Master Thesis

Unveiling Horticulture's Competitive Edge

Labour Costs' Influence on The International Competitive Position of European Horticulture Enterprises

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Abstract

The rising negative view on (labour) immigrants in European countries results in political parties advocating for a decrease in immigrant inflows in their respective countries. This could have a big impact on the horticulture sector, which in many EU countries heavily relies on labour immigrants willing to work for low wages. The effect of reduced labour immigrant inflow means higher labour costs for the horticulture enterprises. This research investigates the role of labour as a determinant factor for the international competitive position of EU horticulture enterprises. The analysis uses the export market share and the profitability as complementary proxies for the competitive position. The results of the robust Blundell-Bond GMM analysis shows a statistically negative relationship between unit labour costs and export market share only with a two-year lag. In addition, there is the instantaneous statistical negative relationship between unit labour costs and profitability. These results suggest that horticulture enterprises might be able to retain their competitive position on the international market in the short run, but it is at the expense of their profitability, reducing the sustainability of their competitive position.

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Chapter 1 - Introduction

Many European agriculture and horticulture sectors heavily rely on foreign labour immigrants. For example, the Dutch horticulture sector, which accounts for around 4.7 percent of all Dutch exports, heavily relies on labour immigrants from Eastern and Middle European countries who are working in poor conditions (Schneider et al., 2020). The Dutch Labour Inspectorate notices that "a flexible contract with low wage and little certainty is the rule rather than the exception" (*Migrant Labour in Dutch Agriculture*, n.d.). A male migrant worker from Poland in the Netherlands made the following statement: "I have been working here for 16 years, 11 years for a temporary work agency. I usually worked long hours, from 6 a.m. to 6 p.m., sometimes until 7 a.m. Say more than 12 hours. I receive a bare wage for this, according to the stipulated hourly wage and no allowances for working on public holidays, […] on Saturdays or Sundays, [or] for overtime." (Siegmann et al., 2020). Via this, the Dutch horticulture sector makes sure that the labour costs are as low as possible. The Dutch horticulture sector is not the only EU horticulture sector that is characterized like this. Especially the German, Italian, Swedish and Spanish horticulture sectors operate with a labour force mainly existing out of labour migrants that experience exploitation (e.g. by reduced payments or inhumane working conditions) to reduce labour costs.

However, the rise of right-wing parties in the European country elections forms a threat to these sectors. Again looking at the Netherlands, where a reduction of labour immigrants in the country was one of the main focuses of the elections in 2023. The Italian public opinion is even more negative about immigration than the rest of the EU countries (Devitt, 2023). But what would a reduction in labour immigration mean for the sector that heavily relies on it? It is unlikely that national workers would be willing to work under these conditions with a low wage. For example, following Brexit, agricultural enterprises in the United Kingdom had difficulties due to a labour shortage, since Brexit prohibited the free movement of workers law of the EU while the enterprises counted on EU workers. Post-Brexit analysis reported that 6 out of 10 agricultural businesses employed the same amount of British seasonal workers, residing in Britain, in 2021 as in the year before Brexit (Barbulescu et al., 2021). This means that the labour immigrants were not replaced in these businesses. The research of Barbulescu et al. also found that some British workers were disappointed with the pay and left the sector before the end of the first month. Answering the question above, the objective of this research is to give insights into the impact of a reduction in labour immigrants on the competitiveness of the horticulture sector in the EU. Given the example

from Brexit, a decrease in the number of labour immigrants allowed in the EU countries could have catastrophic effects on the competitive position of EU horticulture enterprises on the international market. The same if the wages of the workers would increase strongly.

The existing literature shows a lack of consensus on a clear definition and how to empirically measure the competitive position. Competitive position can be measured on different levels, from firm level to national and worldwide levels. With this difference in mind, the most used proxy of competitive position is the export market share (Amable & Verspagen, 1995; Amendola et al., 1993; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Faberberg, 1988; Laursen & Meliciani, 2010). However, Balndinières et al. (2017) conclude that the profitability of a firm should be taken into account together with export market share to get a balanced view of the competitive position. The reason is that firms can lower their prices until they receive profits that reach 0 or even below 0 to gain market share, which leads to an unsustainable competitive position.

The existing empirical research on the relationship between (unit) labour costs and competitive position shows rather inconclusive, and sometimes surprising, results. Kaldor (1978) already showed that in the post-war period, countries that experienced the fastest growth in terms of exports and GDP were also the countries with the fastest growth in relative unit labour costs. These findings are reproduced by Fagerberg (1988) for Japan, the United Kingdom and the United States. His research concludes that the net effect of labour costs on the growth of XMS is negligible. Similarly is the research of Amendola et al. (1993) who only found short-term effects for unit labour costs on export market share. On the other hand, the research of Amable and Verspagen (1995), Wakelin (1998), Laursen and Meliciani (2000, 2010), Carlin et al. (2001), Bournakis and Tsoukis (2016) and Aw et al. (2007) all found negative effects in certain sectors. Lastly is the research of Barrios et al. (2003) which found a positive relationship between wages and export market share. They explained this result with the view that higher wages represent higher-skilled workers (skill hypothesis).

This research uses the export market share and the profitability together to assess the research objective about the role of labour costs on the competitive position of EU horticulture enterprises. The empirical analysis uses, among other sources, enterprise-level data from the publicly available FADN database and trade data from the UN Comtrade database. The economic strategy follows the regression methods of Laursen and Meliciani (2010) for the regression with the export market share, and Kryszak et al. (2021) for the regression with profitability. The results of the analysis show a statistically ambiguous relationship between unit labour costs and export market share, while it shows a strong

negative relationship between unit labour costs and profitability. The results suggest that the export market share is only deteriorating two years after the shock in labour costs while there is a direct negative effect on profitability. This suggests that the weak direct effect of labour costs on the competitive position is accompanied by a strong indirect effect of reduced profitability of the firms, weakening the sustainability of the competitive positions of the enterprises.

The rest of the research will be structured as follows. Chapter 2 will discuss the existing literature on the relationship between unit labour costs and export market share and will result in the main hypothesis of the research. Chapter 3 will discuss the variables used in the analysis and their respective data sources. Subsequently, Chapters 4 and 5 will discuss respectively the methodology and the regression results. Chapter 6 will discuss the robustness of the analysis. Finally, Chapter 7 will give the discussion and conclusion of the research.

Chapter 2 - Literature review and Hypothesis development

This chapter will discuss the existing literature. Section 2.1 will give an overview of the characteristics of the European horticulture sector with the focus on labour. Section 2.2 will explain the divided view on how to empirically measure competitiveness. Subsequently, section 2.3 will overview the existing literature on the relationship between (unit) labour costs and competitiveness. Finally, section 2.4 will give a short conclusion on the main takeaways of the existing literature and will state the main hypothesis of the research.

2.1 European Horticulture Sector

The horticulture sector is investing more and more in technology, with an expected increase of 60 percent in high-tech greenhouses in the Netherlands from 2018 until 2025 (van Horen & Gomersback, 2020). However, it will take several decades before all manual labour in the horticulture sector is replaced by robots, leaving the sector labour-intensive for the upcoming years (Contact, 2022). In 2018, the Annual Working Unit (AWU, which is the full-time equivalent of employment) for horticulture farms in Europe was more than twice as high as the average of the agriculture sector (European Commission, 2021). The horticulture sector is also the sector with the highest percentage of external labour, which are non-family workers (European Commission, 2021) and the fruit and vegetables sector heavily relies on non-national workers, either from other EU member states or third countries (European Parliament, 2021)

Recent research showed that migrants from Central and Eastern Europe form the bulk of the agricultural workforce in the horticulture sector in The Netherlands (*Migrant Labour in Dutch Agriculture*, n.d.; Schneider et al., 2020). In general, these workers work in poor conditions, making the agricultural sector one of the top sectors for unfair work according to the Dutch Labour Inspectorate. They notice that "a flexible contract with low wage and little certainty is the rule rather than the exception" (*Migrant Labour in Dutch Agriculture*, n.d.). A male migrant worker from Poland in the Netherlands made the following statement: "I have been working here for 16 years, 11 years for a temporary work agency. I usually worked long hours, from 6 a.m. to 6 p.m., sometimes until 7 a.m. Say more than 12 hours. I receive a bare wage for this, according to the stipulated hourly wage and no allowances for working on public holidays, […] on Saturdays or Sundays, [or] for overtime." (Siegmann et al., 2020). Other horticulture sectors in European member states are characterized in the same way.

Hess et al. (2011) attribute the reliance on foreign workers in the German agricultural sector to the unwillingness of German workers to do the hard, physically demanding work for relatively low wages. This also accounts for the horticulture sector in Germany (Schneider et al., 2020). Just like in The Netherlands, the agricultural sector is one of the top sectors of extreme labour exploitation in Germany (Schneider et al., 2020). Labour exploitation in their study means that workers who are employed through recruitment agencies are recruited and hired under false pretences (BKA - German Federal Criminal Police Office, 2016), and receive payments on reduced working hours since timesheets are filled out by an employer or foreperson and never shown to the worker (Schneider et al., 2020). Additionally, German food retail markets are characterized by high competition. Price wars and discount battles cause a relatively low price for vegetables and fruits compared to other European countries. This means that the introduction of the minimum wage in Germany in 2015 reduced the profit margin of agri-food producers since they have very little leeway in raising their prices (Schneider et al., 2020). To conclude, the German agricultural sector has the incentive and the ability, although sometimes illegally, to pay as little as possible for labour costs and is therefore, among other things, able to demand low prices relative to other European countries.

The Italian agricultural sector is also not shy of exploiting both Italian and migrant workers to reduce its costs, with occurrences of the violation of the minimum wage, inhumane working conditions and violence (European Commission, 2022). In addition are the agricultural sectors of Spain (Lawrence, 2011; Pablo & Kelly, 2020), and Sweden (Augère-Granier, 2021; Schneider et al., 2020).

In short, the European horticulture sectors of member states are labour-intensive sectors that rely on non-national workers. These workers often experience exploitations, for example in the form of reduced payments and inhumane working conditions. Therefore, the EU agricultural sector, including the horticulture sector, can be characterized by a labour reduction strategy to be competitive on the international market (Navarro-Gambín & Jansen, 2023).

2.2 Defining International Competitiveness

International competitiveness is a concept with many interpretations but not with one single accepted definition (Porter, 1990). The two competing views of competitiveness emerged in the 1980s and 1990s and can be interpreted as two major streams (Falciola et al., 2020).

Brander & Spencer (1985) and Krugman (1986) associated competitiveness with lower labour costs and favourable home country policies. On the other hand, other economists focused on productivity as the driver of competitiveness and prosperity (Delgado et al., 2012; P. Krugman, 1994; Porter, 1990).

However, it is important to take into account that competitiveness can be measured on various levels, from firm-, sector- to even a global level, and all with different definitions. Competitiveness on the firm level can be observed quite easily since they face competition in their respective markets (Berger, 2008). Competitive firms will have a greater market share (Martin, 2005), which means that the competitiveness level of a firm can be measured by it. As Krugman (1994) said: "The bottom line for a corporation weakness, is literally its bottom line: if a corporation cannot afford to pay its workers, suppliers, and bondholders, it will go out of business." (P. Krugman, 1994). He concludes that a corporation is uncompetitive once it's unable to sustain its market position. On the other hand, other economists think it is not as straightforward as it seems (Balndinières et al., 2017; Davidson et al., 2021). Balndinières et al. (2017) follow the enhanced definition of competitiveness of Buckley et al. (1988) who have stressed the multidimensional and dynamic aspects of competitiveness. Therefore, Balnidinières et al. split the concept along three dimensions: competitive performance, competitive potential, and firm capabilities relevant to competitiveness. The first dimension measures the past and current performance of the firm in the market. The competitive potential relation relates to the internal capabilities of firms that determine the firm's current or future competitive performance and the firm capabilities are the capabilities which are key to translating the competitive potential into actual or future performance.

Again, looking at the definition of competitiveness on the sector level, there is no consensus on a clear definition in the existing literature (Balndinières et al., 2017). According to D'cruz (1992), competitiveness in an sector comes from the interactions between the non-business infrastructure - which are the governments, unions, research institutions, etc. – and the policies and strategies of firms that are active in the sector. Therefore, he defines competitiveness on the sector level as "the collective ability of firms in that sector to compete internationally". On the other hand, Collignon and Esposito (2017) look at the gap between actual wages and equilibrium wages as the definition of sector competitiveness. They define the equilibrium wages as the wage levels at which sectors in the euro area would be on a balanced growth path. This path is defined by sectors having the same return on capital stock, which means that all sectors grow at a uniform rate. Other literature on trade has emphasized the underlying role of firms in the success of aggregate industrial performance, claiming the

importance of characteristics of the firms, such as size and technological capacity (Altomonte et al., 2011). A specific characteristic of the agricultural sector, including large parts of the horticultural sector, is the organization in a large number of family farms, with ownership over invested land, machineries and buildings. Compared to industrial firms, these family farms are relatively small, applying a lot of their own labour. Due to the lack of alternative usages of the fixed production factors on the farm and the related 'sunk costs', if needed, a relatively low income is accepted over a long period of time (Balmann et al., 2006).

Balndinières et al. (2017) also highlight the importance of the difference between intra-sector competitiveness, which is the competition between one sector from different national economies, and inter-sector competitiveness, which is the competitiveness of one sector as compared to other sectors within the same country.

Looking at a nation's competitiveness is even more difficult than firm or sector level. Where corporations have a "bottom line", nations lack one: uncompetitive nations do not go out of business (P. Krugman, 1994). Delgado et al. (2012) define foundational competitiveness as "the level of output per working-age individual given the overall quality of a country as a place to do business". Önsel et al. (2008) define a nation's competitiveness as the degree to which it can produce goods and services that meet the standards of international markets while at the same time expanding the real income of its citizens. Whereas other economists have used competitiveness as a synonym for productivity (P. Krugman, 1994; Oral et al., 1999; Porter, 1990; Sala-i-Martin et al., 2007), Önsel et al. argued that they are different terms. According to them, productivity refers to the capability of organizations and/or countries while competitiveness refers to the relative position of an organization and/or countries vis-à-vis its competitors.

The ambiguity in the definition of competitiveness also results in ambiguity on the right measure of competitiveness in the empirical literature. Many have used export market share (XMS) as a measure when looking at the competitiveness of firms, sectors and countries in relation to international trade (Amable & Verspagen, 1995; Amendola et al., 1993; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Faberberg, 1988; Laursen & Meliciani, 2010). Others have used the unit labour costs (ULC) as a measure of competitiveness (Balndinières et al., 2017)

2.3 Labour and competitive position

The relationship between labour costs and the international competitive position of countries, sectors and firms is something that economists have been interested in for a long time with various outcomes as a result.

Kaldor (1978) showed that, in the post-war period, the countries that experienced the fastest growth in terms of exports and GDP were also the countries with the fastest growth in relative ULC, the so-called 'Kaldor paradox'. This showed that the relationship between labour costs and the international competitive position of countries is not as clear as previously assumed.

The research of Fagerberg (1988) reproduces the results of Kaldor for three countries (Japan, United Kingdom and the United States). He investigates the relationship between XMS and ULC while including other factors than price competition and demand. With data from 15 OECD countries between 1961 and 1983, he found that there is a negative effect of the growth of ULC on XMS measured in volumes and a similar, positive effect of the growth of ULC on relative prices (meaning that a relative increase in labour costs in comparison to other countries would increase the country's prices of exports relative to its imports). Fagerberg concludes that the net effect of labour costs on the growth of XMS for exports measured in value is negligible, while technology factors, in this case, investments, patents and R&D, are the main drivers.

Amendola et al. (1993) came up with a similar conclusion as Fagerberg (1988), where technology factors play a bigger role than ULC. The authors find a positive instantaneous effect of an increase in ULC on XMS, which they attribute to the lag in the markets' reactions and the existing firms' market power. However, they find a negative effect when looking at the one-year lag, which quickly fades away when including longer lags. Therefore, Amendola et al. conclude that there are only short-term effects for ULC on the export share of countries.

This conclusion of the limited role of labour costs by Fagerberg (1988) and Amendola et al. (1993) is revised by several papers. For example, Amable and Verspagen (1995) looked at the role of ULC on the XMS at the country-sector level. They found that the coefficients for ULC are negative and significant for 16 (including the food sectors) out of the 18 sectors in low-, medium-, and high-tech sectors. Wakelin (1998) on the other hand found a negative significant effect only for the low- and medium-tech sectors and concluded that the trade performance in these sectors is influenced by the availability of low-cost labour.

Laursen and Meliciani (2010) looked at the role of Information and Communication Technologies (ICT) and the related knowledge flows for the XMS and therefore split their

results into ICT and non-ICT sectors. They found that ULC only had a significant negative coefficient in ICT sectors, not in non-ICT sectors. Nevertheless, after splitting the non-ICT sectors into low-, medium- and high-technology sectors, they found that the ULC are negative and significant in the low-technology, non-ICT sector.

Carlin et al. (2001) investigate the impact of labour cost competitiveness on the export performance of sectors of 14 OECD countries using Ordinary Least Squares (OLS). They point out that the effect of relative labour costs on the XMS will depend on the degree of competition in the product market. They include a full set of country dummies in their first difference regression to see if some countries can hold on to their market share, even if there is a rise in their relative ULC. They argue that, in their case, the exogeneity assumption of OLS is not as restrictive as it may seem. This is because they are estimating in differences and therefore do allow immediate feedback of XMS on relative ULC. Their results suggest that just like Amendola et al. (1993), an increase in relative ULC is accompanied by an increase in XMS in the first year and a decrease in the year afterwards. However, unlike Amendola et al., they conclude that there are still significant effects after five years. The results also showed significant coefficients for the country dummies, suggesting that labour cost competitiveness alone cannot explain all the variations in XMS.

Bournakis and Tsoukis (2016) also find negative significant effects of relative ULC on XMS. However, contrary to Carlin et al. (2001), they pay more attention to the possible violation of the exogeneity assumption when regressing export shares onto the relative ULC. They implement two strategies to mitigate the possible endogeneity bias. The first strategy is to lag all the explanatory variables once to meet the weak exogeneity assumption. However, they think that this strategy still suffers from the possibility that the current export share can influence the future values of relative ULC. They therefore implement a second strategy: the introduction of instrumental variables. The variables that they use are current and one-year lag values of the gross fixed capital formation to GDP ratio and the energy of oil equivalent per capita, coming from the World Bank Development Indicators.[1] The results of the two strategies show that only the significance level of their R&D coefficient changes while the estimates of all the other variables, including the relative ULC, are similar to the regression that assumed weak exogeneity. They therefore concluded that their baseline model without the two strategies did not suffer from major endogeneity biases.

[1] The energy of oil equivalent from the World Bank is measured in Kilograms.

Economists also argued for a reduction in the relative ULC of countries as a key to getting out of the Eurozone crisis. They argued that countries in Europe which had a trade deficit should reduce their real wage and countries with a trade surplus should increase their real wage to re-balance growth in Europe (Storm & Naastepad, 2015). However, other researchers criticized this way of thinking. Storm and Naastepad (2015) argued that the ULC only account for 16 percent of the overall manufacturing gross output price and that the relative ULC elasticity only takes up a small value of the price elasticity. They also show that the exports of South European countries (which had a trade deficit at the time) are sensitive to world income and less to relative ULC.

Until this far, the literature discussed only looked at the country level (Amendola et al., 1993; Bournakis & Tsoukis, 2016; Faberberg, 1988; Storm & Naastepad, 2015) or country-sector level (Amable & Verspagen, 1995; Carlin et al., 2001; Laursen & Meliciani, 2010; Wakelin, 1998). However, the relationship between labour costs and market share has also been investigated on the firm level. Barrios et al. (2003) looked at the relationship between labour costs, the activity of R&D and intra-sectoral spillovers, the decision of firms to export, and the intensity of exports, using data from Spanish firms. On the contrary to the classical literature, they had a different interpretation of labour cost: they used the wage level as an indicator of the firms' skill intensity, with a higher wage representing higher-skilled workers (also referred to as the skill hypothesis (Wakelin, 1998)). They indeed find a positive relationship between wages and the probability of a firm being an exporter, suggesting that more productive and skill-intensive firms are more likely to export.

On the other hand, Aw et al. (2007) found a negative relationship between the average production worker's wages and XMS when looking at data from Taiwanese firms in the electronic sector. This suggests that, in this case, the skill hypothesis is rejected (as this hypothesis implies that an increase in labour costs, measured in wages and associated with a higher skill level of the firm, causes an increase in the level of XMS (Amable & Verspagen, 1995; Wakelin, 1998). Table 1 in the Appendix shows a summary of the results found of the existing literature discussed in this section.

2.4 Conclusion and Hypothesis

The horticulture sectors in member states of the European Union are labour-intensive sectors that try to reduce labour costs as much as possible to improve cost competitiveness. Especially the Dutch, German, Italian, Swedish and Spanish horticulture sectors operate with

a labour force mainly existing out of labour migrants that experience exploitation (e.g. by reduced payments or inhumane working conditions) to reduce labour costs.

Following the literature, the effect of labour costs on international competitiveness is ambiguous. It starts with the non-consensus on a clear definition of competitiveness in the existing literature. This results in empirical research using different measures of competitiveness (e.g. XMS or ULC). However, the results on the effect of labour costs on competitiveness differed even if the researchers used the same measure of competitiveness. The results vary from a negligible effect (Faberberg, 1988), short-term negative effects (Amendola et al., 1993), short-term and long-term negative effects (Amable & Verspagen, 1995; Aw et al., 2007; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Laursen & Meliciani, 2010; Wakelin, 1998), to positive effects (Barrios et al., 2003).

Therefore, the expected role of labour costs on competitiveness can either be negative, meaning that higher costs represent lower competitiveness, or positive, meaning that higher costs represent a higher-skilled workforce. I expect that the horticulture sector in Europe will experience a negative relationship between labour costs and international competitiveness. This is because the sector is a labour-intensive (Rossi, 2019), low- to mid-tech and non-ICT sector (Amable & Verspagen, 1995; Laursen & Meliciani, 2010; Wakelin, 1998) and similar sectors experienced a negative relationship when looking at the results of existing literature. This negative relationship could be dampened by the above-mentioned family farm structure, absorbing higher labour costs via lower farm income. However, this leads to an unsustainable competitive position as financial resources to replace and/or expand existing buildings and machineries are lacking.

Chapter 3 - Data

The analysis for answering the research question and hypothesis is conducted at the sector level and the panel consists of 23 countries with annual data from 2004 until 2019. Section 3.1 will explain the dependent variables of the regressions and their data sources. Subsequently, section 3.2 will explain the independent variables. Finally, section 3.3 discusses the descriptive statistics.

3.1 Dependent Variables

The dependent variables are two proxies for measuring the competitive position of firms and countries on the international market. For this analysis, I chose national XMS and the profitability of firms as complementary proxies. The XMS is the most used proxy in the existing literature on international competitive positions (Amable & Verspagen, 1995; Amendola et al., 1993; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Dosi et al., 2015; Laursen & Meliciani, 2000, 2010; Wakelin, 1998). The European Commission concludes that for a balanced view on competitiveness, the XMS and profitability should be used as key complimentary indicators (Balndinières et al., 2017).

The data on the exports of the countries of interest are taken from the UN Comtrade database (*UN Comtrade*, n.d.). This database provides aggregated detailed data on global trade statistics by product and trading partners. This analysis defines the horticulture sector by HS codes 06 and 07 since the horticulture sector of the FADN is defined by the flower and bulbs (HS06) and vegetables (HS07) sectors.[2] The export data from these codes from all 23 countries to the rest of the world was collected from 2004 until 2019. XMS is calculated by $EXP_{jt} / \sum_{j=1}^{n} EXP_{jt}$ with j representing countries and t representing years. However, it is common in the literature to standardize XMS by all countries average in order to obtain symmetry with the cost variable (Amable & Verspagen, 1995; Laursen & Meliciani, 2000, 2010). This will be explained in paragraph 3.2. Therefore, the XMS is defined as $EXP_{jt} / \sum_{j=1}^{n} EXP_{jt} \, / n$ with n being the number of countries.

The profitability of the horticulture enterprises is taken from the publicly available Farm Accountancy Data Network (FADN) database. This database is produced and published

[2] Specialist horticulture (FT2) in FADN is defined as specialist vegetables indoor and outdoor, specialist flowers and ornamentals indoor and outdoor, mixed horticulture indoor and outdoor, specialist mushrooms, specialist nurseries and various horticulture.

by the EU Commission and provides data on the economic situation of farms by different groups throughout the European Union (*FADN - European Commission*, 2024). The data is collected through national surveys and covers EU farms that can be considered commercial farms due to their size. Kryszak et al (2021) investigate the determinants of EU farm profitability using the FADN database. They use the Return on Assets (ROA) to measure profitability because of their focus on managerial perspectives. This research tries to determine the effects of increased labour costs on the competitiveness of the horticulture sector. Therefore, following Kryszak et al., profitability will be measured by the proxy ROA. By focusing on the ROA, this research can provide critical insight for the managers to the effects of an increase in (unit) labour costs, which can help them to adapt their strategies in response to the cost changes.

3.2 Independent Variables

The independent variables used in this research mainly come from the following two papers: Laursen and Meliciani (2010) for the regression with XMS and Kryszak et al. (2021) for the regression with profitability. Laursen and Meliciani, although having a different independent variable as their main interest, also look at the relationship between XMS and ULC. Their research also includes data from a relatively short panel, making their regression similar to this one. That's why their paper forms a good basis for the independent variables of this research. Kryszak et al. use the FADN database to identify the main determinants of EU farm profitability. This makes the parameters of Kryszak et al. research the same as this research. However, this research uses the publicly available FADN database, while Kryszak et al. use individual farm data from FADN. Individual farm data are only available after application and under high restrictions.

When looking at the XMS, the sectoral trade performance can be specified by a function of both cost and technological advantages: $X_{ij} = f(C_{ij}, T_{ij})$ where C_{ij} represents a proxy for variable costs and T_{ij} represents an indicator of technological levels (Dosi et al., 2015). It is common in the literature to proxy the variable costs by some form of (relative) ULC (Amable & Verspagen, 1995; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Dosi et al., 2015; Faberberg, 1988; Laursen & Meliciani, 2000, 2010). This research defines the ULC as wages per worker at current prices, divided by labour productivity defined as value added at constant 2015 perces per worker (Amable & Verspagen, 1995; Laursen & Meliciani, 2010). This is calculated with data from the FADN database. The indicator for technological levels is commonly proxied by the level of investments and/or the level of patents (Amable &

Verspagen, 1995; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Dosi et al., 2015; Faberberg, 1988; Laursen & Meliciani, 2000, 2010). In this research, the technological levels are proxied by the yearly gross investments in fixed assets taken from the FADN database and the countries' level of patents in biotechnology taken from the OECD database.[3] Additional variables are proxies to control for the different size effects (Dosi et al., 2015; Laursen & Meliciani, 2010). Here, it will be proxied by the population of a country to account for country size and the standard output of the national average farm in euros to account for farm size. Another important variable is the Real Effective Exchange Rates (REER) of the respective currencies. Huang (2004) argues that the exchange rates play an important role in the competitiveness of U.S. agriculture exports, with the magnitude differing per commodity. She justifies this with two researches that proved that the U.S. imports of onions and melons from Mexico increased after a devaluation of the Mexican peso (de Jesus Espinoza-Arellano et al., 1998; Fuller et al., 1991). In this research, the REER data are taken from the working paper of Darvas (2021), which is a trade-weighted measure of the exchange rate. Furthermore, a variable is included that measures the level of precipitation in a country. The level of precipitation is an important impactor on the production of horticulture crops, with levels too high and too low causing important losses for the sector (Bucheli et al., 2023). In addition to this is the lack of insurance against the level of precipitation available for the horticulture sector. This means that the horticulture enterprises are not able to protect themselves in such situations (Bucheli et al., 2023), which can affect their income and subsequently their XMS. The last two important variables measure the impact of the Common Agriculture Policy (CAP) with which the European Commission protects European agriculture. First is the ratio between subsidies received to total output (Bojnec & Latruffe, 2013; Kryszak et al., 2021) and second is the share of total rural development payments (Kryszak et al., 2021).[4]

Following Laursen & Meliciani (2010), all the independent variables will be divided by the average value per year over all countries in the sample and expressed in logarithms.[5]

[3] Biotechnology provides farmers with the tools that make production cheaper. It exists out of a range of tools that can alter (parts) of organisms to make or modify products (*Biotechnology FAQs | USDA*, n.d.).

[4] Farmers can apply for additional payments when meeting certain conditions. For example, payments related to special environment practices (Kryszak et al., 2021).

[5] The patents in biotechnology will not use a logarithmic scale since the variable can take values of zero.

Looking at the proxy of profitability for competitiveness leads to different independent variables. Kryszak et al. (2021) identified the main determinants of farm profitability, which will be used as control variables in the regression. They split the determinants into four groups: production management, financial management, human resource management and subsidies.

Looking at production management, the first determinant is equity turnover, which measures how much a farm can produce relative to its equity. Additionally, the authors argue that investments can be an important determinant of profits if the level of investments exceeds the consumption of fixed materials, proxied by depreciation.

Looking at financial management leads to four more determinants: debt-to-asset ratio, current-to-total assets ratio, the share of external costs and the share of general costs to specific costs. Kryszak et al. argue that farms are more flexible when their share of current assets is high since they are not burdened with fixed costs, which will have positive effects on profitability. External costs are costs that are accompanied by the use of external production factors, e.g. renting external land or hiring external labour. The use of external capital can affect profitability in two ways. For example, farmers have to pay additional rent costs when renting land. However, farmers might also increase the productivity of land usage since it must cover these rent costs.[6] Kryszak et al. also argue that the economic results of a farm can be affected by the relationship between different types of costs. They assume that farms have higher profitability when the share of general costs to specific costs is smaller.[7]

The third group of determinants is the human resources management at farms. The authors use the share of hired labour in total labour input as a proxy for this type of management. The idea is that the decision to hire external labour is made when a farm wants to improve its efficiency, which can lead to higher profitability.

The last two important determinants of farm profitability come from the subsidies that EU farms, and horticulture enterprises, receive from the CAP. Again, Kryszak et al. proxy for this by looking at the relation between subsidies to total output and the share of total rural development payments.

Table 3.1 gives an overview of all (independent) variables used in the two equations. A detailed description of the calculations of the independent variables taken from the FADN database, including their corresponding SE codes, is given in Table 2 of the Appendix.

[6] Same story can be applied to the use of credits.

[7] Specific costs are costs that are linked to a given type of production.

Variable	Proxies	Database	Dependent Variable
Unit Labour Costs	Cost competitiveness	FADN	Export Market Share
Investments in Fixed assets	Technology competitiveness	FADN	Export Market Share
Patents in Biotechnology	Technology competitiveness	OECD	Export Market Share
Population	Size effects	World Bank	Export Market Share
National average farms' Standard Output	Size effects	FADN	Export Market Share
Precipitation	Wheater effects	World Bank	Export Market Share
Real Effective Exchange Rate	Exchange rate differences	Darvas (2021)	Export Market Share
Subsidy rate	Effects of the CAP	FADN	Export Market Share
Rural development payments	Effects of the CAP	FADN	Export Market Share
Unit Labour Costs	Cost competitiveness	FADN	Profitability (Return on Assets)
Equity turnover	Production management	FADN	Profitability (Return on Assets)
Investments to depreciation	Production management	FADN	Profitability (Return on Assets)
Debt-to-Asset ratio	Financial management	FADN	Profitability (Return on Assets)
Current-to-Total Asset ratio	Financial management	FADN	Profitability (Return on Assets)

Share of External Costs to total Costs	Financial management	FADN	Profitability (Return on Assets)
Share of General Costs to total Costs	Financial management	FADN	Profitability (Return on Assets)
Share of hired labour to total labour	Human management	FADN	Profitability (Return on Assets)
Subsidies	Subsidies	FADN	Profitability (Return on Assets)
Rural Development payments	Subsidies	FADN	Profitability (Return on Assets)

Table 3.1 List of all variables used in the paper

3.3 Descriptive Statistics

Figure 3.1 shows the correlation between the percentage change in XMS and the percentage change in ULC. Lithuania, in quadrant 3, stands out the most with a relatively large increase in XMS while also experiencing a deterioration of its cost competitiveness (an increase in ULC). The countries that experience an increase in their XMS and ULC simultaneously are examples of the Kaldor Paradox. Belgium, Cyprus and France, in quadrant 1, also stand out with an increase in their cost competitiveness while simultaneously experiencing a decrease in their XMS. Looking at the correlation between the percentage change in profitability and the percentage change in ULC, shown in Figure 3.2, only Poland shows signs of the Kaldor Paradox.

Quadrants two and four show the expected correlation in both graphs: countries that experience a decrease [increase] in ULC while at the same time experiencing an improvement [deterioration] of their competitive position, proxied by XMS and/or profitability. The correlation between percentage change in profitability and the percentage change in ULC (Figure 3.2) appears much more clear as compared to percentage change in XMS and the percentage change in ULC (Figure 3.1)

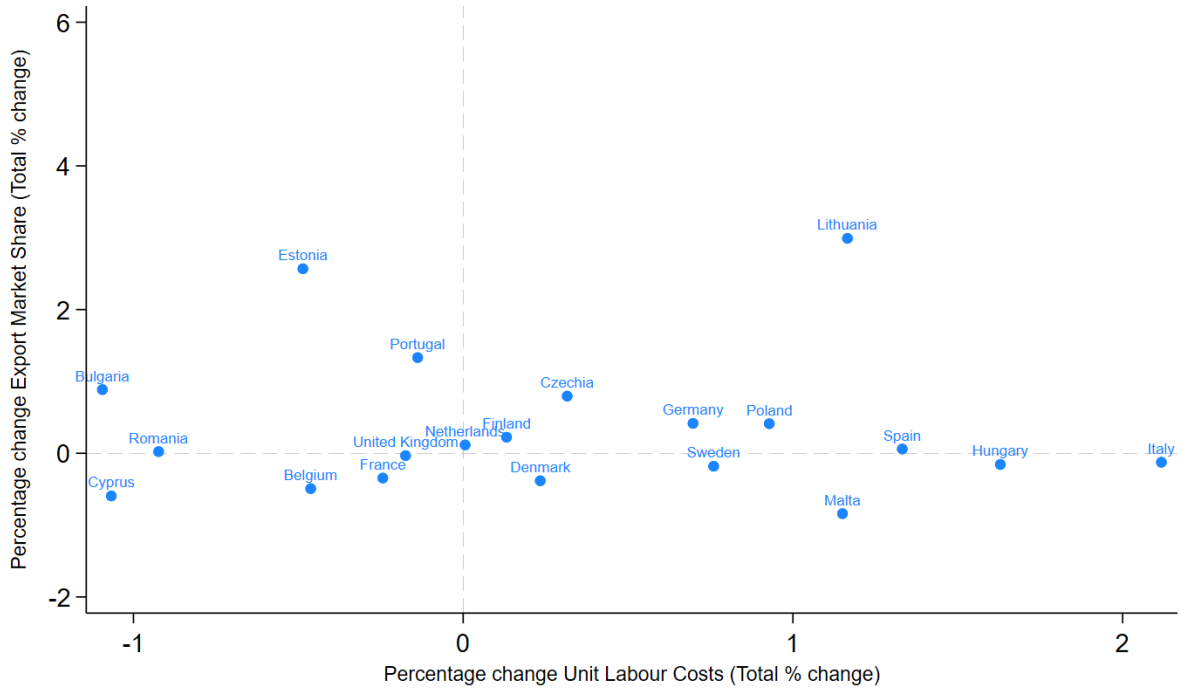

Figure 3.1 Export Market Share and Unit Labour Costs Trends over the period 2004-2019 [8]

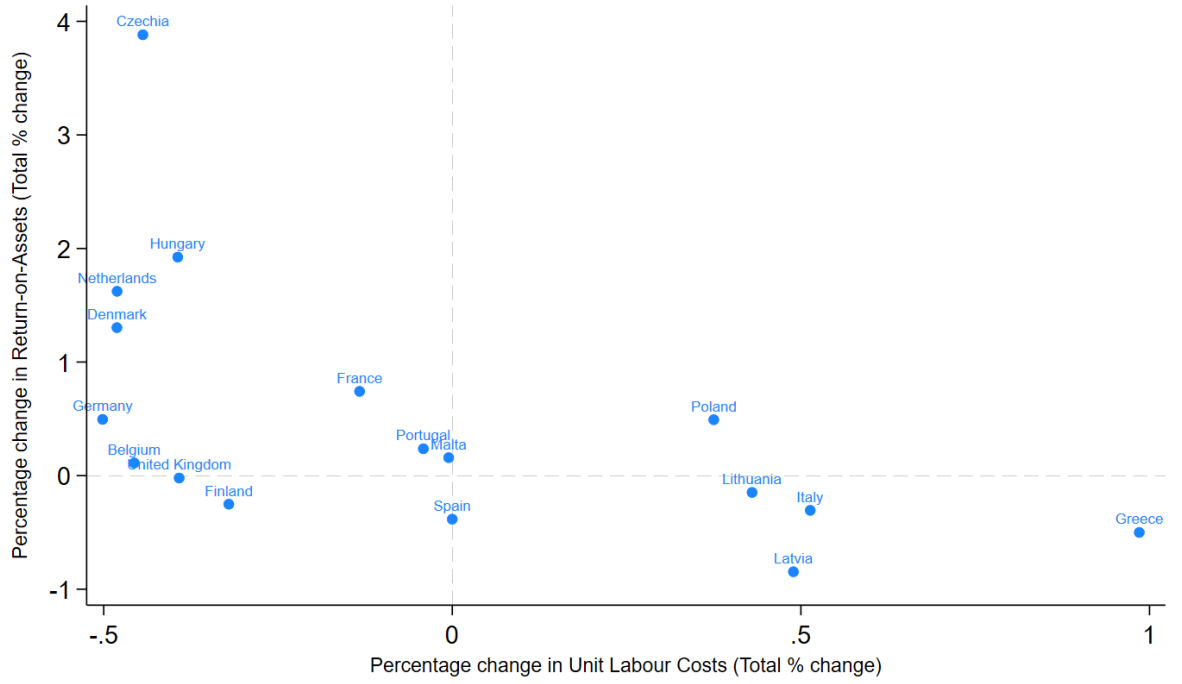

Figure 3.2 Return on Assets and Unit Labour Costs Trends over the period 2004-2019 [9]

[8] Austria, Croatia, Greece, Latvia and Slovenia are excluded because they are outliers.

[9] Bulgaria, Croatia, Cyprus, Estonia, Romania and Sweden are excluded because they are outliers.

Table 3.2 shows the descriptive statistics of the constructed panel before standardizing. Tables 3 and 4 in the appendix show the descriptive statistics per country. Over the whole period, the mean ROA is the highest in Italy and the lowest in Croatia and Latvia, while the mean ULC is the highest in Cyprus. On the other hand, the mean XMS is the highest in the Netherlands, which confirms the power of the Dutch horticulture sector on the export market. However, the Netherlands is not the country with the lowest mean standardised ULC, which is Malta. The highest mean standardised ULC is coming from Latvia.

Descriptive Statistics. Independent variable: Export Market Share

Variable	Obs	Mean	Std. Dev.	Min	Max	Unit
XMS	400	.004	.024	0	.427	Index
ULC	333	.443	.192	.082	1.301	Index
Investments	333	22819.556	30623.673	-10394	174526	€
Patents biotechnology	375	109.878	179.443	0	806.304	No.
Population	400	19784209	23601660	401268	83092962	No.
Total output	333	257592.95	320125.69	8419	1598801	€
Precipitation	400	750.08	200.231	498	1220	mm
REER	400	99.176	7.65	71.825	122.63	Index
Subsidy rate	333	.008	.017	-.014	.143	€
Share of rural development	333	.171	.149	0	.868	€

Descriptive Statistics. Independent variable: Return On Assets (profitability)

Variable	Obs	Mean	Std. Dev.	Min	Max	Unit
ROA	333	.111	.064	-.071	.328	Index
ULC	333	.443	.192	.082	1.301	Index
Equity turnover	333	.9	.649	.044	2.802	Index
Investment-to-depreciation	333	1.045	.958	-6.763	7.427	Index
Debt-to-asset	333	.258	.211	0	.748	Index
Current-to-total assets	333	.252	.131	.02	.669	Index
Share of external costs	333	.254	.068	.098	.457	Index
Share of farming overheads	333	.286	.075	.144	.562	Index
Share of paid labour	333	.541	.199	.091	.912	Index
Subsidy rate	333	.008	.017	-.014	.143	Index
Share of rural development	333	.171	.149	0	.868	Index

Table 3.2 Descriptive statistics

Chapter 4 - Methodology

This section will discuss the methodology of the two regressions, with section 4.1 discussing the XMS and section 4.2 the profitability.

4.1 Export market share as the dependent variable

There can be several cumulative mechanisms that reinforce the competitiveness of firms in international markets, i.e. "success breeds success" (Amendola et al., 1993). To account for these mechanisms, it is common to estimate a dynamic model with an autoregressive structure in the dependent variable (Amendola et al., 1993; Laursen & Meliciani, 2000, 2010; Santos-Paulino & Thirlwall, 2004). The model of this paper uses a first-order autoregressive model. The baseline model is expressed as follows:

$$XMS_{jt} = \beta_0 + \beta_1 XMS_{jt-1} + \beta_2 ULC_{jt} + \beta_3 INV_{jt} + \beta_4 PAT_{jt} + \beta_5 POP_{jt} + \beta_6 EconSize_{jt} + \beta_7 Precip_{jt} + \beta_8 REER_{jt} + \beta_9 SR_{jt} + \beta_{10} RD_{jt} + \varphi_j + \varphi_t + \varepsilon_{jt}$$

Where XMS is the export market share in country j at time t; ULC is the unit labour cost; INV is the level of investments in gross fixed capital formation; PAT is the level of patents in biotechnology; POP is the population of a country; EconSize is the economic size of the average national farm; Precip is the level of precipitation; REER is the real effective exchange rate; SR is the ratio between subsidy rate and total output; RD is the share of rural development payments; φ_j are the country fixed effects; φ_t are the time fixed effects and ε_{jt} is the error term.

In this model, a negative estimate means that the XMS of a country decreases if the variable of interest in the country increases relative to other countries. The existing literature often expects a negative estimate for the ULC while they expect a positive sign for the technology variables (in this model the investment and patent variables) (Amable & Verspagen, 1995; Amendola et al., 1993; Aw et al., 2007; Bournakis & Tsoukis, 2016; Carlin et al., 2001; Laursen & Meliciani, 2000, 2010). There is no clear expectation of the effect of population on the XMS. However, research by the European Central Bank (2017) links the growth in population to the availability of the labour force. Together with their results that labour is a determining factor for XMS in certain countries, I would expect that the population has an (indirect) positive effect on XMS. However, Dell'Ariccia (1999) finds negative coefficients for population influencing bilateral trade flow, which would suggest that there is a negative relationship between population and XMS. I expect a positive coefficient

for the economic size of the average national enterprise, defined as the national average farms' standard output from FADN, since there is a (weak) positive relationship between farm size and output per hectare (yield) and a positive relationship between farm size and labour productivity (Gollin, 2019) and the existence of increasing returns to scale (Berck & Helfand, 2014). The expected coefficient for the REER is also positive, since the REER is defined such that an increase in the value represents a depreciation and previous research showed that a depreciation (or devaluation) increases a country's competitiveness (de Jesus Espinoza-Arellano et al., 1998; Fuller et al., 1991; Huang, 2004). The coefficient for precipitation is more ambiguous since both high and low values can be harmful to the production and therefore the exports. The subsidy rate has a negative expected coefficient. Bojnec and Latruffe (2013) show a negative relationship between subsidy received and technical efficiency. They argue that farms receiving subsidies lower their effort in input waste since the subsidy brings a certain return. The share of rural development payments can create an additional form of income, which can be used to improve the enterprises' competitive position through e.g. investments or hiring more workers. However, they also require additional costs and are often related to environmental constraints (*Rural Development - European Commission*, 2024). This means that the impact of the rural development payments and therefore the sign of the coefficient is ambiguous (Kryszak et al., 2021).

Laursen and Meliciani (2010) estimate a robust version of the Blundell-Bond Generalised Method of Moments (GMM) estimator since the fixed effects estimator will be biased because of their short time-series sample. Following Laursen and Meliciani, I will also estimate a robust version of the Blundell-Bond GMM model with heteroscedastic errors. Furthermore, I will assume the exogeneity of all the explanatory variables as is standard in the literature (Carlin et al., 2001; Dosi et al., 2015; Laursen & Meliciani, 2010; Wakelin, 1998). Laursen and Meliciani (2010) argue that the hypothesis behind the exogeneity of the relative price variables comes from the idea that the export supply price elasticities facing any individual country are infinite. They also argue that the technology variables are exogenous since they capture structural characteristics that respond very slowly to changes in export shares. Furthermore, Laursen and Meliciani argue that an XMS variable is very unlikely to be non-stationary, unlike a variable that measures exports in absolute terms.

4.2. Profitability as the dependent variable

The second model is defined as followed:

$$Prof_{jt} = \beta_0 + \beta_1 ULC_{jt} + \beta_2 ET_{jt} + \beta_3 INV/D_{jt} + \beta_4 DA_{jt} + \beta_5 CA_{jt} + \beta_6 EC_{jt} + \beta_7 OVS_{jt} + \beta_8 PL_{jt} + \beta_9 SR_{jt} + \beta_{10} RD_{jt} + \varphi_j + \varphi_t + \varepsilon_{jt}$$

Where Prof is the profitability, proxied by the Return on Assets, in country j and year t; ULC is the unit labour costs; ET is the equity turnover; INV/D is the investment-to-depreciation ratio; DA is the debt-to-asset ratio, CA is the share of current assets in total assets; EC is the share of external costs; OVS is the share of farming overheads in total costs; PL is the share of paid labours in total labour input; SR is the ratio of total operational subsidies tot total output; RD is the share of rural development payments in total subsidies; φ_j is the country fixed effects; φ_t is the time fixed effects and ε_{jt} is the error term.

In this model, a negative coefficient means that the profitability of the farm decreases when the variable increases. ULC is expected to have a negative sign: a decrease in a farm's cost competitiveness will decrease its profitability. Equity turnover is a proxy for productivity and therefore is expected to have a positive sign. The investment-to-depreciation ratio is also expected to have a positive sign since investments can create opportunities for long-term growth. The debt-to-asset ratio and the share of the cost of external factors in total costs is ambiguous: it creates further costs which will decrease the profitability, however, it can also mean that farmers use the resources more efficiently to cover the additional costs (which will increase the profitability). The ratio of general overhead costs-to-specific costs is expected to have a negative sign: the smaller the ratio, the higher the profitability (Kryszak et al., 2021). The share of paid labour relative to total labour is expected to have a positive sign since the decision to hire external labour is made to improve farm efficiency, which increases the profitability of the farm. Bojnec and Latruffe (2013) find a positive link between subsidies received and the profitability of Slovenian farms using the FADN database. This leads to an expected positive sign for the subsidy-to-total output ratio. The impact of the rural development payments is ambiguous, as explained earlier in this Chapter.

Kryszak et al. (2021) highlight a possible endogeneity problem and argue that some managerial decisions are not fully independent of each other and the profitability variable. They propose to solve the problem by estimating a two-step dynamic panel model using the Blundell and Bond Generalized Method of Moment (GMM). This research will follow the same approach. Furthermore, Kryszak et al. argue that some of the variables might be predetermined. This means that their levels depend on previous values of the return on assets.

These variables are the investment-to-depreciation ratio; debt-to-asset ratio; current-to-total asset ratio; the share of external costs and the share of paid labour. These variables become endogenous in the first differences. Kryszak et al. propose to use these variables as “internal” instruments for the levels equation. This research will follow the same approach.

Chapter 5 - Results

This chapter will present the results of the methodology described in Chapter 4. 5.1 will look at the regression results with the XMS as the dependent variable and 5.2 will look at the regression results with the profitability as the dependent variable.

5.1 Export market share as the dependent variable

Before looking at the results of the regression described in Chapter 4, it is useful to look at Impulse Response Functions (IRF) to gain a better understanding of the impacts of a shock in ULC. IRF investigates the marginal effect of a shock of one variable on other variables (Lütkepohl, 2010). Figure 5.1 shows the effect of a shock in ULC on the number of biotechnology patents, the XMS, the total investments and the total output of the horticulture enterprises via IRF. As the graph shows, an increase in ULC causes an almost immediate drop in XMS. After one period, the XMS increases to a value slightly above zero in period 2 after which it again decreases until period 5. After period 5, the XMS declines to approximately the same level observed after the first period. The effect of an increase in ULC on the total output of the horticulture enterprises is also negative. There is a small drop in total output in the first period, which can be explained by the use of less paid labour because of the labour costs increase. The total output increases again after the decline in the first two periods. A possible explanation for this is that small enterprises have left the sector, which increases the average size and total production of the remaining enterprises. The biggest response to a shock in ULC is given by the investments. The investments experience a big drop almost immediately after the shock in ULC. This could be explained by the lack of money available to make investments because it is used to pay the increased ULC. The investment increases a lot after the third period, which is consistent with the increase in farm size. Additional is the increase in biotechnology patents around the same time. This could mean that enterprises switch to new products that are less labour intensive due to the increase in ULC.

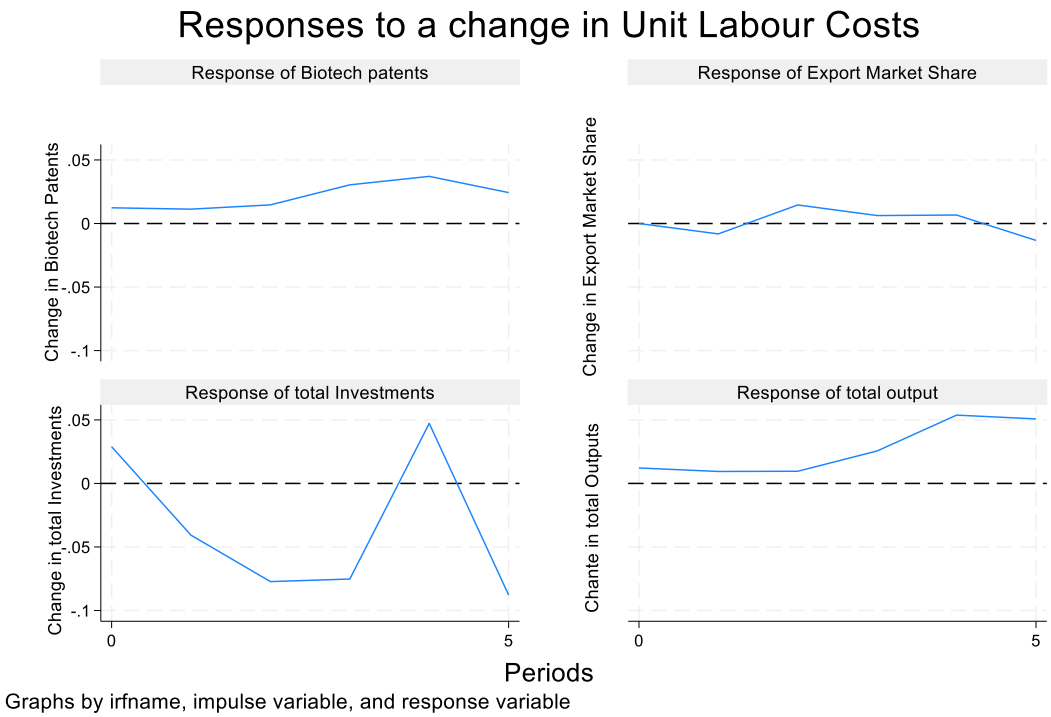

Figure 5.1 Impulse Response Functions of a Shock in Unit labour Costs.[10]

Table 5.1 shows the regression results of the robust version of the Blundell-Bond GMM regressions with XMS as the dependent variable. All columns include robust standard errors and country and year fixed effects. Column 1 is a regression with only the autoregressive structure and the ULC as independent variable. This model finds an instantaneous significant positive effect between ULC and XMS. This coefficient can be explained by the previously discussed skill hypothesis, where higher ULC represent a higher skilled labour force. However, Amendola et al. (1993) argue that their instantaneous positive effect comes from the fact that markets need time to adjust, which explains that firms and/or countries retain their competitive position.

Column 2 includes lags up to 2 periods. These results show that the positive effect of an increase in ULC remains, even though it gets less strong. This suggests that, in this case,

[10] The responses of the precipitation, real effective exchange rate, subsidy rate and rural development payments are interpreted as exogenous and are therefore not shown.

	(1) XMS	(2) XMS	(3) XMS	(4) XMS
Lag XMS	.124	.135*	-.138***	-.136***
	(.084)	(.072)	(.043)	(.044)
ULC	1.207*	.692**	-.366	-.232
	(.69)	(.333)	(.435)	(.342)
Lag ULC		.676**		-.314
		(.288)		(.324)
Lag 2 ULC		.331		-1.032***
		(.887)		(.388)
Investments			-.038	-.101
			(.131)	(.138)
Population			1.575***	1.638***
			(.304)	(.324)
Total output			.163	.496**
			(.266)	(.236)
Biotech patents			.336	.061
			(.43)	(.373)
REER			9.454***	10.615***
			(1.643)	(1.892)
Precipitation			.451	2.76
			(2.769)	(2.943)
Subsidy rate			-9.126***	-14.283***
			(3.383)	(3.771)
Rural development payments			-.406	-.804
			(.571)	(.769)
Constant	-5.725***	-5.103***	-56.841***	-81.94***
	(1.134)	(1.572)	(19.311)	(21.355)
Observations	315	282	280	255
Country Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

**** p<.01, ** p<.05, * p<.1*

Table 5.1 Regression results from the robust Blundell-Bond GMM regression with export market share as the dependent variable. Robust standard errors are in parentheses.

the positive coefficient is explained by the skill hypothesis, rather than the argument that markets need time to adjust.[11] However, the significance and the sign of the instantaneous coefficient change after including the control variables. The results of column 3 suggest that the ULC are not as important as previously assumed. The existing literature suggests that in the case of insignificant effects of ULC, the XMS should mainly be determined by the proxies of technical competitiveness. However, the insignificant coefficients of both investments and biotechnology patents suggest that the XMS of the horticulture enterprises is led by something different. Instead, the country and enterprise size effects determine a big part of the XMS. The positive effect of the total output can be explained by the previously mentioned Increasing Returns to Scale for crops grown in greenhouses and crops grown on land (Berck & Helfand, 2014). The positive significant coefficient for the population size

[11] Amendola et al. (1993) found negative coefficients for the one-year lagged effect.

effect corresponds to the results of Laursen and Meliciani (2010). The third significant coefficient is the one from the real effective exchange rate. The coefficient has the expected positive sign, meaning that depreciation or devaluation from the country's currency increases its competitiveness measured by XMS (de Jesus Espinoza-Arellano et al., 1998; Fuller et al., 1991; Huang, 2004). The final significant coefficient is the expected negative effect of the subsidy rate. This coefficient corresponds to the results of Bojnec and Latruffe (2013), who found negative relationships between the subsidy rate and technical efficiency scores.

The results stay approximately the same after, again, including lags of ULC up to 2 periods. The most interesting part is the sign change of the ULC coefficients in comparison with column 2, where all ULC coefficients were positive. However, the coefficients of the instantaneous effect and the effect of the one-period lag are insignificant while the coefficient of the lag 2 periods afterwards is significant. This suggests that the argument from Amendola et al. (1993) is applicable in the horticulture sector: the market needs around 2 periods to adjust to the increase in ULC. During these 2 periods, the horticulture enterprises can retain their competitive position, after which it will deteriorate in the second period.

5.2 Profitability as the dependent variable

For a full picture of the effect of ULC on competitiveness, one should also look at the effect of ULC on profitability. The IRF shows a positive response of ROA to a shock in ULC in the first period. After the first period, the ROA decreases fast and keeps below zero for the next five periods. This can be explained either by non-changing prices, which means that the profit margin decreases, or by increasing prices with a decrease in output, which can also decreases the total ROA.[12]

The regression results from the Blundell and Bond GMM regression described in 4.2 show a similar outcome to the IRF. Column 1 shows a significantly negative coefficient from the ULC, meaning that an increase in ULC causes a decrease in the profitability of the horticulture enterprises. This effect remains almost identical after including the control variables. Other important determinants of profitability are the share of paid labour, equity turnover, and subsidy rate, which all have the expected positive sign. Additionally is a significant positive coefficient of the share of external costs, which means that the farmers use the external production factors indeed more efficiently. On the contrary is the

[12] See the IRF in figure 5.1 to see the decrease in total output after a shock in ULC.

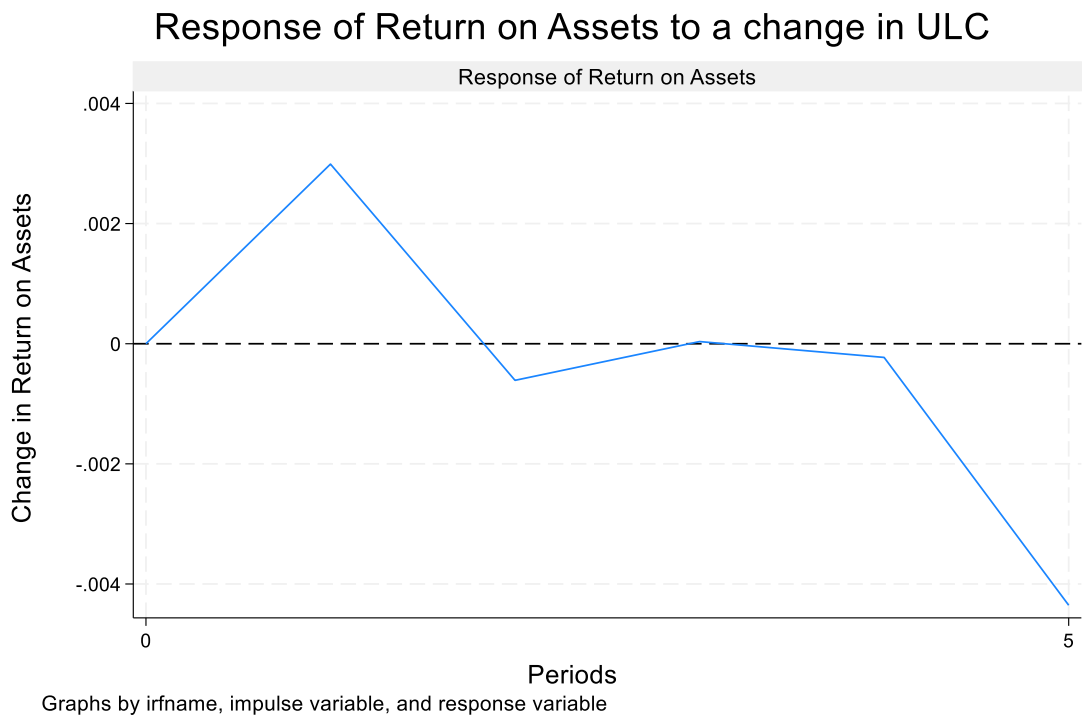

Figure 5.2 Impulse Response Function of the response of ROA to a Shock in Unit Labour Costs

	(1) ROA	(2) ROA
Lag ROA	.315***	.293***
	(.04)	(.026)
ULC	-.248***	-.284***
	(.017)	(.013)
Investment-to-depreciation		0
		(.001)
Share of paid labour		.062***
		(.016)
Current to total assets		-.032**
		(.015)
Equity turnover		.09***
		(.007)
Debt to asset		-.198***
		(.024)
Share of external costs		.206***
		(.041)
Share of farming overheads		-.005
		(.025)
Subsidy rate		.248**
		(.101)
Share of rural development		.001
		(.01)
Constant	.185***	.095***
	(.009)	(.012)
Observations	307	307

Country Fixed Effects	YES	YES
Year Fixed Effects	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 5.2 Regression results from the robust Blundell-Bond GMM regression with profitability as the dependent variable. Robust standard errors are in parentheses.

debt-to-asset ratio, which has a significant negative coefficient. This means that the cost of debt is higher than the productivity. The coefficient of the current-to-total asset ratio gives the unexpected sign: having more current assets, meaning that enterprises are more flexible, does not lead to an increase in profitability. However, the results are similar to the one Kryszak et al. (2021) found. They argue that, although it is an unexpected result, the marginal impact is rather weak, which is also the case for the horticulture enterprises.

This means that, even though there is no strong statistical evidence for a direct effect of an increase in ULC harming the competitive position of horticulture enterprises measured by the XMS, the rise in ULC can indirectly harm their competitiveness by reducing the profitability of the farms. This suggests that farms may hold their competitive position in the international market despite higher labour costs but at the expense of lower profits, reducing the sustainability of the position in the longer term.

Chapter 6 - Robustness

The results of the previous chapter suggest that an increase in ULC harms the competitive position of the horticulture enterprises mainly through profitability, rather than through the XMS. However, the results of the regressions might be biased.

To start, the profitability function might be biased due to endogeneity problems. This is because the value added is used as a proxy for the productivity, by which the labour costs are divided. This could mean that the significance level between the ROA and ULC comes from the common ground of ROA and the value added, rather than from the ULC itself. To check the bias, one can rerun the regression and use the total output per AWU as a productivity measure. Table 5 in the Appendix shows the results of the baseline model in column 1 and the new model with the robust ULC in column 2. The results of both regressions are almost identical. The ULC remains highly significant and negative after removing the endogeneity problem. Only the magnitude of the coefficient changes, but this can be assigned to the difference in the size between value added and total output. This suggests that the results of the profitability regression are not biased through the endogeneity between the profitability and ULC.

There can also be differences in the results from the consideration that some enterprises employ more non-national workers in their workforce than others. As mentioned earlier, these workers work under extreme conditions with a very low pay rate, which means that the ULC is significantly lower for these enterprises compared to when they had employed national workers. This could mean that they are highly dependent on their cost competitiveness to secure a competitive position in the international market, making their position more sensitive to an increase in ULC. France, Germany, Italy, Poland and Spain are the top 5 countries that use labour immigration in their fruit and vegetables sector (Augère-Granier, 2021). The regression results with only these five countries are shown in Table 6 in the Appendix. What stands out is the significant positive coefficient of the instantaneous effect in column 4, again explained by the argument of Amendola et al. (1993) that markets need time to adjust. Secondly, the coefficient of the second lag is not only more negative but also more significant when compared to the results from the entire population. This means that an increase in ULC hits the competitive position of these countries harder in the second period. Additionally is a significant negative coefficient of the investments, which is surprising. Possible explanations for this could be that the enterprises' investments need time before they can positively affect the XMS, or because the investments are made in areas not

meant to increase their XMS (e.g. socially responsible investments). If the latter is the case, it would mean that the enterprises do not invest in their technology competitiveness, making them rely even more on their cost competitiveness.

Chapter 7 - Conclusion and Discussion

The results of this research primarily show an important negative relationship between ULC and the profitability of the horticulture enterprises, measured as return on assets. This relationship shows that an increase in ULC will lead to a direct fall in profitability, even after including the control variables and accounting for possible endogeneity. The relationship between ULC and the XMS is not as straightforward. The instantaneous effect and the effect in the first lag are negative but insignificant, meaning that an increase in ULC would not lead to a significant change in XMS. However, the relationship becomes statistically significant in the second lag, meaning that an increase in ULC would lead to a decrease in XMS, but only two years after the shock. The results change slightly when looking at the five EU countries with the most labour immigrants in their horticulture sector. These results suggest that these countries experience an instantaneous positive significant effect, which can be assigned to markets needing the time to adjust. The effect two years after the shock is stronger and bigger compared to the entire population, suggesting that these countries experience a bigger shock in their competitive position after a shock in their ULC.

This leads to the conclusion that the competitive position of the horticulture enterprises may not be directly hit after a shock in ULC. Nevertheless, the strong significant effect of a shock in ULC on profitability suggests that the sustainability of the competitive position is at risk, possibly affecting the competitive position in the future. These results are of importance to the policymakers in the EU countries that decide on the future acceptance of labour immigrants in their respective countries.

However, there are some shortcomings in the results. The foremost problem is coming from data limitations and the aggregation level of the enterprise data. The FADN data calculates data on the "average agricultural firm", leading to the exclusion of farm heterogeneity within countries. Possible future research could directly collect the data on ULC through interviews or questionnaires.[13] Another shortcoming is the data on the proxies for technology competition in the horticulture sector. The existing literature uses direct data on the number

[13] Wageningen University and Research (WUR) is currently investigating the labour conditions in the Dutch horticulture sector using surveys. The results of this research could lead to more precise and heterogeneous data on the current labour conditions and labour costs. Future research could build further upon this research.

of patents demanded or received either by the United States Patent and Trademark Office (USPTO) or the European Patent Ofice (EPO) (Amendola et al., 1993; Carlin et al., 2001; Dosi et al., 2015; Laursen & Meliciani, 2000, 2010). Unfortunately, I was unable to find this data solely for the horticulture sector. To solve this problem, this research uses the patents in biotechnology as a proxy, which is inferior to the direct patent data. This could lead to flawed results when calculating the importance of technology competition in the horticulture sector. An additional data limitation problem is the exclusion from farm size effects in the profitability regression. Kryszak et al. (2021) divide their population data into 6 categories, based on the farm sizes indicated by the FADN database. Unfortunately, dividing the data on the horticulture sector from the publically available FADN database into these categories would lead to very few data points in the various categories. Therefore, this research refrains from following the exact practice of Kryszak et al. However, future research on the effects of ULC on profitability with the inclusion of research on the effect of farm size could lead to more nuanced estimations.

Future research could also investigate the effect of a shock in ULC on competitive position using a different kind of analysis. A possible analysis could be the use of partial equilibrium models to calculate changes in prices and quantities, including trade due to a shock in labour costs. Bunte and van Galen (2005) apply a partial equilibrium model to investigate the effects of a rise in energy costs for Dutch glasshouse horticulture producers. Reflecting the importance of energy use in the Dutch horticulture sector, it was found that a 10 percent increase in energy prices has potentially large impacts on production and trade. An advantage of partial equilibrium models is that they take all prices as endogenous. The model of Laursen and Meliciani (2010) assumes a form of exogeneity in the export prices where the supply curve is horizontal. This is a strong assumption that would not be necessary when using partial equilibrium models. However, partial equilibrium models assume that all markets are in equilibrium and resources are optimally allocated. The drawback of this approach is that pathway from one equilibrium to the other is not clear. This research shows that XMS of the EU horticulture sector might be more stable in the short run. However, it is also shown that the impact can be significant in a two year lag. This could be included in a more dynamic partial equilibrium model.

Furthermore, this research does not discuss the ongoing efforts of the horticulture sector in robotizing and digitalizing the sector in detail. However, as mentioned earlier, it will take several decades before all manual labour in the horticulture sector is replaced by robots (Contact, 2022). This makes it hard to predict how fast the technical developments will take

place and what the influence is on production and labour savings. Future research can give a better understanding of the role of these developments in the sector.

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Appendix

Research	Period	Number of countries	Level of data	Number of sectors or Firms	Effect of labour costs on competitiveness
Fagerberg (1988)	1961-1983	15	Country level	Aggregate Economy	Negligible effect
Amendola et al. (1993)	1967-1987	16	Country level	Aggregate manufacturing	Short-term negative effect
Amable and Verspagen (1995)	1970-1991	5	Country-sector level	18 sectors	Negative effect
Wakelin (1998)	1988	9	Country-sector level	22 sectors	Negative effect
Laursen and Meliciani (2010)	1981-2003	14	Country-sector level	16 sectors	Negative effect
Carlin et al. (2001)	1970-1992	14	Country-sector level	12 sectors	Negative effect
Bourkanis and Tsoukis (2016)	1980-2005	18	Country level	Aggregate economy	Negative effect

Barrios et al. (2003)	1990-1998	1 (Spain)	Firm-level	Approximately 2000	Positive
Aw et al. (2007)	1986-1996	1 (Taiwan)	Firm-level	518 to 1311 firms	Negative

Table 1. Summary of the literature on the effect of labour costs on competitiveness

Variable	**Formula**	**SE codes**
Unit Labour Costs	Wages paid/Total labour input in AWU	SE370/SE010
Return on Assets	Farm Net Income/Total assets	SE425/SE436
Equity Turnover	Total Output/Net worth	SE131/SE501
Investment-to-depreciation ratio	Gross investment on fixed assets/Depreciation	SE516/SE360
Debt-to-asset ratio	Total liabilities/Total assets	SE485/SE436
Current-to-total-assets ratio	Total current assets/Total assets	SE465/SE436
Share of external costs	Total external factors/Total inputs	SE365/SE270
Share of farming overheads	Total farming overheads/Total inputs	SE336/SE270
Share of paid labour	Paid labour/Total labour input	SE021/SE011
Subsidy rate	Balance subsidies and taxes on investments/Total output	SE405/SE131

Share of rural development payments	Total support for rural development/Total subsidies (excluding investments)	SE624/SE605
Economic size	-	SE005
Investments in Fixed Assets	-	SE516

Table 2. Detailed explanation of the calculation of the variables, including the SE codes from the FADN database.

Summary statistics

	N	Mean	SD	Min	Max
Austria					
XMS	16	.001	0.001	0	.005
ULC	0	.	.	.	.
POP	16	8483583.3	229812.407	8171966	8879920
INV	0	.	.	.	.
PAT	15	69.281	11.169	54.357	90.846
EconSize	0	.	.	.	.
Precip	16	1110	0.000	1110	1110
REER	16	105.178	9.781	91.249	122.63
SR	0	.	.	.	.
RD	0	.	.	.	.
Belgium					
XMS	16	.009	0.021	.003	.089
ULC	16	.411	0.049	.307	.48
POP	16	10992871	357420.667	10421137	11488980
INV	16	63357.75	36082.811	16814	174526
PAT	15	123.947	20.592	95.587	177.621
EconSize	16	441338.56	157844.912	218487	720528
Precip	16	847	0.000	847	847
REER	16	100.336	2.024	96.539	103.921
SR	16	.006	0.005	-.003	.016
RD	16	.155	0.191	.004	.602
Bulgaria					
XMS	16	0	0.000	0	.002
ULC	13	.495	0.100	.358	.644
POP	16	7336288.9	228661.343	6975761	7716860
INV	13	6501	5860.212	1736	21122
PAT	15	1.225	0.848	0	2.85
EconSize	13	26433.769	7213.942	18968	37842
Precip	16	608	0.000	608	608
REER	16	103.921	7.799	86.984	112.392
SR	13	.006	0.006	0	.02
RD	13	.321	0.232	0	.868
Croatia					

XMS	16	0	0.000	0	0
ULC	7	.51	0.217	.237	.875
POP	16	4240267	84293.251	4065253	4311159
INV	7	3758	3031.039	959	9889
PAT	15	2.076	1.787	.25	6
EconSize	7	35963	9969.739	22797	54162
Precip	16	1113	0.000	1113	1113
REER	16	99.414	2.818	95.555	105.184
SR	7	.021	0.054	0	.143
RD	7	.25	0.114	.123	.456
Cyprus					
XMS	16	0	0.001	0	.002
ULC	7	.646	0.239	.499	1.173
POP	16	1137816.4	66713.153	1018684	1228836
INV	7	2400.571	2232.488	414	6037
PAT	15	1.292	1.526	0	4.7
EconSize	7	34555	11916.645	20357	51361
Precip	16	498	0.000	498	498
REER	16	98.431	3.457	93.018	103.88
SR	16	.011	0.019	0	.046
RD	16	.079	0.109	0	.343
Czechia					
XMS	16	0	0.001	0	.004
ULC	16	.393	0.093	.228	.547
POP	16	10456507	149102.156	10197101	10671870
INV	16	6510.188	6211.006	-2279	20651
PAT	15	10.664	3.576	4.8	18.533
EconSize	16	166367.88	54209.828	84819	274067
Precip	16	677	0.000	677	677
REER	16	105.729	9.062	85.347	116.455
SR	16	-.005	0.001	-.007	-.002
RD	16	.078	0.026	.05	.141
Denmark					
XMS	16	.002	0.005	.001	.022
ULC	16	.718	0.024	.68	.767
POP	16	5593259.1	134866.093	5404523	5814422
INV	16	60387.938	21263.171	34768	97985
PAT	15	154.465	16.890	124.272	182.584
EconSize	16	1005705.9	368311.363	540625	1598801
Precip	16	703	0.000	703	703
REER	16	99.074	2.455	95.683	104.823
SR	16	.002	0.002	0	.005
RD	16	.11	0.070	.043	.247
Estonia					
XMS	16	0	0.000	0	0
ULC	16	.533	0.134	.332	.807
POP	16	1330501.8	14673.361	1314545	1362550
INV	16	10947.812	7896.169	435	30996
PAT	15	4.585	1.963	1.567	7.733
EconSize	16	62401.438	49707.225	26037	233398
Precip	16	626	0.000	626	626
REER	16	107.121	8.675	89.954	118.734
SR	16	.033	0.022	-.001	.085
RD	16	.329	0.143	.126	.586
Finland					
XMS	16	0	0.000	0	.001

ULC	16	.615	0.052	.511	.715
POP	16	5391736.5	101932.402	5228172	5521606
INV	16	39511.75	18066.121	16092	75581
PAT	15	46.184	6.597	33.37	53.793
EconSize	16	366028.63	149027.987	173119	715611
Precip	16	536	0.000	536	536
REER	16	100.813	2.027	98.406	105.407
SR	16	0	0.002	-.008	.005
RD	16	.089	0.085	.015	.335
France					
XMS	16	.007	0.018	.002	.073
ULC	16	.564	0.052	.493	.635
POP	16	65358402	1470675.201	62716304	67388000
INV	16	24693.25	6219.153	15558	38099
PAT	15	472.455	42.483	370.697	546.674
EconSize	16	270057.5	23165.798	232334	316878
Precip	16	867	0.000	867	867
REER	16	97.387	2.919	92.56	102.466
SR	16	-.002	0.003	-.01	0
RD	16	.077	0.057	.022	.24
Germany					
XMS	16	.006	0.014	.002	.059
ULC	16	.562	0.028	.522	.609
POP	16	81902360	879707.455	80274984	83092960
INV	16	25417.875	12446.374	15951	56546
PAT	15	714.34	57.610	638.924	806.304
EconSize	16	365535.69	110892.503	250893	685598
Precip	16	700	0.000	700	700
REER	16	103.323	9.918	81.423	117.229
SR	16	.003	0.001	.001	.005
RD	16	.108	0.066	.031	.318
Greece					
XMS	16	.001	0.001	0	.006
ULC	16	.253	0.064	.176	.367
POP	16	10945689	143088.676	10721582	11121341
INV	16	1392.562	921.709	243	3447
PAT	15	6.568	1.491	4.683	10.361
EconSize	16	51200.812	6865.721	38973	64534
Precip	16	652	0.000	652	652
REER	16	98.209	3.945	92.524	104.184
SR	16	.009	0.003	.005	.014
RD	16	.123	0.145	.018	.41
Hungary					
XMS	16	.001	0.002	0	.009
ULC	16	.375	0.066	.307	.55
POP	16	9939098.9	119228.587	9771141	10107146
INV	16	9325.812	5686.569	1988	21668
PAT	15	11.177	2.659	8.111	16.117
EconSize	16	75079.938	22432.693	28292	104568
Precip	16	589	0.000	589	589
REER	16	93.836	5.163	88.246	104.253
SR	7	.002	0.006	0	.017
RD	7	.118	0.079	0	.22
Italy					
XMS	16	.007	0.016	.003	.068
ULC	16	.264	0.044	.199	.342

POP	16	59464031	1040079.720	57685328	60789140
INV	16	3598.688	2024.470	1220	9521
PAT	15	168.348	20.520	132.605	198.263
EconSize	16	140313.5	15207.835	110734	165145
Precip	16	832	0.000	832	832
REER	16	98.389	2.329	94.962	102.736
SR	16	.012	0.015	-.001	.05
RD	16	.104	0.084	.007	.336
Latvia					
XMS	16	0	0.000	0	.001
ULC	9	.844	0.268	.572	1.301
POP	16	2072369.6	119568.623	1913822	2263122
INV	9	28083.889	29693.455	2547	101360
PAT	15	.772	0.943	0	3
EconSize	9	115445.78	39809.894	83168	208313
Precip	16	667	0.000	667	667
REER	16	106.193	9.452	87.531	118.029
SR	16	.001	0.001	-.002	.003
RD	16	.173	0.144	.046	.509
Lithuania					
XMS	16	.001	0.002	0	.008
ULC	16	.284	0.057	.186	.367
POP	16	3047650.2	192604.916	2794137	3377075
INV	16	12791.375	9758.031	5075	37889
PAT	15	4.25	2.238	1	7.667
EconSize	16	56516.25	28345.864	29421	148564
Precip	16	656	0.000	656	656
REER	16	107.971	7.691	93.673	115.586
SR	16	.034	0.019	0	.071
RD	16	.157	0.120	.049	.452
Malta					
XMS	16	0	0.000	0	0
ULC	16	.149	0.035	.082	.194
POP	16	431713.69	31299.691	401268	504062
INV	16	1797.25	838.830	845	3918
PAT	15	.3	0.455	0	1
EconSize	16	27715.062	4125.845	21578	36863
Precip	16	560	0.000	560	560
REER	16	98.17	2.991	93.352	104.362
SR	9	.016	0.026	0	.078
RD	9	.333	0.140	.153	.571
Netherlands					
XMS	16	.043	0.102	.017	.427
ULC	16	.533	0.065	.444	.686
POP	16	16732270	338854.388	16281779	17344874
INV	16	103679.19	35228.564	64337	174112
PAT	15	215.737	25.860	191.508	267.947
EconSize	16	953781.44	257063.609	552289	1352099
Precip	16	778	0.000	778	778
REER	16	97.952	2.456	93.862	102.499
SR	16	.009	0.009	0	.024
RD	16	.337	0.090	.193	.6
Poland					
XMS	16	.003	0.008	.001	.034
ULC	16	.252	0.033	.204	.302
POP	16	38061222	77034.872	37965476	38182224

INV	16	7509.375	3264.732	3831	16337
PAT	15	22.419	7.224	8.506	31.112
EconSize	16	58139.562	8336.685	42225	69536
Precip	16	600	0.000	600	600
REER	16	95.198	5.859	83.015	110.573
SR	16	0	0.001	-.001	.004
RD	16	.137	0.083	.052	.362
Portugal					
XMS	16	.001	0.002	0	.01
ULC	16	.289	0.042	.23	.387
POP	16	10452290	108821.605	10283822	10573100
INV	16	6172.125	2946.006	2642	12931
PAT	15	13.921	4.238	6.811	21.583
EconSize	16	37668.875	5972.717	28593	51271
Precip	16	854	0.000	854	854
REER	16	97.595	1.925	94.327	101.413
SR	16	-.002	0.005	-.014	.003
RD	16	.171	0.096	.015	.32
Romania					
XMS	16	0	0.000	0	.002
ULC	13	.291	0.128	.115	.579
POP	16	20253179	658816.200	19371648	21451748
INV	13	130.923	4667.055	-10394	11183
PAT	15	1.599	1.542	0	5
EconSize	13	12949.769	5950.607	8419	29686
Precip	16	637	0.000	637	637
REER	16	88.653	6.022	71.825	100
SR	16	.026	0.019	-.002	.075
RD	16	.4	0.100	.21	.641
Slovenia					
XMS	16	0	0.000	0	.001
ULC	0	.	.	.	.
POP	16	2045076.2	27934.328	1997012	2088385
INV	0	.	.	.	.
PAT	15	4.873	1.746	1.333	7.238
EconSize	0	.	.	.	.
Precip	16	1162	0.000	1162	1162
REER	16	94.436	5.311	83.431	102.41
SR	13	0	0.001	0	.004
RD	13	.077	0.125	0	.395
Spain					
XMS	16	.016	0.038	.006	.159
ULC	16	.358	0.060	.238	.48
POP	16	45947782	1239492.622	42921896	47134836
INV	16	4071.125	3280.293	-2362	12850
PAT	15	117.526	16.258	82.076	146.924
EconSize	16	111554.5	38404.752	62648	191360
Precip	16	636	0.000	636	636
REER	16	98.574	2.445	95.288	103.134
SR	12	.001	0.002	0	.006
RD	12	.117	0.137	0	.46
Sweden					
XMS	16	0	0.001	0	.003
ULC	12	.457	0.089	.3	.608
POP	16	9540445.3	414657.878	8993531	10278887
INV	12	36343.833	33435.437	4792	93882

PAT	15	120.351	11.418	99.333	140.879
EconSize	12	464740.92	142220.959	190346	613043
Precip	16	624	0.000	624	624
REER	16	96.085	5.558	84.385	103.529
SR	0	.	.	.	.
RD	0	.	.	.	.
United Kingdom					
XMS	16	.002	0.004	.001	.016
ULC	16	.695	0.099	.44	.794
POP	16	63448810	2218106.419	59987904	66836328
INV	16	42630.062	21499.504	19088	98514
PAT	15	458.605	60.207	363.447	567.588
EconSize	16	695403	224342.349	430006	1193308
Precip	16	1220	0.000	1220	1220
REER	16	87.4	7.683	78.701	100
SR	16	.001	0.001	0	.003
RD	16	.182	0.069	.045	.28

Table 3. Summary statistics per Member state for the regression with export market share as independent variable. XMS is the export market share, ULC is the Unit Labour Costs, POP is the population, INV is the investments, PAT is the level of biotech patents, EconSize is the economic size measured by output, Precip is the level of precipitation, REER is the Real Effective Exchange rate, SR is the ratio between subsidy rate and total output and RD is the share of Rural Development payments

	Mean	SD	Min	Max
(BE) Belgium	.09	.021	0.057	.131
ULC				
ROA	.127	.033	0.088	.194
Equity Turnover	1.066	.155	0.592	1.284
Investment-to-depreciation ratio	1.114	.447	0.550	2.511
Debt-to-asset ratio	.362	.054	0.215	.425
Current-to-total assets ratio	.177	.062	0.073	.245
Share of External Costs	.219	.009	0.210	.243
Share of Farming Overhead	.277	.015	0.258	.319
Share of Paid Labour	.537	.058	0.452	.626
Subsidy Rate	.006	.005	-0.003	.016
Share of Rural Development Payment	.155	.191	0.004	.602
(BG) Bulgaria				
ULC	.163	.031	0.118	.223
ROA	.062	.044	0.005	.123
Equity Turnover	.46	.262	0.044	.877
Investment-to-depreciation	1.869	1.458	0.578	5.096
Debt-to-asset ratio	.216	.111	0.027	.328
Current-to-total assets ratio	.252	.117	0.039	.341
Share of External Costs	.258	.029	0.216	.32
Share of Farming Overhead	.341	.052	0.245	.409
Shareof Paid Labour	.569	.043	0.511	.652
Subsidy Rate	.006	.006	0.000	.02

Shareof Rural Development Payment	.321	.232	0.000	.868
(CY) Cyprus				
ULC	.295	.099	0.209	.508
ROA	.038	.015	0.017	.063
Equity Turnover	.256	.064	0.176	.373
Investment-To-Depreciation ratio	.652	.548	0.175	1.55
Debt-To-Asset ratio	.013	.013	0.002	.036
Current-To-Total Assets ratio	.183	.021	0.161	.226
Share of External Costs	.279	.055	0.172	.348
Share of Farming Ovehead	.301	.017	0.278	.332
Share of Paid Labour	.448	.117	0.316	.595
Subsidy Rate	.021	.054	-0.000	.143
Share of Rural Development Payment	.25	.114	0.123	.456
(CZ) Czechia				
ULC	.089	.016	0.064	.116
ROA	.139	.071	0.057	.316
Equity Turnover	.895	.269	0.542	1.54
Investment-To-Depreciation ratio	.549	.481	-0.259	1.449
Debt-To-Asset ratio	.198	.117	0.048	.435
Current-To-Total Assets ratio	.371	.104	0.240	.669
Share of External Costs	.228	.035	0.167	.3
Share of Farming Overhead	.33	.049	0.239	.392
Share of Paid Labour	.54	.13	0.284	.778
Subsidy Rate	.011	.019	0.000	.046
Share of Rural Development Payment	.079	.109	0.000	.343
(DE) Germany				
ULC	.104	.016	0.066	.132
ROA	.12	.02	0.091	.153
Equity Turnover	1.599	.152	1.352	1.893
Investment-To-Depreciation	.905	.214	0.692	1.588
Debt-To-Asset ratio	.457	.037	0.363	.518
Current-To-Total Assets ratio	.227	.014	0.206	.246
Share of External Costs	.3	.02	0.276	.341
Share of Farming Overhead	.319	.049	0.241	.38
Share of Paid Labour	.715	.036	0.660	.791
Subsidy Rate	-.005	.001	-0.007	-.002
Share of Rural Development Payment	.078	.026	0.050	.141
(DK) Denmark				
ULC	.089	.021	0.058	.115
ROA	.039	.014	0.020	.066
Equity Turnover	1.481	.343	1.004	2.053
Investment-To-Depreciation	1.058	.33	0.624	1.862
Debt-To-Asset ratio	.543	.034	0.494	.595
Current-To-Total Assets ratio	.305	.048	0.229	.368
Share of External Costs	.382	.015	0.357	.403
Share of Farming Overhead	.219	.025	0.177	.261
Share of Paid Labour	.846	.041	0.777	.912
Subsidy Rate	.002	.002	0.000	.005
Share of Rural Development Payment	.11	.07	0.043	.247
(EE) Estonia				
ULC	.256	.084	0.139	.397

ROA	.075	.037	0.027	.161
Equity Turnover	.671	.261	0.331	1.194
Investment-To-Depreciation ratio	1.843	1.242	0.134	5.072
Debt-To-Asset ratio	.275	.093	0.118	.435
Current-To-Total Assets ratio	.286	.085	0.137	.42
Share of External Costs	.238	.026	0.187	.268
Share of Farming Overhead	.329	.067	0.254	.478
Share of Paid Labour	.557	.115	0.403	.768
Subsidy Rate	.033	.022	-0.001	.085
Share of Rural Development Payment	.329	.143	0.126	.586
(EL) Greece				
ULC	.119	.026	0.083	.168
ROA	.173	.063	0.093	.28
Equity Turnover	.456	.095	0.303	.62
Investment-To-Depreciation ratio	.257	.173	0.040	.613
Debt-To-Asset ratio	.012	.014	0.000	.056
Current-To-Total Assets ratio	.043	.015	0.020	.075
Share of External Costs	.227	.032	0.185	.287
Share of Farming Overhead	.241	.02	0.209	.275
Share of Paid Labour	.381	.082	0.269	.506
Subsidy Rate	0	.002	-0.008	.005
Share of Rural Development Payment	.089	.085	0.015	.335
(ES) Spain				
ULC	.117	.018	0.095	.157
ROA	.106	.037	0.045	.203
Equity Turnover	.3	.077	0.203	.451
Investment-To-Depreciation ratio	.878	.711	-0.333	2.733
Debt-To-Asset ratio	.05	.013	0.027	.074
Current-To-Total Assets ratio	.354	.07	0.267	.495
Share of External Costs	.364	.044	0.306	.457
Share of Farming Overhead	.213	.027	0.151	.251
Share of Paid Labour	.576	.08	0.464	.755
Subsidy Rate	-.002	.003	-0.010	0
Shareof Rural Development Payment	.077	.057	0.022	.24
(FI) Finland				
ULC	.137	.022	0.097	.182
ROA	.079	.019	0.044	.118
Equity Turnover	1.838	.344	1.382	2.678
Investment-To-Depreciation ratio	1.073	.429	0.663	2.475
Debt-To-Asset ratio	.582	.051	0.503	.657
Current-To-Total-Assets ratio	.261	.023	0.231	.315
Share of External Costs	.236	.016	0.217	.265
Share of Farming Overhead	.409	.032	0.358	.463
Share of Paid Labour	.585	.087	0.472	.751
Subsidy Rate	.003	.001	0.001	.005
Share of Rural Development Payment	.108	.066	0.031	.318
(FR) France				
ULC	.133	.01	0.118	.158
ROA	.161	.039	0.111	.218
Equity Turnover	2.583	.141	2.334	2.802
Investment-To-Depreciation ratio	.917	.216	0.607	1.372
Debt-To-Asset ratio	.578	.02	0.543	.611
Current-To-Total Assets ratio	.411	.022	0.369	.459

Share of External Costs	.276	.008	0.260	.291
Share of Farming Overhead	.334	.017	0.305	.361
Share of Paid Labour	.642	.019	0.605	.683
Subsidy Rate	.009	.003	0.005	.014
Share of Rural Development Payment	.123	.145	0.018	.41
(HR) Croatia				
ULC	.214	.071	0.106	.296
ROA	.032	.024	0.004	.076
Equity Turnver	.202	.046	0.132	.256
Investment-To-Depreciation ratio	.559	.394	0.181	1.339
Debt-To-Asset ratio	.009	.014	0.001	.041
Current-To-Total Assets ratio	.045	.019	0.029	.071
Share of External Costs	.188	.032	0.141	.234
Share of Farming Overheads	.2	.018	0.185	.237
Share of Paid Labour	.304	.079	0.203	.445
Subsidy Rate	.002	.006	0.000	.017
Share of Rural Development Payment	.118	.079	0.000	.22
(HU) Hungary				
ULC	.14	.033	0.093	.204
ROA	.14	.043	0.051	.206
Equity Turnover	.7	.127	0.515	.912
Investment-To-Depreciation	1.199	.551	0.446	2.08
Debt-To-Asset	.248	.044	0.191	.322
Current-To-Total Assets ratio	.36	.08	0.170	.479
Share of External Costs	.251	.023	0.208	.282
Share of Farming Overhead	.256	.025	0.212	.312
Share of Paid Labour	.679	.065	0.524	.728
Subsidy Rate	.012	.015	-0.001	.05
Share of Rural Development Payment	.104	.084	0.007	.336
(IT) Italy				
ULC	.104	.019	0.081	.145
ROA	.192	.052	0.097	.265
Equity Turnover	.507	.097	0.322	.628
Investment-To-Depreciation ratio	.408	.302	0.092	1.452
Debt-To-Asset ratio	.023	.02	0.008	.094
Current-To-Total Assets ratio	.31	.147	0.078	.505
Share of External Costs	.247	.029	0.209	.312
Share of Farming Overhead	.185	.019	0.144	.219
Share of Paid Labour	.406	.041	0.331	.475
Subsidy Rate	.001	.001	-0.002	.003
Shareof Rural Development Payment	.173	.144	0.046	.509
(LT) Lithuania				
ULC	.099	.03	0.035	.144
ROA	.19	.06	0.091	.274
Equity Turnover	.522	.117	0.308	.675
Investment-To-Depreciation ratio	1.814	.947	0.628	4.246
Debt-To-Asset ratio	.129	.053	0.054	.232
Current-To-Total Assets ratio	.413	.066	0.315	.532
Share of External Costs	.255	.056	0.183	.366
Share of Farming Overhead	.264	.052	0.185	.347
Share of Paid Labour	.499	.078	0.406	.701
Subsidy Rate	.034	.019	-0.000	.071
Share of Rural Development	.157	.12	0.049	.452

Payment				
(LV) Latvia				
ULC	.143	.055	0.077	.219
ROA	.032	.066	-0.071	.129
Equity Turnpver	1.667	.42	0.943	2.184
Investment-To-Depreciation ratio	2.226	2.13	0.260	7.427
Debt-To-Asset ratio	.567	.135	0.383	.748
Current-To-Total Assets ratio	.391	.071	0.281	.476
Share of External Costs	.275	.044	0.185	.334
Share of Farming Overhead	.426	.071	0.352	.562
Share of Paid Labour	.823	.035	0.762	.869
Subsidy Rate	.016	.026	0.000	.078
Share of Rural Development Payment	.333	.14	0.153	.571
(MT) Malta				
ULC	.101	.022	0.054	.126
ROA	.099	.02	0.066	.15
Equity Turnover	.223	.036	0.154	.275
Investment-To-Depreciation ratio	.917	.342	0.483	1.633
Debt-To-Asset ratio	.023	.005	0.008	.028
Current-To-Total Assets ratio	.058	.014	0.045	.105
Share of External Costs ratio	.138	.022	0.098	.182
Share of Farming Overhead	.334	.038	0.266	.404
Share of Paid Labour	.13	.025	0.091	.176
Subsidy Rate	.009	.009	0.000	.024
Share of Rural Development Payment	.337	.09	0.193	.6
(NL) Netherlands				
ULC	.077	.019	0.054	.108
ROA	.055	.029	0.003	.098
Equity Turnover	1.088	.108	0.945	1.27
Investment-To-Depreciation ratio	1.141	.378	0.706	2.056
Debt-To-Asset ratio	.524	.059	0.411	.597
Current-To-Total Assets ratio	.234	.02	0.207	.279
Share of External Costs	.265	.01	0.250	.286
Share of Farming Overhead	.297	.046	0.231	.349
Share of Paid Labour	.733	.045	0.663	.798
Subsidy Rate	0	.001	-0.001	.004
Share of Rural Development Payment	.137	.083	0.052	.362
(PL) Poland				
ULC	.088	.012	0.074	.106
ROA	.115	.016	0.091	.153
Equity Turnover	.513	.04	0.453	.59
Investment-To-Depreciation ratio	1.104	.509	0.583	2.42
Debt-To-Asset ratio	.179	.047	0.125	.253
Current-To-Total Assets ratio	.104	.016	0.086	.132
Share of External Costs	.152	.016	0.124	.175
Share of Farming Overhead	.316	.021	0.272	.343
Share of Paid Labour	.421	.042	0.326	.475
Subsidy Rate	-.002	.005	-0.014	.003
Share of Rural Development Payment	.171	.096	0.015	.32
(PT) Portugal				
ULC	.141	.015	0.123	.182
ROA	.156	.033	0.089	.205

Equity Turnover	.504	.123	0.339	.713
Investment-to-depreciation ratio	1.086	.442	0.513	1.984
Debt-to-asset ratio	.048	.013	0.030	.07
Current-to-total-assets ratio	.094	.028	0.060	.139
Share of External Costs	.197	.023	0.152	.243
Share of Farming Overhead	.193	.015	0.164	.214
Share of Paid Labour	.279	.043	0.202	.371
Subsidy Rate	.026	.019	-0.002	.075
Share of rural development payment	.4	.1	0.210	.641
(RO) Romania				
ULC	.165	.055	0.076	.244
ROA	.057	.037	0.003	.141
Equity Turnover	.206	.094	0.084	.362
Investment-to-depreciation ratio	-.262	2.215	-6.763	2.541
Debt-to-asset ratio	.095	.114	0.001	.34
Current-to-total-assets ratio	.205	.105	0.087	.438
Share of External Costs	.211	.08	0.114	.343
Share of Farming Overheads	.286	.023	0.252	.326
Share of Paid Labour	.251	.16	0.117	.548
Subsidy Rate	0	.001	-0.000	.004
Share of rural development payments	.077	.125	0.000	.395
(SE) Sweden				
ULC	.118	.041	0.089	.224
ROA	.133	.061	0.034	.222
Equity Turnover	1.473	.564	0.673	2.277
Investment-to-depreciation ratio	1.473	1.151	0.264	3.48
Debt-to-assets ratio	.406	.106	0.199	.56
Current-to-total-assets ratio	.334	.09	0.173	.443
Share of External Costs	.278	.017	0.245	.312
Share of Farming Overheads	.381	.018	0.355	.418
Share of Paid Labour	.574	.08	0.445	.664
Subsidy Rate	.001	.002	0.000	.006
Share of rural development payment	.117	.137	0.000	.46
(UK) United Kingdom				
ULC	.074	.02	0.034	.107
ROA	.094	.076	0.037	.328
Equity Turnover	1.007	.186	0.856	1.527
Investment-to-depreciation ratio	1.295	.315	0.751	1.773
Debt-to-asset ratio	.242	.042	0.191	.337
Current-to-total-assets ratio	.286	.036	0.194	.325
Share of External Costs	.354	.011	0.332	.378
Share of Farming Overheads	.184	.018	0.149	.216
Share of Paid Labour	.836	.03	0.785	.88
Subsidy Rate	.001	.001	0.000	.003
Share of rural development payments	.182	.069	0.045	.28

Table 4. Summary statistics per Memeberstate for the regression with profitability as independent variable.

	(1) Baseline Regression	(2) Robustness regression

Lag ROA	.293***	.346***
	(.026)	(.031)
Investment-to-depreciation	0	.002
	(.001)	(.001)
Share of paid labour	.062***	.059***
	(.016)	(.019)
Current-to-total assets	-.032**	-.062***
	(.015)	(.018)
ULC	-.284***	
	(.013)	
Equity turnover	.09***	.084***
	(.007)	(.008)
Debt-to-asset	-.198***	-.228***
	(.024)	(.028)
Share of external costs	.206***	.825***
	(.041)	(.073)
Share of farming overheads	-.005	-.065**
	(.025)	(.03)
Subsidyrate	.248**	.202*
	(.101)	(.12)
Share of rural development	.001	-.013
	(.01)	(.012)
ULC Robust		-1.249***
		(.083)
Constant	.095***	.071***
	(.012)	(.015)
Observations	307	307
Country Fixed Effects	YES	YES
Year Fixed Effects	YES	YES

**** p<.01, ** p<.05, * p<.1*

Table 5. Robust Blundell-Bond GMM regressions with column 1 the baseline regression with the regular ULC and column 2 with the robustness check regression with the robust ULC. Profitability is the dependent variable and robust standard errors are in parentheses.

	(1) XMS	(2) XMS	(3) XMS	(4) XMS
Lag XMS	-.016	-.042**	-.024	-.031
	(.019)	(.02)	(0)	(.076)
ULC	.307	1.699***	.609	1.133***
	(.343)	(.586)	(0)	(.222)
Lag ULC		-.819		-.323
		(.569)		(.637)
Lag 2 ULC		-1.401***		-1.755***
		(.338)		(.352)
Investments			-.584	-.564***
			(0)	(.107)
Population			-2.12	-1.905
			(0)	(3.144)
Total output			.318	.837
			(0)	(.692)
Biotech patents			.122	.185
			(0)	(.22)
Reer			8.905	10.004***
			(0)	(2.878)

Precipitation			2.784	1.473
			(0)	(3.028)
Subsidy rate			-7.896	-16.098**
			(0)	(7.873)
Rural development payments			1.207	1.546***
			(0)	(.587)
Constant	-5.503***	-6.476***	-67.107	-71.74***
	(.49)	(.18)	(0)	(26.787)
Observations	75	70	71	66
Country Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES

**** p<.01, ** p<.05, * p<.1*

Table 6. Robust Blundell-Bond GMM regression with data from France, Germany, Italy, Poland and Spain. Robust standard errors are in parentheses.