first section of analysis manage to explain around 40% of the raw gap for Mathematics in 2012, and we can explain even more for Reading and Science, respectively 62% and 59% in 2012.

Finally, we would like to refer to the 3 hypotheses Danhier & al. (2014) stated at the end of their report regarding the unexplained part of the Community gap. For them, the remaining part of the Community gap could be related to the funding per student, the evaluation of the schooling and the learning's objectives.

Indeed, while the total share of the Belgian GDP invested in education was 6.5% in 2016, which is the 9th highest share in the world (UNESCO Institute for Statistics, 2016), both communities do not invest equally. Indeed, it seems that the Flemish Community invests more per student than the French Community (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014) and it is the case since 2004 (Hindriks, 2012). In his book about public management, Hindriks (2012) says that the Flemish Community invests 18% more per student in secondary education than the French Community. However, as explained by Danhier & al., the link between funding and student performance is not straightforward and this variable is unlikely to explain the entire part of the gap which is still unexplained.

Regarding the evaluation, it seems that the Flemish Community is keener to evaluate its educational politics than the French Community. It seems obvious that evaluating its system gives space for improvement because we know what works and what does not. However, it would be wrong to say that the French Community is completely blind about the efficiency of its system as it is being increasingly innovative as well. (Danhier, Jacobs, Devleeshouwer, Martin, & Alarcon, 2014)

Lastly, about the learning's objectives, this is the community's indication of what we expect students to be able to do, it is much more precise in the Flemish Community than in the French Community, as shown by both Hindriks &Verschelde (2011) and Hirtt (2008). Hirtt (2008) analysed both the "*Socles de compétences*" and "E*indtermen*" and he found that the Flemish Community was referring twice more to concepts and abilities than the French Community. According to him, it means that they have higher expectations but also are being more precise regarding what they expect.

Lastly, one element Hirtt (2008) analysed in his paper about the understanding of this Community gap which seems to be of importance as well is the schooling orientation (general,

[35] This is school average ESCS and school average backwardness

pre-vocational and vocational). Indeed, it is well-known that the French Community tends to make students repeat a year while the Flemish Community tends to reorient lagging students toward pre-vocational and vocational education. He concluded that both the level and the orientation of the students could explain 10% of the raw gap. (Hirtt, 2008)

5.4 Family structure gap in the literature

In de Lange & al. (2014), they do not split countries for their analysis and show both the individual and concentration effect of the family structure using 2000 and 2003 PISA data for 25 OECD countries. As they checked whether their results were driven by one of the countries[36] and concluded that it was not, we assume that the Belgian results should not be too far away from the ones they presented. They found that the raw gap due to the family structure was about 14 points, while we found something around 37 points. As we used data from 2003, 2009 and 2012 we could maybe believe that the negative effect of being in a single-parent family has increased over time, which seems to be confirmed by Woessmann (2015) findings. He shows that while the raw gap due to the family structure for Belgium was about 20 points in 2000, it was 35 points in 2012, close to what we found.

When de Lange & al. (2014) control for the gender, the educational, the immigrant status and the ESCS index, they reach a gap of 7 points while ours, using slightly different variables, is 20 points. We see that even though the levels are not the same, the share that both managed to explain, their paper and our analysis, is roughly the same, around 50% of the initial gap.

In Woessmann (2015), who used 2012 PISA data in order to compare the United States to the other OECD countries, we have a raw and a mitigated estimation of the individual effect of the family structure in Belgium. It seems that in 2012, the raw gap in Belgium was the largest of the OECD and far above the average, almost twice as much. It was 35.1 points while the average was 18 points. Once he controls for some background factors, such as number of books at home, parental education (which are both captured in the ESCS index), the immigrant status and the language spoken, the gap reaches a size of 22.2 points which is still the largest of the OECD. This estimate is really close to ours, which is 20.71 points. Moreover, it is consistent with Downey (1994) and Pong (1997) who said that the economic deprivation, somehow captured by the ESCS, could account up to half of the performance gap due to the family structure.

Finally, regarding the concentration effect of the family structure, de Lange & al. (2014) found a very different estimate than we did. They have an initial gap (however after adding all the variables to explain the individual gap, which we did not) of 79 points. We cannot really expect the same from our analysis since we did not use the same model, but our raw estimate is about -369 points which is almost 5 times what they found. However, as for the individual effect it is likely that the negative effect increased between 2000 and 2012. Their final estimate of the concentration gap, which is found after controlling for a large variety of variables[37], is around 32 points while ours is still way above as it is 140 points.

[36] To asses that, they conducted their multi-level analysis 25 extra times by taking out of the sample each time one of the countries.

[37] The school ESCS index, the school size, the school's share of immigrants, the community (urbanisation), the teacher shortage, the student teacher ratio and some interactions.

5.5 Policy recommendation & potential extensions

From this paper, we can easily conclude that paying attention to the child's family structure is important in order to deal with the lagging position both of children from single-parent families, children attending schools with a high concentration of single-parent families and of the French Community. Indeed, as there is a gap between the scores, which is supposed to show the abilities of children, based on the family structure there are reasons to be worried and to do something for those children and schools. As we have seen, paying attention to the children's background, proxied by the ESCS, and trying to counteract its negative effect is important since it can help to decrease the gap due to the family structure, but it will not be enough. Other actions must be taken, as, for example, putting more resources towards children and schools is such situation. Those resources could be money, books, extra teaching support, etc. as suggested by de Lange & al. (2014). Moreover, we could try to awake single parents to this problematic as they might be unaware of the disadvantage their children suffer from and of what they could do to help them.

Overall, in all researches, some part and usually a large, of the gap due to the family structure ends up unexplained. For this paper, unfortunately, it seems that it is this unexplained part that decreases further the Community gap. Therefore, we cannot know the channels to act on if we want to have a more equitable schooling system in Belgium.

However, Pong & al. (2003) wrote a paper and showed that children from single-parent families were less disadvantaged with respect to children from two-parents' families when the national policies in place equalises the resources across the different family structures. It would mean that playing on the social, time and financial differences could lead to a better outcome and help Belgium to build a better schooling system. Sadly, we could not test that with PISA data as we did not find measures for all of the dimensions and that the ESCS index is not capturing the parental implication or the social support, for example.

We believe that further research should be conducted on this hot topic as it seems to be relevant to consider the family structure, both for Belgium as a whole but also if we want to close the Community gap in particular. The mechanisms underpinning the family structure gap should be studied deeper, a longitudinal study focusing on that specific topic could be of great value as well to answer the limits of cross-sectional data.

No matter what we do regarding the schooling system in Belgium in the next months, years or even decades, we cannot disregard this inequality of chances based on the family structure anymore.

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