



# **The Impact of EU Accession on Agricultural Self-Sufficiency in Sweden and Finland**

A Nordic Comparison

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## Abstract

Using a Difference-in-Difference analysis, this thesis tests the hypothesis that Sweden and Finland experienced a decrease in overall self-sufficiency ratio after their EU accession compared to the control group during the given time period. The data is compiled of quantity produced, imported and exported for eleven agricultural goods for the years between 1990-2000 for each respective country. The trade-off between being self-sufficient and trade reliant is of great concern, especially in times of trade-disrupting events like Covid-19 or the Russian invasion of Ukraine. Additionally, we identify if any specific categories of agricultural goods were particularly affected by the EU accession. The study contributes to existing research by using the self-sufficiency ratio with a Difference-in-Difference approach to understand the causal effects of EU accession on Sweden and Finland compared to other Nordic countries.

The results indicate that there was no statistically significant change in the overall self-sufficiency ratio for agricultural goods in Sweden and Finland following EU accession when compared with the control group consisting of Norway and Denmark. However, when examining specific categories of goods, the findings suggest that crops experienced a significant decrease in SSR, vegetables showed a slight but statistically significant increase, while meats did not exhibit any statistically significant change. Because of the noise in the data and the bias introduced by the method and assumptions, we suggest further research to strengthen the results of this thesis.

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# Abbreviations

SLU	Swedish University of Agricultural Sciences
DiD	Difference-in-Difference
CAP	Common Agricultural Policy
FAO	Food and Agriculture Organization of the United Nations
SSR	Self-sufficiency Ratio
EEC	European Economic Community
SUTVA	Stable Unit Treatment Value Assumption

# 1. Introduction

## 1.1 Background

All countries face unique conditions in food availability, and it is of importance that they balance self-sufficiency and trade, to maximize the benefits associated with both concepts (Clapp, 2017). In times of crises, food security and self-sufficiency become increasingly debated (SLU, 2023). The recent invasion of Ukraine and other on-going conflicts around the world, multiple actors are examining ways to strengthen the domestic food production to decrease import dependency, according to the Swedish minister of rural affairs (Kullgren, 2023). The pandemic illustrated the vulnerability to disruptions in the food chain both in terms of trade between countries, but also the low level of self-supply and foods reserves in households (Roubík et al., 2022). These are phenomena that reappear when the food chain is tested during crisis and remind us that a steadily growing population and extensive trade dependency make us vulnerable. Naturally, this leads to a reconsideration of the importance of being self-sufficient in food supply and relying less on imported foods (Porkka et al., 2013). At the same time, globalization and trade liberalization have enabled affordability and availability of food on a global scale (Kearney, 2010). The global population will continue to grow which calls for increased food production, while considering the Earth's finite resources (Godfray et al., 2010)

In terms of monetary value, Swedish farmers have gone from producing 75% of the food consumed in Sweden in 1988 to 50% today (LRF, 2023). If food is not domestically produced, it must be imported. In the past decades, global food trade systems have grown in both magnitude and complexity to meet the needs that an increasing population has (Wang and Dai, 2021). Almost all of Sweden's food imports originates from other EU member states. Not only are exotic goods that cannot be produced domestically imported, but also goods that are in direct competition with domestically produced goods, such as meats and vegetables (Jordbruksverket, 2024). During the 1970s, Finland was self-sufficient in most products except fruit and vegetables (Kettunen, 1986). Today, it is estimated that around 80% of the food consumed is produced domestically (DigiSarka, 2020). Finland, which participated in World War 2, continued post-war to invest in self-



sufficiency to strengthen food security in case of another crises. As the countries joined the EU and thereby could access the internal union market where food moves freely, they became more integrated in the new food market. Joining the EU raised worries about the future of Finland's food production. While domestic food production involves more than just being self-sufficient, achieving a high self-sufficiency needs a variety of locally produced foods (ibid.) Clapp (2017) defines a country as self-sufficient in food when it produces enough to meet its own demands. Even though some researchers claim that self-sufficiency is defined as a country that only relies on domestic produced food and completely avoid food trade, Clapp suggests a more realistic definition where the country may trade food but still produce at least 100% of the food consumed domestically.

For the past 10 years, Swedish imports of agricultural commodities and foods have exceeded the exports by around 60-70%. A high reliance on imports is not necessarily something negative. Feenstra and Taylor (2021) reference the famous economist David Ricardo who showed that all countries could gain from free trade by specializing in exporting goods in which they have comparative advantages to produce and importing such goods other countries have comparative advantage for. A central purpose of the European Union is to promote free trade, and members have agreed to not impose tariffs on each other (ibid).

The 90s was a turbulent decade for agricultural trade and policy in Sweden. In 1990, the Swedish government conducted an extensive deregulation of agriculture. According to Livsmedelsekonomiska institutet (2005, pp 6-7) the purpose was to achieve lower prices and a policy more similar to the OECD-countries. January 1st, 1995, Sweden along with Finland and Austria became members of the European Union and adopted the Common Agricultural Policy (CAP). At the time, the CAP had just been reformed to shift from a market support system to providing farmers directly with income support (Council of the European Union, 2024).

During the 1990s, the CAP consisted of price support, direct subsidies, and production regulations through quotas and subsidy rights. While the European Union promotes free trade, which is favourable for the country with comparative advantage in producing a specific good, the CAP imposed various regulations on the union members and its producers, to ensure that countries that did not have the most favourable conditions to produce still could maintain a certain level of production (Livsmedelsekonomiska institutet, 2000). This was an extensive change of agricultural policy for the concerned countries with complex outcomes that affects the domain of agricultural economics and trade. On one hand, free trade increases competition and can result in lower prices, on the other hand, price support and other regulation can keep prices high.

Concerns have been raised that Sweden is heading towards an increased dependency on other countries in terms of food and that it would make Sweden vulnerable to famine in case of a crisis such as a trade blockade or a conflict that would obstruct trade (Strömer, 2021). But even if Sweden managed to increase production to meet domestic demand, it would still be dependent on imported inputs such as fertilizers, pesticides, machinery, fuel and more. The term ‘self-sufficiency’ does not necessarily account for imported inputs, it is hard to identify a single food line of production that is entirely self-sufficient on Swedish produced inputs. Instead of ‘self-sufficiency’, institutions like the FAO and the Swedish Board of Agriculture commonly use the term ‘market share’ to illustrate how big of a share of the total consumption that is produced domestically (Jordbruksverket, 2022)

There are of course more perspectives in the debate of trade dependency and self-sufficiency, but the common goal for all countries is to achieve a high degree of food security to ensure food availability across the populations. In a policy brief, researchers Hansson et al. (2024) recommends Swedish policymakers to create resilient and sustainable food systems to achieve a higher preparedness in terms of food security. Better resilience means the food system will be more resistant and flexible to shocks. The researchers emphasize that stocking up on inputs is not enough to create a long-term resilient food production even though it is a necessary precaution for short term shocks.

Self-sufficiency, food security, preparedness and trade all go hand in hand, and when discussing the terms, it is important to have a distinct definition of the discussed term and be careful not to presume a direct interrelation between the terms since they all have distinct characteristics and implications. Self-sufficiency may not guarantee food security and although trade can enhance food security, it may also introduce vulnerabilities in the food system.

## 1.2 Aim and research question

The aim of this thesis is to examine if there is a causality between the development of self-sufficiency of agricultural goods in Sweden and Finland and their EU accession in 1995, through a comparison with Denmark and Norway. To clarify, Sweden and Finland are the treated group, while Denmark and Norway act as the control group. Denmark joined the EU in 1973, and Norway is not a member. The study is limited to the years 1990-2000 where 1995 is the year of the accession for the treated group. This approach will sort out whether the development of self-sufficiency ratio in the groups behaved differently in the period after the accession. Understanding the effects of the EU accession and the implementation of the free

trade as well as the Common Agricultural Policy on agriculture and self-sufficiency are current issues, especially with the recent British exit from the EU.

Based on the aim of the study, the following hypothesis is formulated to guide the research:

*Sweden and Finland experienced a decrease in overall self-sufficiency ratio after their EU accession compared to the control group during the given time period.*

Whether or not we can observe a change in the overall self-sufficiency ratio for the countries it might be possible to isolate the effect to certain categories of agricultural goods which leads us the following question:

*Is there a discrepancy between different categories of agricultural goods and how their self-sufficiency ratios have changed with the EU accession?*

### 1.3 Delimitations

This study uses data from the Food and Agriculture Organization (FAO), spanning from 1990 to 2000, focusing on unprocessed agricultural goods. Processed goods are naturally excluded from the study since they can consist of multiple ingredients with multiple countries of origin and are therefore not suitable for the type of comparison made in this study. The selection of goods is made with consideration to if there is a demand of the goods as well as the possibility to grow them in the Nordic climate, whereas ‘exotic’ goods are excluded. Additional goods such as eggs and dairy were intended to be included had to be removed because of missing data. Through this selection process, the study aims to provide valuable insights into the characteristics of self-sufficiency of agricultural goods in the Nordic countries during the 1990s.

### 1.4 Disposition

The thesis is organized as follows. Section 2 discusses previous studies relating to self-sufficiency as well as methodological approaches. Section 3 provides the theoretical framework of the study. Section 4 provides information on the variables used and descriptive statistics to help the reader understand the dataset. In section 5, we explain the method and its assumptions. Finally, results are presented in section 6, followed by a discussion in section 7, and in section 8, the conclusion is presented.

## 2. Literature Review

The literature review contains selected parts from papers and reports relating to self-sufficiency as well as exploring papers employing similar methods or presumptions as this study. The importance of self-sufficiency and the complexity of examining how a policy change can alter the market balance in a country will be central. Other than describing the current state of knowledge, the literature review will identify gaps in or weaknesses in the research that could require more investigating and convey how this thesis fills a gap in the current research.

### 2.1 Self-sufficiency ratio application

Self-sufficiency of a country can be measured from multiple perspectives. The self-sufficiency ratio (SSR) is suitable to apply for specific commodities or category of commodities, for example pork, beef, or all types of meat combined. In research the SSR is mostly applied to crops or root vegetables. Notable is also that the SSR is not suitable to be applied on the overall food supply since that could falsely portray a country as self-sufficiency if the country is specialized in a single or a few commodities (Clapp, 2017). Specifically, the SSR indicates to which extent a country, or a region is reliant on net-imports of food (Kaufmann et al., 2022).

Self-sufficiency ratio is defined as following:

*Equation 1*

$$\frac{\textit{Production}}{\textit{Production} + \textit{imports} - \textit{exports}} = \textit{Self Sufficiency Ratio}$$

In this thesis, production, imports and exports are measured in metric tons. In research however the units of the variables can vary. Clapp (2017) suggests that the unit can be in terms of calories, monetary values or in weight as adopted in this study. The unit should not be chosen arbitrarily but with regard to what the study aims to accomplish. If the study is focused on a country's ability to feed its population, the calorie method is suitable while if the study aims to evaluate output

after a policy change, weight or monetary value is best suited. Prices can differ from year to year, and data on historic prices is not always available, why weight is preferred for this kind of study.

As suggested by the FAO, this measurement is used to depict to which extent a country produces its food domestically (FAO, 2012). A number close to 1 usually indicates that a country is close to self-sufficient in producing that good, but it could also mean a country exports a large portion of its produce and simultaneously rely on imports. The ratio can also exceed 1, indicating that there is an abundance of produce compared to what is being imported and exported. The denominator in the equation serves as the total consumption in a country. Which is why the quota will equal the self-sufficiency ratio, or the share of domestically produced of the total consumption.

Jordbruksverket, The Swedish Board of Agriculture, uses the same measurement as the FAO and refrain from using the term 'self-sufficiency', since this term can be easily misinterpreted. A concern with the term that is raised is if a country can be considered as self-sufficient if the domestic production is dependent on imported inputs. In the context of Swedish agriculture that would be fertilizer, pesticides, fuel, animal feed, machinery and more. Some of these inputs are more important than others, such as fuel, but a shortage of any of these inputs could constrain domestic production severely. (Jordbruksverket, 2023)

Clapp (2017) discusses what is described as a binary debate, where one side favours self-sufficiency as safeguard against potential trade disruptions and the other side opposes countries striving for self-sufficiency since the policies invoked to increase self-sufficiency can distort the trade market. Clapp concludes that instead of the binary discussion where it is between relying solely on domestic production with shut borders or an import reliance with open borders, the focus should be more realistic since most countries are somewhere in the middle between the two extremes in their ability to produce and trade. Discussion should focus on creating more productive policies in combination with a versatile commerce system to ensure a suitable degree of self-sufficiency and trade reliance.

In Clapp's calculation of the SSR, production is in the numerator and the total consumption in the denominator consists of production added by imports subtracted by exports. In a paper by Puma et al. (2015), the authors add another dimension to the SSR calculation by incorporating  $\Delta R$  in the denominator, denoting the change in reserves of a good for a country. This is in line with FAOs suggestion of calculation and  $\Delta R$  assumes a positive value if the country consumes from its reserves. The authors applied the SSR to assess fragility in global food systems that

may arise with increased economic integration and trade dependency. While pointing to the necessity of accounting for the systemic risk that becomes prevalent with economic integration, the authors also point out that the global trade system is generally robust against small shocks. To stay robust during major shocks requires an increased redundancy in the food system meaning production can easily be relocated in the case of regional shocks appear.

The increase in trade over the past decades have altered food systems from the perspective of consumers and producers. An increase in trade both between countries and in absolute terms have led to a globalization of the food system, resulting in a more diverse supply of foods. Consumers can therefore adapt their diet by incorporating diverse ingredients from around the world. While the supply has grown increasingly diverse because of globalization, the diversity in production has decreased in those countries that are major exporters of food, but the decrease in production diversity was not proven to have occurred in countries that were not major exporters, for those, it either remained constant or increased. The decrease in production diversity for major exporters suggests there has been a form of specialization for food production on the international market (Kummu et al. 2020).

In a study by Cui et al (2013) the trend of falling self-sufficiency was observed in the African continent. To observe the effect, the authors use the self-sufficiency ratio provided by FAO as a benchmark for measuring food security. In the period from early 1960 until 2007, the average self-sufficiency ratio decreased from being almost 1 in the early 1960s to being 0,8 by 2007. The decrease is explained by an increase in food imports from other countries, indicating a general increase in trade reliance for Africa as a whole. Other factors that explain fluctuation in SSR during the time period on a more individual level for the Africa countries was climate change and other stress factors. Kaufmann et al. (2022) explore European regions using the SSR in the category's livestock products, cropland products and primary agricultural biomass. On the topic of self-sufficiency, the authors investigate the relationship between consumption and agricultural production. They conclude that not only urban regions show import-dependent tendencies, but many rural regions as well. The authors employ a multi-dimensional approach suitable for the agricultural system allowing them to draw complex conclusions regarding regional self-sufficiency.

Not only is self-sufficiency used in terms of food security and the ability to feed a hungry population, but the term is also used in a civil defence matter. Eriksson and Peltomaa (2017) compare Sweden and Finland in terms of national food self-sufficiency and how both countries aimed for complete self-sufficiency during the Cold War era to ensure food access in case of war or other trade-disrupting conflict.

Following the de-escalation of the Cold War, more economists argued the cost of maintaining high self-sufficiency through agricultural policy exceeded the gain and that the solution would be deregulation of price support, tariffs and subsidies. The deregulation was not carried out in Finland, but Swedish agricultural policy was extensively deregulated from the early 1990s until the EU accession when Swedish and Finnish agricultural policy was to be included in the Common Agricultural Policy as a product of the 1995 EU accession.

## 2.2 Methodological challenges with assessing EU accession

In a paper by Campos et al. (2019), the authors conduct a study, of how income per capita could differ, if a country would not have joined the European Union. Their paper involves comparing how countries could have performed in a certain quantification if they were not affected by the policy change that is joining the EU. The paper is relevant to this study since it defines several weaknesses that are associated with the Difference-in-Difference (DiD) approach. One weakness being that DiD approaches cannot estimate dynamic effects of EU membership on individual countries but only an overall average effect. To combat this problem, the authors use a synthetic control method to construct counterfactuals for countries to enhance the results of the study. The authors also determine that this type of comparison between countries is often severely affected by country heterogeneity.

Boronenko et al. (2014) also research how an EU accession changed economic performance. The authors focus on central and eastern European countries that joined the EU in the years 2000-2011 while using Croatia, who did not join the EU until 2013, as control country. The short time period is mentioned as a weakness in study and although they do not use a DiD approach, the arrangement is more similar to this thesis than the method of using a synthetic control group, which Campos et al. used.

Kutan and Yigit (2009) examine the productivity growth after an EU accession for five new EU-members. By using France as a proxy for European standard and with structural break tests and data envelopment analysis, the results show that newly accessed union members experienced productivity growth that exceeded the benchmark level of EU-members.

Slaughter (2001) explores the impact of trade liberalization on per capita income convergence across various post WWII-events, using the DiD approach. Unlike the studies mentioned above, which examine EU accession as the treatment or crucial

event, Slaughter studies various events, but through a method similar to the one of this thesis. Although the author does not find any systematic evidence of trade liberalization and income convergence, the study provides an example of possibilities and limitations of the DiD. The method proves to be easy to use and straightforward in comparing changes in economic outcomes between treated and control groups before and after a policy intervention. Among the limitations mentioned by the author, one is that the effect of the trade liberalization might be biased if it is widely anticipated by firms and investors, which might harm the result of the model. A proposed solution to this problem is to replicate the analysis but dating the crucial date before the actual event. The problems with control groups are also identified as crucial, since there seldom are perfect control groups when comparing countries. The differences between the control group and treated group should be identified as a weakness since there are meaningful differences between the two.

## 2.3 Evolution and impact of the Common Agricultural Policy

This section provides background and key points about the Common Agricultural Policy that are useful, both for understanding the economic impact that the EU accession have, and to why self-sufficiency developed as provided in the result. Also included is a description of how trade balance changed for the newly admitted union members.

The common agricultural policy originates from when the European Economic Community (EEC) formed in 1957. The policy was implemented the following year for the member states and although there were no guidelines regulating operational policy there were several articles specifying the agricultural related goals with the EEC. Specifically, article 39 states multiple objectives, for example that the technological progress should drive agricultural productivity by optimizing the utilization of production factors and labour. Moreover, the EEC should ensure that the agricultural community can enjoy a fair standard of living while maintaining an economically viable agricultural business. The importance of stable markets, availability of supplies and reasonable pricing for both suppliers and consumers are emphasized as necessary to reach the goals. In the 1960s, the need for a more specified and extensive policy led up to the formulation of the CAP, regulating tariffs and financing in addition to the free trade agreement between the six member states. The extensive regulation that was necessary to reach the original intentions with the CAP led to higher commodity prices because of the price support which was implemented to support farms that lacked large scale benefits. Other than the



issue with high commodity prices, member states also disagreed about structural policies which regulated the quantities of farms and their ability to produce (Zobbe, 2001).

Assessing the impact of how agriculture is affected by an accession to the EU is extensive and depends on each country's unique prerequisites and circumstances. Kiss (2011) examines the agricultural development characteristics of the twelve, mostly eastern European countries that joined the union in the years 2004 and 2007. The accession of the eastern countries increased the total agricultural land in the European Union by 40% but only increased EU production by 10-20%. Kiss's results show a tendency for a higher crop production increase in the new member states compared to the pre-2004 members for the period following the accession. Animal produce did not share a common trend but varied between substantial increase to substantial decrease among the new member states. Kiss concludes that common to the twelve new members is that domestic competition intensified and a significant increase in imports altered their trade balance.

The common agricultural policy (CAP) has been under constant change since it was first implemented. Nalin (2000) provides us with an insight into what the CAP was during the late 1990s. To counteract that the trade balance changes become too extensive when joining a free trade union such as the EU, the union enforces CAP to restrict the maximal use of a member's comparative advantages it might have in production of specific commodities. The CAP enforcements can take the shape of quotas, subsidy rights and more. This means that production does not necessarily occur where it is most efficient, and that production could be more efficient without the CAP. The purpose of the CAP is not to maximize production and achieve the lowest price for consumers, but to promote income distribution and employment across the member states and to ensure that the environmental effects are accounted for. (Nalin, 2000 pp 20-23)

A study by Kettunen (1996) examined how the agricultural market in Finland developed in the first year after the EU accession and the integration of the Common Agricultural Policy into Finnish agriculture. Generally, there was no initial drop in production even though prices of agricultural commodities dropped significantly, and trade increased to other EU member states while it decreased some with non-EU countries. Prices of inputs such as fodder and fertilizer decreased, but not to the same extent as output prices. It is worth noting that the CAP applies a degressive support to make the integration run smoothly and avoid creating a negative income shock on producers. Although the CAP integration seemed to have been implemented without any serious difficulties, Kettunen points

out that Finnish farmers found that the administrative part of the agricultural policy was not adapted to the Nordic climate and various seasons for production practices.

## 3. Theoretical framework

### 3.1 Self-sufficiency ratio

In the theoretical framework, we verify the usage of the key concept of this thesis, which is the self-sufficiency ratio, a metric used to evaluate a country's domestic production compared to total consumption. The framework is based on research by Clapp (2017) and Kaufmann et al. (2022). These papers complement each other as the theoretical foundation for this thesis. Kaufmann et al. has a numerical application where they map self-sufficiency ratio on a regional level while Clapp provides conceptual structure to understand why food self-sufficiency can be sensible as a policy goal.

Kaufmann et al. employs a more complex application of the SSR than this thesis aims to provide. However, their application of SSR has proven to be a suitable measurement for self-sufficiency, showing that trade between net-importing and net-exporting regions is an important protection against food insecurity. The use of SSR also highlights the complexity in achieving self-sufficiency on a regional level in an integrated market like the European Union.

Similarly, Clapp has a nuanced perspective of self-sufficiency. Trade between net-importing and net-exporting is beneficial in reducing costs and providing market efficiency at the same time as strong self-sufficiency is beneficial in reducing dependency on other countries and strengthening in terms of food security. These papers provide us with necessary tools for discussing and interpreting the results of this thesis and reaching a conclusion in what the result implies in terms of self-sufficiency and food security.

Given the data and method applied in this thesis, any complex definition regarding self-sufficiency would be unnecessary. Therefore, we will not be any more specific than to equal a higher self-sufficiency ratio with a higher self-sufficiency. If a country's self-sufficiency ratio is decreasing, it means that production is decreasing relative to its consumption. Given that, it should not be a controversial claim to equal a changing self-sufficiency ratio with a changing self-sufficiency.

### 3.2 The theory of comparative advantage

The answer to the question of why trade occurs between countries does not necessarily have to be more complicated than that countries differ in their

technological and natural conditions which creates comparative advantages in producing certain goods. Through trade, our home country can benefit from the comparative advantages that foreign countries offer and vice versa. This is the essence of the Ricardian Model. A country is said to have a comparative advantage when the opportunity cost of producing a certain good is lower than the opportunity cost of producing that same good in another country. A country can also have an absolute advantage, meaning it has the best technology for producing that good. (Feenstra, Taylor, pp 127, 176-178)

In this thesis, the concept of comparative advantages is particularly relevant within the context of the European Union. Countries within the EU may experience comparative advantages or disadvantages in agricultural production due to differences in climatic conditions. Sweden and Finland, with their long winters, might be disadvantaged compared to southern EU members that can achieve multiple harvests in a single season. Consequently, when Sweden and Finland allow free trade of food after joining the EU, certain Swedish and Finnish agricultural produce may have difficulties competing with imports from other EU members. As a consequence, Sweden and Finland may specialize in producing specific types of agricultural goods or try to compete in other sectors.

## 4. Data and variables

### 4.1 Variables

The commodities in the study are chosen with regards to ensure this study is both feasible and relevant. Firstly, only commodities that are possible to produce at large scale in the Nordic countries are used in the study, meaning it is not relevant to include goods that can be considered exotic. The Nordic countries do not only share similar conditions for producing crops, vegetables, meats and other commodities, they are also culturally close and although they are not always similar when it comes to regulation and consumption patterns, these are the countries that are most comparable to Sweden in this regard. Secondly, no processed goods are included in the data set, that is, no goods that are compounds of multiple raw products since this could enable the same good being accounted for multiple times.

Yearly data during the time period 1990 – 2000 for Sweden, Finland, Norway and Denmark of amount produced, imported and exported in the unit tonnes was collected from the FAO and compiled in Excel. From equation 1 we calculate the SSR for each good, year and country. The following goods are included in the study: barley, cabbages, carrot and turnips, cucumbers and gherkins, meat of cattle, meat of chickens, meat of pig, oats, potatoes, rye, and wheat. This accounts to a total of 480 observations. Because comparing SSR between all goods aggregated is unsuitable according to earlier research, see Clapp (2017), three categories were generated to help specify the effect on different types of agricultural production. The “crops” category contains oats, rye, barley and wheat. The “meat” category contains all meats and lastly, the “vegetable” category contains the goods: cabbages, carrots and turnips, cucumbers and gherkins, and potatoes. Earlier research has made similar categorical division with meat, crops and starchy roots. This study deviates carefully from this by including root vegetables together with other vegetables which, although have not been observed in other studies, should not pose a threat to the credibility of this study.

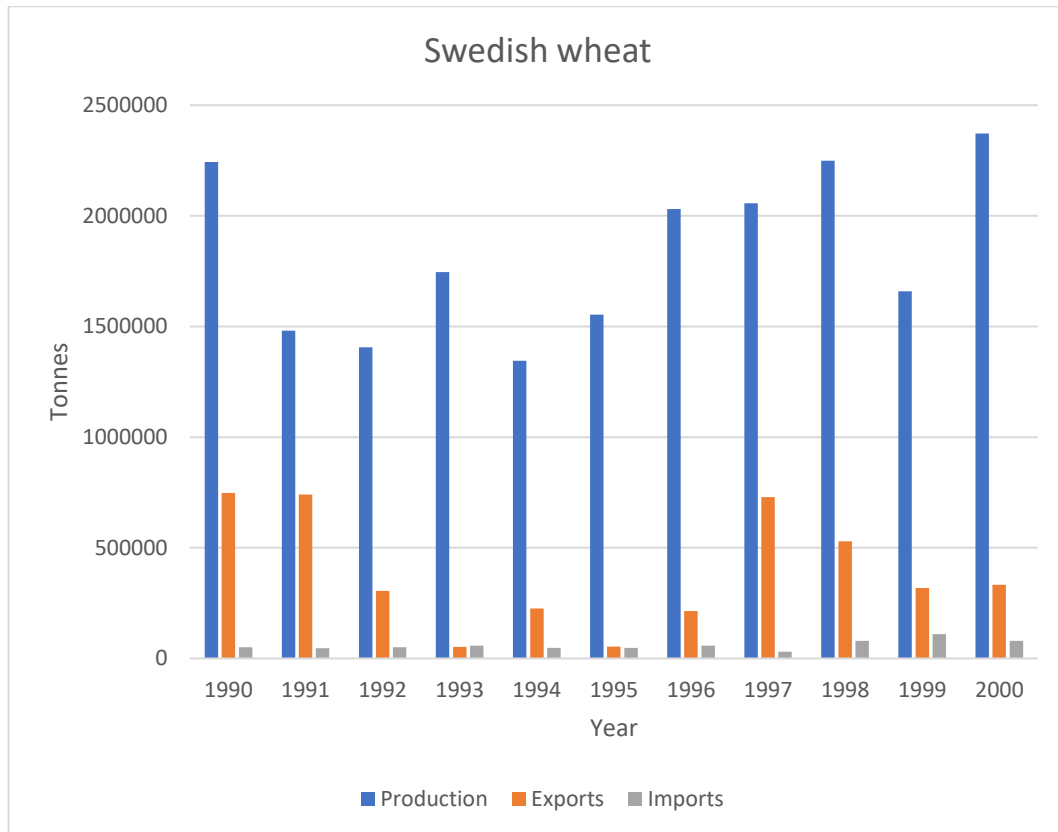
### 4.2 Descriptive statistics

This section contains descriptive statistics to illustrate the data and to provide the reader with more context needed to interpret the results.

### 4.2.1 Production, imports and exports

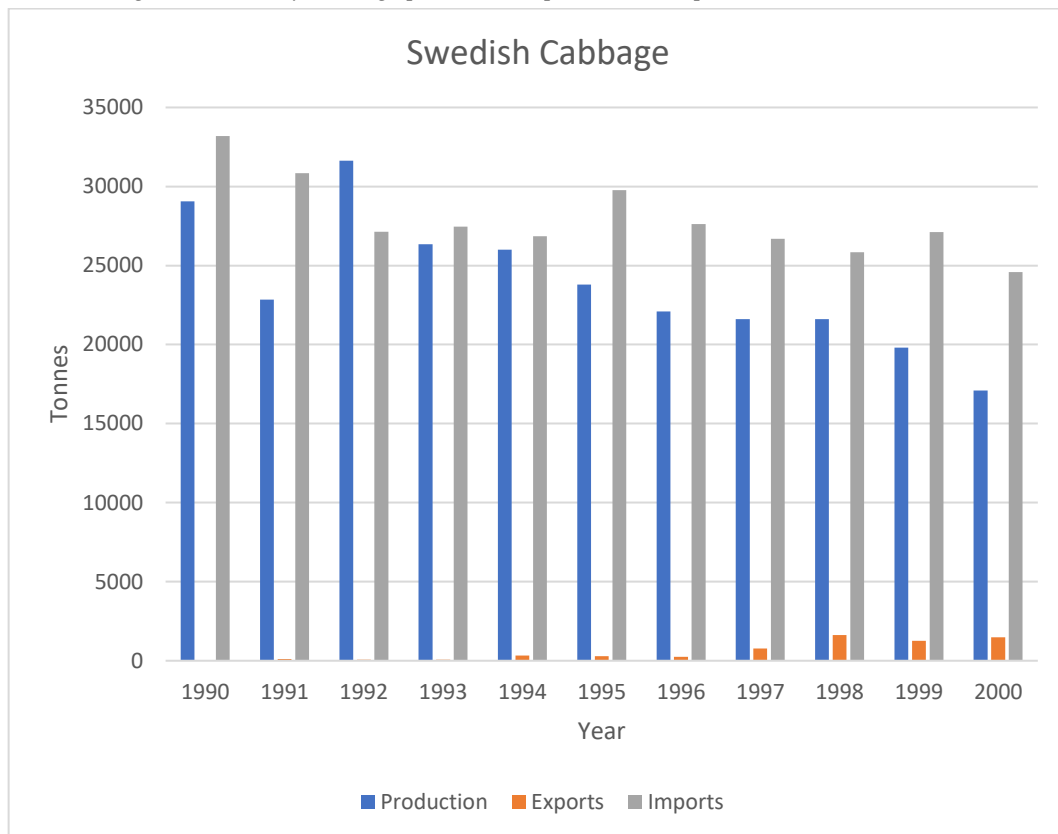
To calculate the self-sufficiency ratio, we use the produced, exported and imported quantity. The volumes of the goods and the ratio between them differs depending on the ability to produce, trade and to which extent consumer desire these goods.

Figure 1: Quantity wheat produced, exported and imported in Sweden.



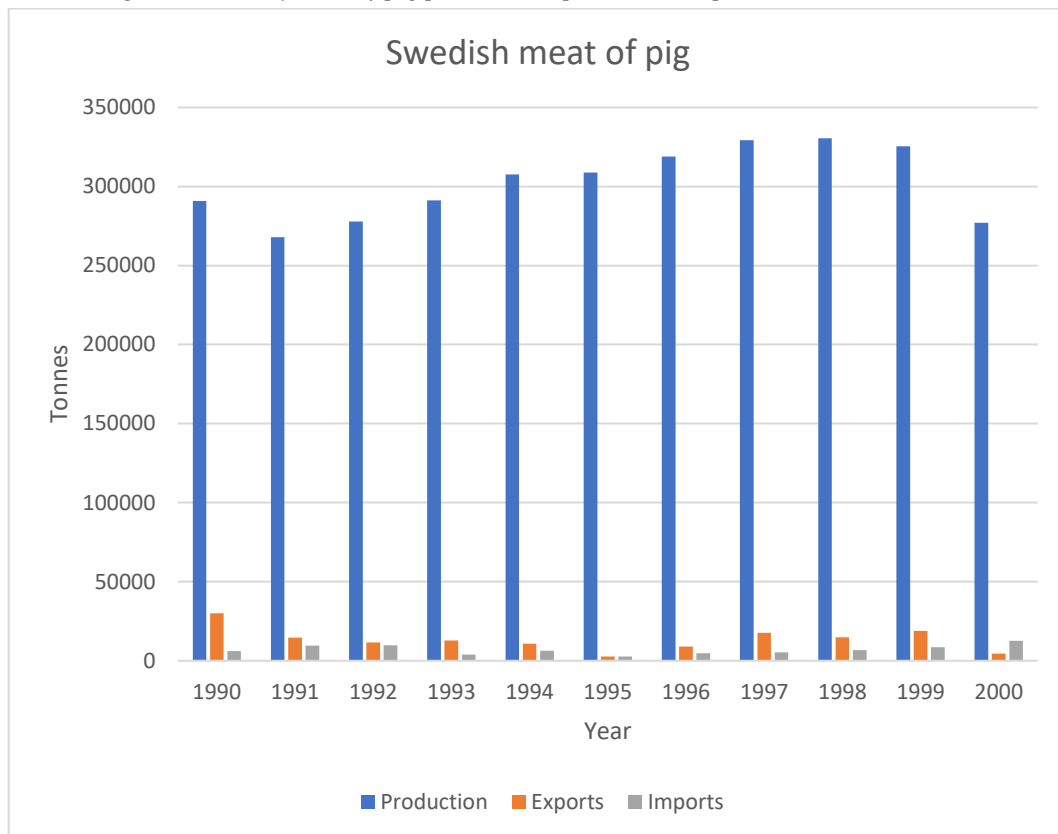
If we look at the example of wheat in Sweden for the time period of interest in this study, naturally, the production fluctuates from year to year depending on whether, demand, price and more. From this figure, one cannot simply assume that a big harvest will result in more exports which could be the natural way of assuming the relationship. Exports and imports are dependent on the supply, demand and price in other countries too. The self-sufficiency ratio for wheat in Sweden during this time period fluctuated between 0,997 in 1993 as lowest and 1,882 in 1991 as highest. Wheat is a clear example of a good that Sweden consumes large quantities of and are capable of producing a surplus of which is visible from the orange bars denoting exports, also noting that the grey import bar is consistently minimal during the whole period in comparison with amount produced.

Figure 2: Quantity cabbage produced, exported and imported in Sweden.



Dissimilar to wheat, cabbage is not a good that Sweden produced a surplus of during this time period. During the years 1990-2000, the highest SSR was 0.539 in 1992 and the lowest was 0.425 in 2000. With the only exception being 1992, imports exceed domestic production every year for cabbages and exports of Swedish cabbage is minimal during the whole time period.

Figure 3: Quantity meat of pig produced, exported and imported in Sweden



From figure 3, depicting production, exports and imports of meat of pig with bone we see that trade with meat of pig in Sweden during the time period is minimal and that Sweden is almost solely dependent on the domestic production. This causes the self-sufficiency ratio of Swedish meat of pig to be close to one throughout the time period. Since exports exceed imports of pig meat throughout the time period with the only exception being year 2000, the self-sufficiency ratio of pig meat in Sweden is just above 1.

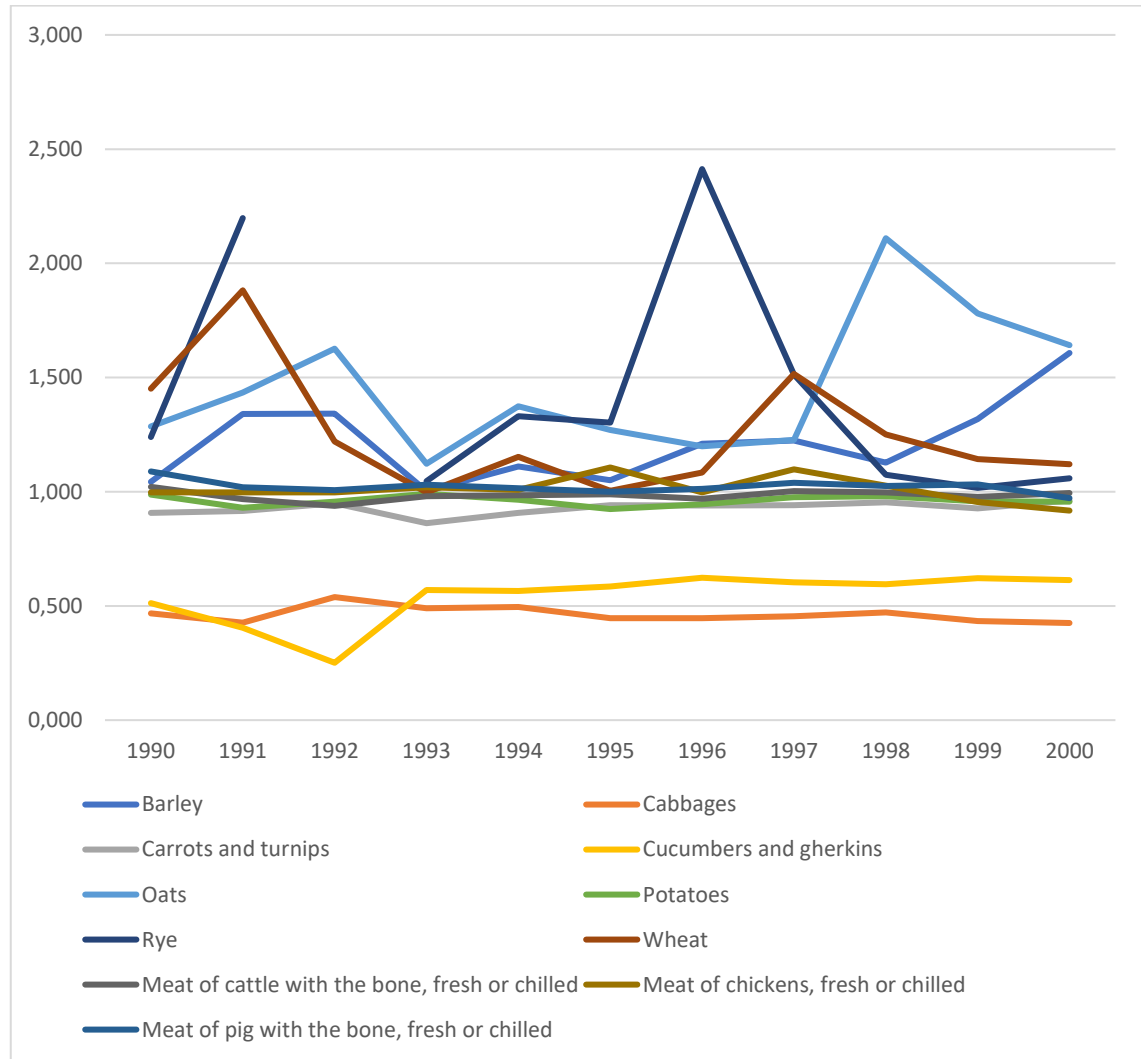
These three examples, wheat, cabbage and meat of pig, are representative of the dataset for agricultural goods. If a good is produced in abundance, the country will produce enough to sustain the domestic demand and to export the surplus to other countries which will cause the self-sufficiency ratio to exceed 1 just like the example with Swedish wheat. If there is a deficit in production of a good, imports will be necessary to supply the domestic demand and the self-sufficiency ratio will be between 0 and 1. In some cases however, trade barely occurs because a country's production is close to the domestic demand and the self-sufficiency ratio will approach 1, as with meat of pig.



## 4.2.2 Self-sufficiency ratio figures

In this section, the SSR of all goods for all countries included in the thesis is depicted with SSR on the Y-axis and year on the X-axis.

Figure 4: Swedish self-sufficiency ratios



An observation from the graph depicting the self-sufficiency ratio for Sweden is that the goods around 1 in SSR stay stable throughout the time period while the outliers above and below 1 vary over time. Note that for rye 1992, data was available but gave an unreasonably large negative number which is why this data point was removed from the data set.

Figure 5: Finnish self-sufficiency ratios

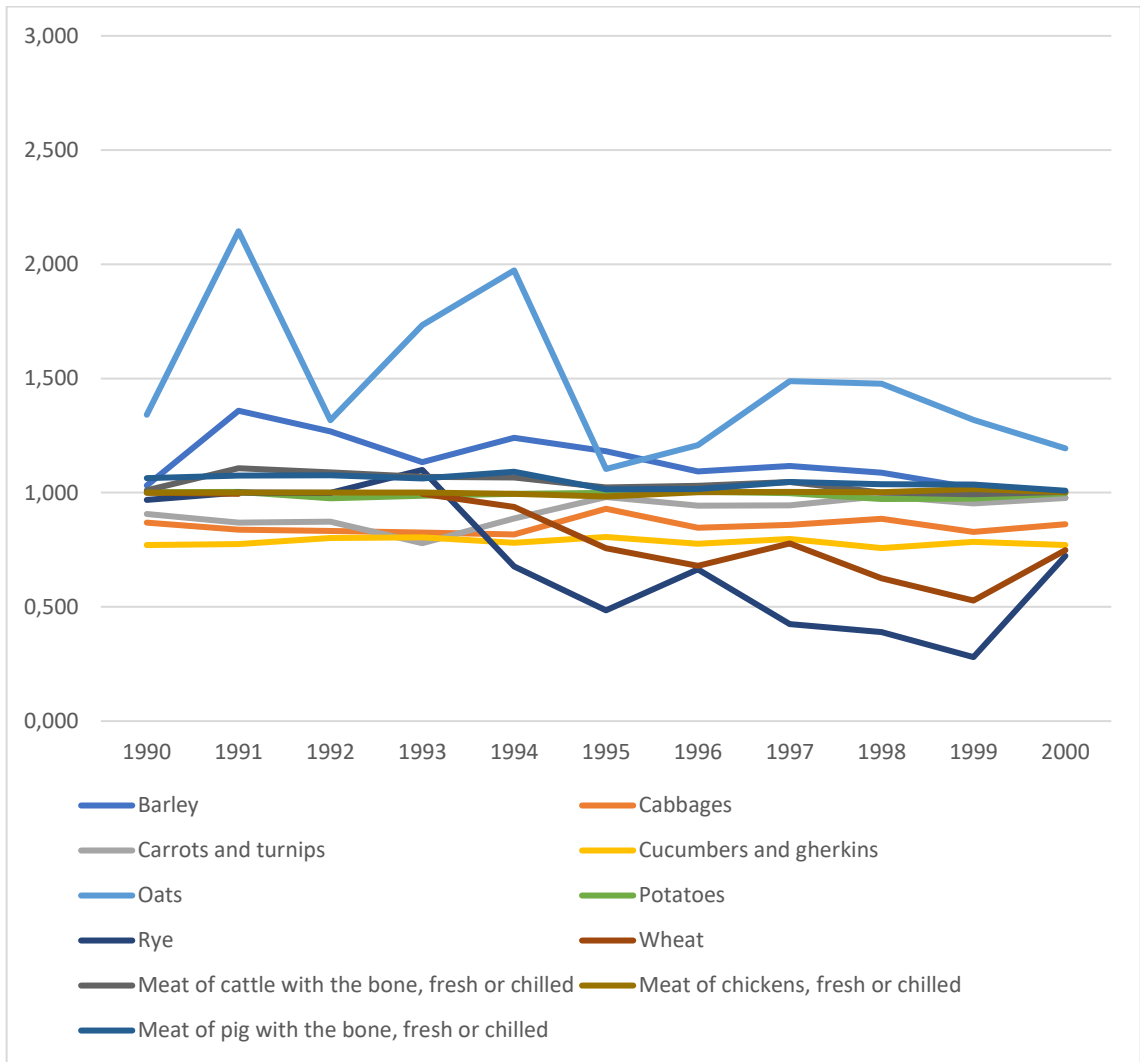
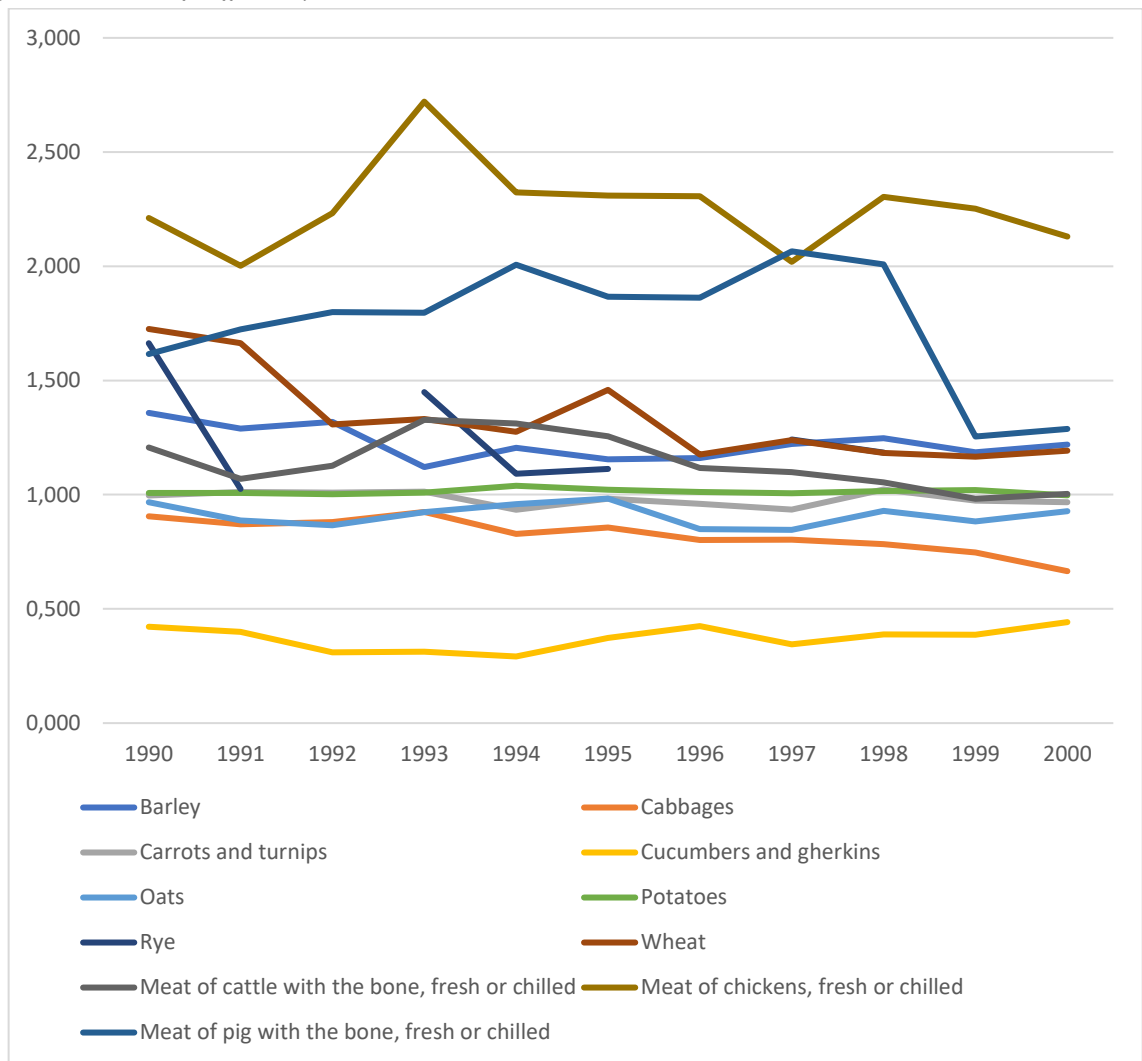


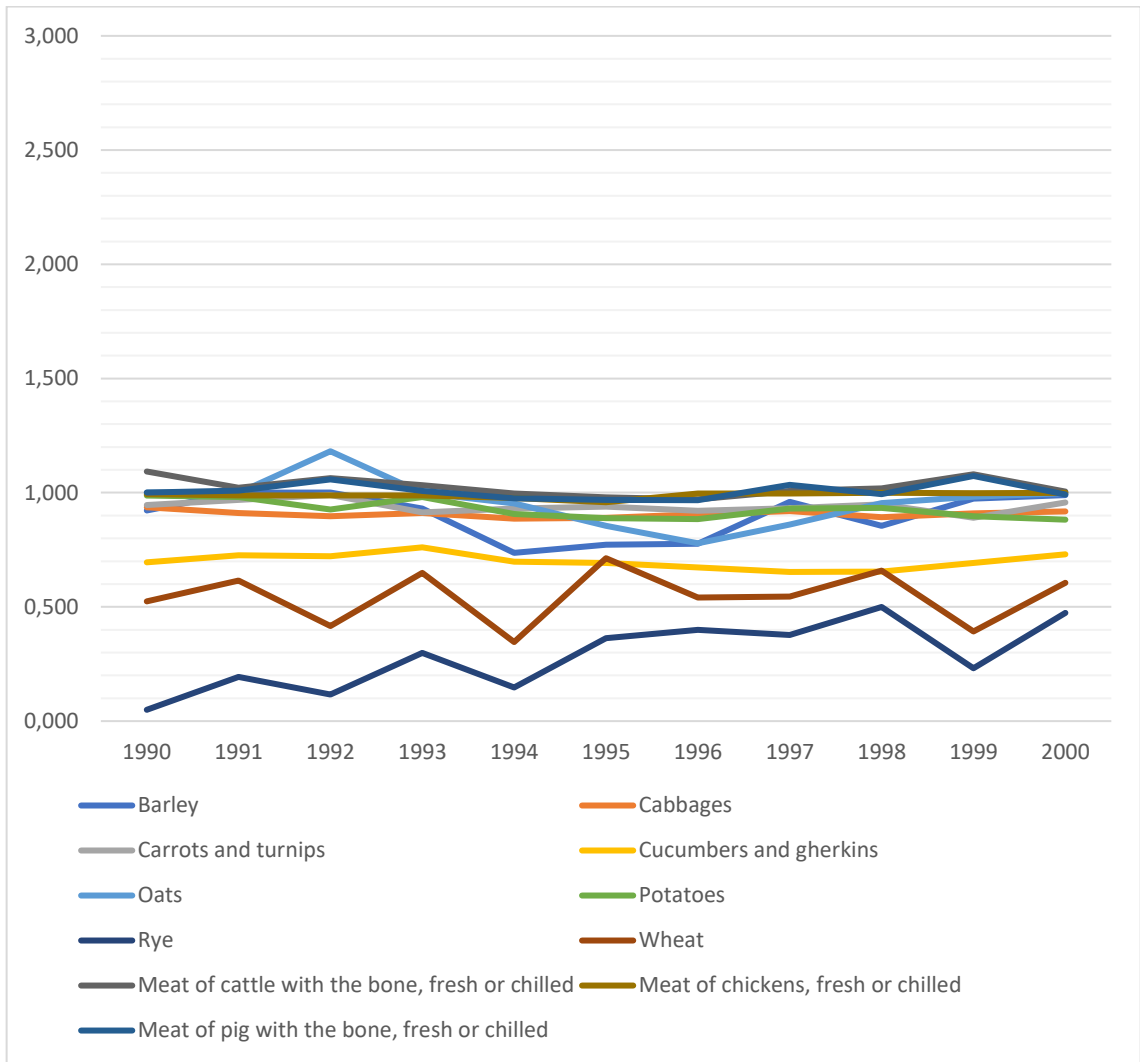
Figure 5 depicts self-sufficiency for Finland during the 1990s. For most crops, the SSR is close to 1 or above, with the exception of rye and wheat that are both close to 1 during the beginning of the time period but begins to decrease during 1993. The SSR of cucumbers are as with Sweden quite close to each other, but here they remain steady at around 0.8 during the whole time period, as compared to Sweden's 0.5. Oats and barley have a higher SSR during the first half of the time period but are lower in the second half. The meat category remains close to 1 during the whole time period.

Figure 6: Danish self-sufficiency ratios



The Danish self-sufficiency ratios have the most variation of the countries, ranging from 2-2.7 for meat of chicken to around 0.3 for cucumber and gherkins. Meat of pig is the commodity with second highest SSR, indicating that Denmark during the 1990s was a big exporter of meat of chicken and pig. For crops, we note that oats are the only crop that has an SSR below 1. This could also be the case for rye since there are a few years with missing values, but for all years we have data, it exceeds 1.

Figure 7: Norwegian self-sufficiency ratios



Norway is characterized by having no goods that are produced to such abundance that they can be exported continuously throughout the time period. Only for a few years, meat of pig, meat of cattle and oats exceed 1 in SSR. The Norwegian self-sufficiency of meats is close to 1 during the whole time period. And although oats and barley are close to 1 too, the other crops, wheat and rye remain relatively low during the whole period.

From these figures, it is clear that each country has its unique agricultural prerequisites and trade dynamics although some general trends emerge. For example, all countries are close to self-sufficient when it comes to potatoes. Denmark exhibits general export-oriented ratios and Norway exhibits general import dependence. Sweden and Finland on the other hand is not as generalizable from looking at the figures.

## 5. Method

The regressions are conducted in the statistical software Stata using a Difference-in-Difference (DiD) method. The DiD is a suitable method for estimating the causal effect of a policy intervention or any kind of treatment when dealing with panel data, meaning that the data is simply a dataset of observations made over one or multiple time periods on multiple entities. Time fixed effects used in equation 2 are similar to regular fixed effects but instead of controlling for variables being constant across time series, years in this case, time fixed effects control for variables that change over time but remain constant across entities. This method cannot be executed without first making certain assumptions which we will clarify further on (Stock & Watson, 2018).

*Equation 2*

$$Y_{it} = \beta_0 + \beta_1 post_t \times treatment + \alpha_i + \lambda_t + \varepsilon$$

Where Y is the dependent variable which represents the change in self-sufficiency ratio. Treatment is a binary variable indicating whether the country joined the EU during the given time period. Post is also a binary variable indicating if the observation is from the post-treatment period, that is, after 1995. Post x Treatment is the interaction term between the treatment and observations made after 1995. This will capture the effect of the treatment over time.  $\beta_0$  is the intercept and  $\beta_1$  is the coefficient to be estimated,  $\alpha_i$  denotes the country fixed effects,  $\lambda$  denotes the time fixed effects and  $\varepsilon$  denotes the error term.

In this thesis, year fixed effects are used to account for unobserved year-specific factors which aims to combat bias from external factors in the result. By including year fixed effects, we can more accurately isolate the impact of EU accession on the SSR which allows for a clearer interpretation of whether joining the EU leads to a reduction in SSR from the year of the accession, and potentially throughout the entire period under study.

The DiD estimator allows for a comparison in the change between the treated group, those that joined the EU, and the control group, those that already are or are not members of EU.

The Parallel Trends assumption and the Stable Unit Treatment Value assumption (SUTVA) are necessary to fulfil to assume that the result of the estimation can be trusted. The parallel trends assumption states that in the absence of treatment, the difference between the treatment group and the control group is constant over time. This assumption is not possible to verify since we cannot know for sure if the absence of an EU accession for Finland and Sweden would have generated a different trend in self-sufficiency ratio in line with the control groups. The countries of interest in the study are carefully picked to be similar in terms of economic integration, climate and culture to ensure that the parallel trends assumption is as fulfilled as it can be.

Looking at the graphs for self-sufficiency ratio, it becomes apparent that most goods with a self-sufficiency ratio of around 1 and below tend to stay stable throughout the time series, while goods with a SSR above 1 tend to fluctuate more in absolute terms. This is only natural since harvests yield different from year to year depending on the conditions for cultivation, demand and supply, but it is also a threat to the validity of the parallel trends assumption. The fluctuation in yields makes the data noisy which leads to difficulties in making causal claims for this method. It is obvious that we are dealing with omitted variable bias here, but uncertain to which extent. With this in mind, we must be careful when interpreting the results since occasional deviations of the SSR might be due to above mentioned factors, not relating to CAP-implementation. Instead, the goal is to identify deviations in the SSR that aligns with the hypothesis of the thesis.

Another important assumption to make when using DiD is the stable unit treatment value assumption (SUTVA) implicates. Just as the name suggests, the SUTVA implicates that the treatment status of one unit does not affect the potential outcomes of another unit (Lechner, 2010). In the case of this study, this would mean that Sweden and Finland's EU accession does not directly influence Denmark and Norway's self-sufficiency ratios or vice versa.

This thesis is exposed to weaknesses and bias in multiple ways of different magnitude. The Parallel Trends assumption and SUTVA are challenging to verify explicitly. While it is not uncommon in research that these assumptions are impossible to verify, it is occasionally easier to assume they do hold, than it is in this thesis. Even though this thesis makes a careful selection of the countries included, we cannot ignore that country heterogeneity exists to a large extent. It does not seem to exist countries that are better comparable to Sweden and Finland than Norway and Denmark in this context. One way to tackle the research question while reducing country heterogeneity could be to make the comparison on a

regional level instead of country level. One could compare regions, such as southern Sweden and carefully selected parts of Denmark before and after Sweden's EU accession to ensure similar natural conditions for agricultural production. Heterogeneity between countries involving legislation or culture, would still be present when comparing regions.

We also need to be aware of the self-selection bias of this study, considering that joining the European Union, is a non-random event, both in terms of occurrence and consequences. Sweden and Finland both held referendums on joining the EU and the majority voted in favour of joining. Institutions wanting to adapt their agricultural business was surely aware of the possibility of their countries joining the EU, but they could not be sure until the referendums had been held in the autumn of 1994.

Although countries self-select into the EU, the exact timing of accession is arguably somewhat random. Both in Sweden and Finland, the outcome of the election was just above 50% in favour of joining (Östling, 2014). This could imply that joining the EU was not a certainty before the outcome was revealed. With this in mind, we can only state that the treatment is not fully random. There is also a possibility that economic actors made preparations based on their expectations, which would introduce bias.

## 6. Results

Table 1: DiD with Time Fixed Effects results

Column	1	2	3	4
Category	All Categories	Meats	Crops	Vegetables
Treat_post	<b>-0.033</b> 0.033	<b>0.034</b> 0.036	<b>-0.176**</b> 0.085	<b>0.057***</b> 0.013
Year				
1991	<b>0.042</b> (0.039)	<b>-0.026</b> (0.042)	<b>0.154</b> (0.098)	<b>-0.018</b> (0.016)
1992	<b>0.047</b> (0.039)	<b>0.006</b> (0.042)	<b>0.167</b> (0.102)	<b>-0.025</b> (0.016)
1993	<b>-0.004</b> (0.039)	<b>0.061</b> (0.042)	<b>-0.046</b> (0.098)	<b>-0.012</b> (0.016)
1994	<b>-0.023</b> (0.039)	<b>0.037</b> (0.042)	<b>-0.066</b> (0.098)	<b>-0.024</b> (0.016)
1995	<b>-0.027</b> (0.042)	<b>-0.004</b> (0.045)	<b>-0.037</b> (0.107)	<b>-0.032*</b> (0.017)
1996	<b>-0.015</b> (0.043)	<b>-0.021</b> (0.045)	<b>0.018</b> (0.109)	<b>-0.042**</b> (0.017)
1997	<b>-0.007</b> (0.042)	<b>-0.004</b> (0.045)	<b>0.026</b> (0.107)	<b>-0.042**</b> (0.017)
1998	<b>-0.002</b> (0.043)	<b>-0.003</b> (0.045)	<b>0.030</b> (0.107)	<b>-0.033*</b> (0.017)
1999	<b>-0.055</b> (0.043)	<b>-0.071</b> (0.045)	<b>-0.049</b> (0.109)	<b>-0.048***</b> (0.017)
2000	<b>-0.035</b> (0.042)	<b>-0.099**</b> (0.045)	<b>0.021</b> (0.107)	<b>-0.041**</b> (0.017)
N	480	132	172	176

Estimated coefficient in bold and standard error in parenthesis. This table presents the results of estimating the interaction term using Equation 2 which is the DiD with time fixed effects.

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



The estimated coefficient for the “Treat\_post” interaction term in column 1 shows a 0.033 reduction in self-sufficiency ratio for agricultural goods for Sweden and Finland after joining the European Union, however, this result is not statistically significant. To find if the effect of the EU accession on Sweden and Finland differs across different goods, we look to column 2, 3 and 4. Column 2 shows the coefficient for the interaction term for the “Meats” category. This result is 0.034 but not statistically significant for the 132 observations (N) in the Meats-sample meaning we cannot be certain that the EU accession affected the self-sufficiency ratio of meats in Sweden and Finland. In the “Crops” category in column 3, we estimate a coefficient of -0.176. As indicated by the two asterisks (\*\*), this result is proven to be statistically significant to at least 95% for the sample population which implies that the SSR of crops were affected more than any other of the categories in this study. Lastly, in column 4, the interaction term for vegetables showed a slight increase of 0.057 in SSR that is proven to be statistically significant for the 176 observations in this data set.

Further down in the table is the estimated yearly coefficients for Sweden and Finland compared to Denmark and Norway to capture unobserved year-specific effects that affect all countries in the analysis. This allows us to see how the EU accession affected the self-sufficiency ratio for each time entity. The first year, 1990 is omitted in the regression to avoid multicollinearity, which can emerge if variables in the regression are strongly correlated. The estimates for ‘All Categories’ and ‘Crops’ showed no significant results with this method. In the ‘Meat’ regression, we find one single value that is significant, the year 2000 shows a -0,099 decrease in the SSR for meats for Sweden and Finland. For the ‘Vegetables’ category, there are significant results for every year from 1995, which marks the start of the CAP implementation in Sweden and Finland, and throughout the rest of the 1990s. The results show a steadily decrease in the SSR for vegetables for every year, in the interval of -0.032 and -0.048. In contrary with the results from the regular regression, where the coefficient was significantly estimated to 0.033 for vegetables, the time fixed effects indicate a negative trend. These two results are not necessarily contradictory for that reason but can potentially be explained as the CAP-implementation having positive effects for SSR of vegetables, but they were counteracted by other time-varying factors which caused the trend to be negative when employing time fixed effects.

## 7. Discussion

In this section, the results and interpretations from the previous section are discussed in relation to the literature review and theoretical framework of the study. It is unlikely that the conclusion of the study can be used to make predictions about how other countries self-sufficiency ratios would change if they chose to join the EU, since each country is subject to unique conditions and such a reform as CAP will therefore affect countries differently.

As seen in the literature review, researchers have examined the effects of the EU accession to evaluate if the policies meet the expectations. This study is unique in the way that it applies a DiD-model to evaluate if the Swedish and Finnish domestic production relative to consumption have been affected differently compared to Denmark and Norway. Although these results might be difficult to actualize today, this thesis aims to evaluate the short-term effect that the accession had on Sweden and Finland. Five years post-accession is a relatively short time in the context of agricultural development and the nearly 30 years of EU membership.

The results do not, with statistical significance, prove that the overall domestic production relative to consumption changed for the treated group compared to the control group, but it does suggest that certain categories experienced a change. The results point to a slight increase in vegetable SSR, an insignificant change for SSR of meats, and a larger decline for crops SSR. Before formulating the conclusion, the exact implication of this result must be carefully interpreted. A decreasing SSR does not automatically mean that domestic production has decreased or that net imports have increased for that matter. But it tells us that relative to net imports, domestic production has decreased. It is not likely to be either solely lower domestic production or solely increased net imports, but more realistically a combination of both, that slowly pushes the SSR in a new direction. This statement is backed up from what we generalized from figure 1, 2 and 3 in chapter 4.2 where the goods with an SSR above or below 1 differed in quantity produced, exported and imported every year, but the goods with an SSR close to 1, varied in quantity produced but barely varied in exported and imported quantity.

Even if the results suggest that the SSR of vegetables increased with the EU accession, we should be careful to conclude that the results prove that Sweden and Finland have become more self-sufficient in vegetables production. Omitted variable bias, unobserved heterogeneity, selection bias, missing data bias, all add uncertainty into these results, even if they are statistically significant.

In this thesis, we have simplified the definition of what self-sufficiency is, to be directly translated from the self-sufficiency ratio. More realistically however, as The Swedish Board of Agriculture (Jordbruksverket, 2022) have pointed out. the reliance on imported inputs such as fertilizer, pesticides, etc., is not captured when using the SSR. With consideration to where the inputs come from, it is not obvious that achieving a higher SSR is equal to being more self-sufficient and less trade reliant. Clapp (2017) stated, it should not be a binary debate where less or more trade reliance is favoured, countries should make use of the difference in ability to produce and focus on more productive policies and more flexible commerce systems. This goes hand in hand with Puma's (2015) thesis that a more economically integrated food system is more vulnerable to systemic risks, which is why a resilient food system is of high importance. Increased trade reliance, climate change and other stress factors have been driving a long-term downward trend in SSR in Africa as Kummu et al. (2020) found, implying that the SSR is not only affected by the magnitude of trade, but also driven by climate and shocks.

One of the purposes of the European Union is to create stable markets for agricultural commodities through free trade and, through the Common Agricultural Policy, regulate the balance of the union members ability to produce and trade. Joining the EU simplifies food trade with the other members while intending to enable and maintain domestic production according to Zobbe (2001). Kiss (2011) found this true when evaluating the effect of the accession for eastern European countries that joined the union in the 2000s. Trade balance changes as the countries enter the new market because they can benefit from domestic comparative advantages, as well as foreign comparative advantages in production. The new trade balance naturally alters the SSR of agricultural commodities. Applying the theory of comparative advantages to the result of this study, might imply that Sweden and Finland have comparative disadvantages in producing crops compared to the other EU-members since the SSR decreased in that category, while for meats and vegetables, the conditions for production might be similar to the other members since the SSR did not experience an extensive change in the SSR of those categories.

The results of the DiD-model, supported by the theoretical frameworks of Clapp (2017) and Kaufmann et al. (2022), suggest that the integration into the European

Union's free trade market and agricultural policies led to a shift in agricultural production relative to consumption for Sweden and Finland in comparison to Denmark and Norway, specifically for crops and vegetables, but not for meats. This aligns with Clapp's view that while increased trade can make the market more efficient, it can also reduce self-sufficiency by increasing reliance on other countries.

## 8. Conclusion

### 8.1 Conclusion

As stated in the introduction of this thesis. The aim of this thesis is to examine whether the 1995 accession of Sweden and Finland to the European Union had a causal effect on the self-sufficiency ratio of agricultural goods, compared to Denmark and Norway. Specifically, the hypothesis is that joining the EU would result in an overall decrease in the SSR for Sweden and Finland relative to the control group. We also question, if there is a discrepancy between different categories of agricultural goods and how their self-sufficiency ratios changed with the EU accession?

Based on the results of the Difference-in-Difference analysis, we cannot conclude that that the overall SSR for agricultural goods changed significantly in Sweden and Finland after the EU accession, but notable differences were observed across specific categories. Therefore, the hypothesis of an overall decrease in SSR is not supported by the data. When it comes to categorical discrepancies, all categories of goods behaved differently. The meat category showed no significant change that suggest that the EU-accession played a role in changing the SSR. The result for crops suggests that there is an overall decrease in SSR, but no significant results for the specific years. The results for vegetables are the most interesting since the change is significant for every year after the EU accession. The interpretation of the vegetable category results is not as straightforward as for the other categories since the overall change is positive while the year specific coefficients are negative. This suggests that the development of vegetable SSR after 1995 was negative for the treated group, but less negative than for the control group.

Although we have been able to test the hypothesis and answer the question to some extent based on the results of the Difference-in-Difference analysis, we have identified multiple uncertainties regarding the data and method along the way that we can assume have introduced bias in the result. These biases caution against drawing conclusions based on the results. Perhaps if more work is done, with

complementary methods, this study may contribute to a more certain conclusion on how an EU accession affects the self-sufficiency ratio.

## 8.2 Implications and further research

This thesis offers some insight for stakeholders, including policymakers, agricultural producers and other researchers, by illustrating the complexities of trade and self-sufficiency. Extensive regulations, such as those associated with the EU and the CAP, can produce unexpected effects across different sectors. Specifically, the thesis enhances our understanding of the impact the EU accession had on agricultural trade and self-sufficiency in Sweden and Finland during the 1990s.

However, some questions remain unanswered regarding this topic. Future research could benefit from including a broader set of goods and categories, as well as extending the timeline to the present day, allowing for a more comprehensive analysis. Additionally, the effects on newer EU member states with similar agricultural profiles could be relevant to include, or perhaps categorize states based on their agricultural production profiles.

A broader set of goods also have the potential to reduce noise in results of future theses or papers with similar aim. More data have the potential to strengthen the results and conclusions in their generalizability. Employing different methodological approaches such as envelopment analysis or synthetic control groups as mentioned in chapter 2.2 can be crucial for verifying whether similar results can be achieved through alternative methods and thereby reinforcing the conclusions of this thesis.

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