LUND UNIVERSITY
School of Economics and Management

Self-Sufficiency, sufficient enough?

A study of Sweden's self-sufficiency and its impact on employment

Axel Johansson

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Supervision by Policy Officer and Associate Professor Martin Nordin

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Contents

Abstract

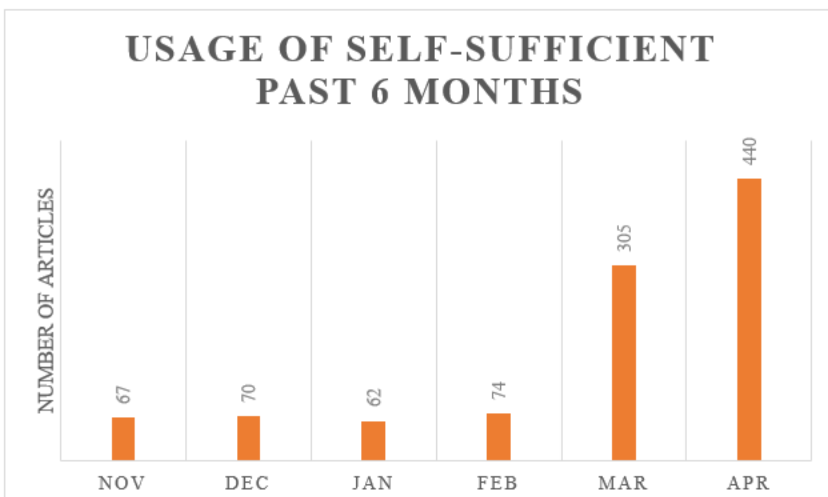
As the pandemic of Covid-19 evolved during the spring of 2020, so did the discussion of Sweden's degree of self-sufficiency. The Federations of Swedish Farmers and the Ministry of Enterprise and Innovation shared the view that Sweden's production of agricultural goods should be expanded to increase the degree of self-sufficiency of food and promote employment in the agricultural sector. The objective of this thesis is to critically discuss the concept of food self-sufficiency in a Swedish discourse. In addition to that investigate whether or not an increased degree of self-sufficiency, through increased production would increase employment in the agricultural sector. To determine this, time-series data from the Swedish Board of Agriculture and Statistics Sweden, stretching from 2000 to 2019, was analyzed through a time series model. The results suggested some connections between self-sufficiency and employment; these links were an effect of consumption behavior rather than production volumes. The focus should be on the consumer behavior rather than self-sufficiency, if one wants to promote employment in the agricultural sector.

Chapter 1

Introduction

During the spring of 2020, the pandemic of Covid-19 hit the world with full power. Due to the pandemic, a discussion on the degree of self-sufficiency emerged in Sweden in terms of medical supply and the self-sufficiency of food. A quick search on Retriever (2020) shows that articles about self-sufficiency has increased rapidly during the spring of 2020, see figure 1.1 below.

Figure 1.1: Statistics from Retriever (2020)



Many of the published articles concerns the state of readiness in case of emergency in Sweden, which has decreased since the nineties (Stenerus et al. 2019) and with it Sweden's degree of self-sufficiency. According to the Federation of Swedish Farmers (LRF 2020), the degree of food self-sufficiency has decreased from 85 percent in 1988 to 50 percent today, and every second bite of food consumed is imported. The Federation of Swedish Farmers urges the Swedish state to take action to increase the degree of food self-sufficiency. In a report Nordenskjöld et al. (2016), argue that a one million

SEK increase in turn-over will create 2.51 new jobs in the farming industry. These calculations are from Lindberg's report (Lindberg 2016), where he, on behalf of the Federations of Swedish Farmers, investigated what would happen to the Swedish economy if there were a shift in the agricultural sector. To do this, he used an Input-Output model to calculate disaggregated multipliers for Swedish counties. The Federation of Swedish Farmers' approach regarding self-sufficiency and employment is in line with the Ministry of Enterprise and Innovation's food strategy (Ministry & Innovation 2017), which states the overall food strategy for 2030. According to them Sweden should increase its production of food, and while doing so aim *"to generate growth and employment and contribute to sustainable development throughout the country."* (Ministry & Innovation 2017). Also, an objective is to reduce Sweden's vulnerability of food supply chain distributions by increasing self-sufficiency. The idea is that higher production of food in Sweden will increase the self-sufficiency, thus generate employment in the agricultural sector.

In this paper, I will critically discuss the concept of food self-sufficiency and contrast with other perspectives such as food security. Furthermore, I investigate whether or not increasing the degree of self-sufficiency of food would increase employment in the agricultural sector. I will also provide insight into the problems associated with using the Input-Output model for such estimations and instead estimate the relationship between self-sufficiency and agricultural employment. To do so, I will analyze agricultural data from the Swedish Board of Agriculture and employment data from Statistics Sweden through a time series model with monthly specific effects, since the agricultural sector is highly seasonally dependent. My objective is to investigate the approach held by the Federation of Swedish Farmers and the Ministry of Enterprise and Innovation, whether an increase of Sweden's self-sufficiency by increasing the production, would increase employment.

The structure of the paper will be as follows. In the following chapter, I will describe the background by defining the concept of food self-sufficiency and describe the Input-Output model and the modifications made by Lindberg (2016) in order to fit the agricultural sector. In chapter three, I will present my data, my method, and my results regarding employment and self-sufficiency. Chapter four will provide a discussion regarding the results, self-sufficiency, and employment in the agricultural sector. Lastly, chapter five will conclude this paper.

Chapter 2

Background

2.1 Definition of food self-sufficiency

To be *food self-sufficient* might vary in meaning. The Food and Agriculture Organization of the United Nations (FAO) defines food self-sufficiency as follows, *"The concept of food self-sufficiency is generally taken to mean the extent to which a country can satisfy its food needs from its own domestic production"* (FAO 1999). To measure self-sufficiency (FAO 2012), the FAO uses the self-sufficiency ratio (SSR), and it is defined as:

$$SRR = production * 100/(production + imports - exports) \tag{2.1}$$

The formula measures the extent to which a country relies on its production of a commodity or group of commodities. However, one should not take a high SSR value as a guarantee of high self-sufficiency as countries can export all its production and still be heavily dependent on imports to feed its population (FAO 2012). As mentioned by FAO (1999), food self-sufficiency is often viewed as an excellent way to increase food security, i.e., assuring that all humans have physical and economic access to the food they need. The FAO (2009) defines food security as:

> *Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*

Food security and self-sufficiency can be an essential cornerstones for developing countries as they grow economically. However, it is more difficult to discuss food security and self-sufficiency in already developed countries, since, one could argue that most developed countries, like Sweden, have the physical, social and economic access to sufficient, safe, and nutritious food that they need. Maybe not the food that consumers want at all times, but most of the Swedes can access food to manage their nutritional needs (Ministry & Ministry 2017). Gullstrand & Jörgensen (2016) even argues that as income increases, people tend to spend less money on food, which has been the case for Sweden and other relatively wealthy countries. This trend follows the law of Engels, which says that the income elasticity for food is below one, and, therefore, as our income increase, we tend to spend a lower share of our income on food. In addition to that, Gullstrand & Jörgensen (2016) also discusses the concept of Bennet's law. As incomes increase, people tend to demand and consume a greater variety of diets, which is positive from a health perspective. Therefore, one can ask whether or not it is reasonable to discuss food self-sufficiency and food security in a Swedish discourse. Brunstad et al. (2005) showed in a case study of Norway, that the support for food security and land preservation in the agricultural sector is disproportional in public goods perspective. They argued that such support is not economically efficient in high-cost countries, even when accounting for the ability to feed its population if a crisis occurs.

Sweden and Norway, both high cost-countries, have many similarities when it comes to the ability to produce agricultural goods, both of them being in the Nordic region. However, Sweden is part of the European Union, and Norway is not. Therefore Norway can impose support, such as tariffs, for their agricultural goods in a way that Sweden can not. As the economic standards are so high, it is cheaper to import food than it is to produce, and in many cases, a lot of the food that is consumed can not be produced within the country. Even for the food that can be produced domestically, how far does self-sufficiency stretch? If all inputs used in the agricultural sector has to be produced domestically, very few countries would be able to call themselves food self-sufficient. In a sense, it is not easy to discuss self-sufficiency from an economic perspective, but Clapp (2017) presented five different scenarios where perusing food self-sufficiency would benefit a country. Out of these five scenarios, Sweden could fit one of them:

> *Countries that have the potential to be food self-sufficient in terms of their natural resource base, but which are currently net food importers, can benefit from increasing domestic food production*

Moreover, when talking about benefiting from increasing domestic food production, Clapp (2017) refers to reducing the risk associated with volatile export earnings and food prices. Once again, one could argue that Sweden does not face that great risk from volatile export earnings and food prices.

One other aspect regarding food security is lifted by Kummu et al. (2020), investigating the import dependence, production diversity, supply diversity, and import partners when it comes to nutrients. They find that Sweden is among the countries that have decreased its import dependence the most from 1989 to 2013. Also, Sweden's amount of import suppliers has decreased from 1989 to 2013, according to Kummu et al. (2020) the ones that see a connection between high diversity in diets and the trade-dependent food sector. As countries develop, they tend to change their consumption behavior of food towards a more global approach. However, they also find that for low and middle-income countries, one can achieve high diversity in both production and supply of food, in terms of nutrients, without high import dependence. Therefore, one can ask whether or not it is feasible to discuss the self-sufficiency of food in Sweden.

2.2 The Input-Output Model

The Input-Output model is based on the works of Leontief (1936), for which he received the Nobel price in economics in 1973. It is generally constructed to portray the economic connections between industries in one specific geographic region, that could be a nation, a state, or a county, at a given point in time. Through matrices, which can be written as a system of equations, each industry's inputs and outputs are described and to which industry they sell their output and from what industry they buy their inputs (Miller & Blair 2009). This can be shown through a simple example: *a farm needs to buy 0.5 units of seeds and 0.5 units of fertilizer to be able to produce 1 unit wheat, which they then can sell to the bakery.* The idea is to measure the flow of products from one industry sector to another, and these flows between industry sectors are presented in an interindustry transactions table, called Input-Output table. The rows of the table describe the distribution of the outputs in the economy, and the columns describe the required inputs for each industry to produce its output. From these tables, one can measure the importance of one industry to the economy, i.e., the importance of one industry's outputs as inputs for other industries. Many extensions of the Input-Output model exists, for more readings see Oosterhaven (2019) or Miller & Blair (2009). I will now focus on the assumptions underlying the extension of the model and the method used by Lindberg (2016) on behalf of the Federation of Swedish Farmers.

The Input-Output model used by Lindberg (2016) is a static model where the prices are assumed to be fixed. It is also assumed that the production functions are based on fixed proportions, constant return to scale and no substitutes among inputs exist. With these assumptions and the tables described above, showing the use of resources within each industry, one can compute multipliers which describe links within the economy. These links can be direct, indirect, or induced. Direct links describe what happens to an industry as it produces the output; indirect links describe how one industry's growth affects other industries from which the first one buys its inputs. Induced links take into account the workers of the industry and how their consumption of goods recirculates money into the economy. Lindberg (2016) describes two kinds of multipliers, closed and open. Closed multipliers take into account the induced effect, whereas the open does not. Both of them show the effect of an exogenous demand shock and are often described as one SEK increase in demand for a product. Lindberg (2016) uses data from Statistics Sweden (SCB 2019) and uses the results from Lindberg & Hansson (2009) to break down the multipliers into regional disaggregated multipliers. These multipliers are also used in the report *The green business world and its importance for the society* by The Federation of Swedish Farmers Nordenskjöld et al. (2016). The authors argue that the agricultural sector's employment multiplier is 2.51, which means that an increase in revenue would create 2.51 new jobs. In addition to that, according to their calculations using these multipliers, the agricultural and forest industry have the potential to create 50 000 new full-time employments until 2030.

2.3 Critique of the model

In the previous section, I have briefly described the Input-Output model used by Lindberg (2016) and then the predictions made by the Federation of Swedish Farmers (Nordenskjöld et al. 2016). I will here describe the issues associated with their predictions.

Firstly, the calculations made by Lindberg (2016) are based on the paper of Oosterhaven & Stelder (2002), which presents a *compensated net multiplier*, which would account for the double-counting of effects when computing the multiplier. The *compensated net multiplier* was criticized by De Mesnard (2007), who argued that it was no longer stable, and it would not work with an initial exogenous output shock. Secondly, the Input-Output model fails to account for the opportunity cost regarding inputs. As Lindberg (2016) mentions, these multipliers represent indicators for how the economy would react if demand increased with one unit. If that were the case and the demand in the agricultural sector would increase with one unit. In order for the agricultural sector to meet the increased demand, they would have to invest in more inputs from their suppliers. For any investment, there is an opportunity cost of foregone returns from options not chosen. With the assumption that no substitutions among inputs exits, no opportunity cost exists either. This makes the Input-Output model inadequate. In addition to this, the assumption that prices and proportions are fixed together, combined with the assumption of constant return to scale makes the model static. In today's fast-growing economy, an economic model often has a trade-off between internal and external validity (Angrist & Pischke 2008). With these assumptions, the Input-Output model has high internal validity, which is under these assumptions, the employment multiplier of 2.51 exists. However, as the assumptions imposed are so strong, it is hard to say anything without the assumptions, and therefore the external validity of this model is low.

As an interest group of agriculture, the Swedish Federation of Farmers wants to increase the agricultural sector and its employment. It can be argued that the reason why they use the Input-Output model is that the model produces numbers that are easily understood. This leads to a conception of the importance of the agricultural sector. I will, therefore, in the next chapter, investigate the relationship between employment and food self-sufficiency since the Swedish Federation of Farmers wants them both to increase.

Chapter 3

Methodology

This chapter will present the model I have used to estimate the effect of the self-sufficiency of food on employment. I have chosen a time series model with monthly specific effects in an attempt to capture the seasonal dependence, which is thought to define the Swedish agricultural sector. I will also discuss some issues regarding the data presented, which boils down to that the data is not optimal. Ideally, the data would have been on farm specific levels to really capture the effect of self-sufficiency on employment. However, such data is not available, and I have instead tried to estimate the effect of the self-sufficiency of food on employment with monthly data on a national level. Section 3.1 presents the data used to estimate the effect of self-sufficiency on employment and its issues. Section 3.2 will first describe what is required to estimate time series data and then investigate whether the variables meet these requirements. Lastly, I will describe the time series model used, and in section 3.3 I will present the results.

3.1 Data

To investigate the impact of import and export of agricultural goods on employment, I used monthly data from 2000 to 2019. I have used import and export data of agricultural goods from the Swedish Board of Agriculture (Jordbruksverket 2020*b*). The production data were collected from the Swedish Board of Agriculture's statistical database (Jordbruksverket 2020*a*) to calculate my independent variable, the SSR. The production data were selected to fit the import and export data. One issue was identified, which was that the Swedish Board of Agriculture does not have monthly data on the production of barley, potato, rye, and wheat; it only has yearly data. The reason for this is that farms in Sweden only produces one harvest per year, which means that whenever a farm is harvesting it is producing all of its output at the same time. Although one could argue that in some southern parts of Sweden, you can have two harvests within a year if the weather is good, however, this is a rare case. To create monthly data of these grains, I divided the production of each year with twelve to get a monthly average. From this data have I calculated the net of the import and export for all goods, and the SSR, see equation 2.1, in line with FAO (2012). The SSR was then cleared of outliers, which were greater or smaller than five-hundred percent, respectively minus five-hundred percent. The reason for this is that there were some extreme cases; for example, milk powder, for some months, has a SSR of 60 000 percent, see in figure A.1 in appendix A, which would have had misleading effects on the results. In addition to this, I have used employment data from Statistics Sweden from three different databases to cover the whole period (SCB 2020*a*) (SCB 2009) (SCB 2006) to calculate my dependent variable. As the definition of employment used by Statistics Sweden has changed over time, I had to adjust SCB (2006) to fit with the rest of the employment data. The previous definition of employment was expressed in average hours worked per week instead of the number of employed persons. I divided the number of average hours of work per week with 40, since it is considered to be the number of hours work for full-time employment. To control for omitted variables, I choose to include the exchange rate between SEK and EURO (Riksbanken 2020), the GDP for Sweden (SCB 2020*b*), the Producer Price Index (SCB 2020*d*), the population of Sweden (SCB 2020*c*) as my covariates. For an overview of all variables used, see figure 3.1.

Figure 3.1: Varlist

Y-variables (thousands)	**Definition**	**Name in regression**
Employment	Employed persons aged 15-74 in Sweden	emp
Employment in agricultural sector	Employed persons aged 15-74 in agricultural sector Sweden	empagr
X-Variables (tons)	**Definition**	**Name in regression**
Barley	Self-Sufficiency Ratio	ssrba
Beef	Self-Sufficiency Ratio	ssrbe
Butter and other milk fat	Self-Sufficiency Ratio	ssrbu
Cheese	Self-Sufficiency Ratio	ssrch
Eggs	Self-Sufficiency Ratio	ssreg
Milk powder	Self-Sufficiency Ratio	ssrmi
Oats	Self-Sufficiency Ratio	ssroa
Pig meat	Self-Sufficiency Ratio	ssrpi
Potato Wheat	Self-Sufficiency Ratio	ssrpo
Rye	Self-Sufficiency Ratio	ssrry
Wheat	Self-Sufficiency Ratio	ssrwh
Control Variables	**Definition**	**Name in regression**
Exchange rate SEK EURO	Value of one EURO in SEK	eurorate
PPI	Producer Price Index by products SPIN 2015	ppi
Population in Sweden	Population in Sweden	pop
GDP	Gross Domestic Product production approach	gdp

3.2 Method

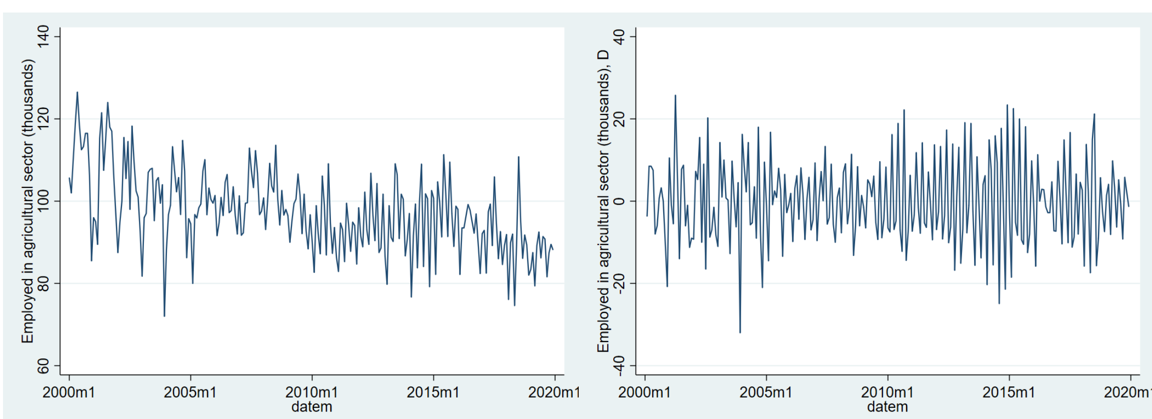
I worked with time series data, due to this I wanted my data to be stationary, meaning that the mean and variance do not depend on time and that the covariance can depend on the distance in time between two points but not time itself. The reason for this is that in order to trust the statistical results, the data must be stationary. Hence, before presenting a model, I went through my data to determine whether it was stationary or not. I used two different techniques, visualizing the data and test for unit roots by the Augmented Dickey-Fuller (ADF) unit-root test (Enders 2015). The ADF test tests the null hypothesis that a variable contains a unit root against the alternative that the variable follows a stationary process. The ADF test involves fitting a model by ordinary least squares and controlling for serial correlation (Stata 2019). I choose to include a constant and a trend component; thus, the model for the ADF test looks like equation 3.1. k stands for the number of lags used, which will be chosen by using an information criterion individually for each variable.

$$\triangle y_t = a_t + \beta y_{t-1} + \delta t + \zeta_1 \triangle y_{t-1} + \zeta_2 \triangle y_{t-2} + ... + \zeta_k \triangle y_{t-k} + \epsilon_t \tag{3.1}$$

3.2.1 Dependent Variables

The agricultural sector in Sweden is heavily seasonally dependent. With the highest workload during the summer, followed by spring and fall. Which one can see in figure 3.2 below. It shows the number of employed people in the agricultural sector and apart from the high fluctuations, one can also notice a slightly decreasing trend over the past 20 years.

Figure 3.2: Employed in Agriculture

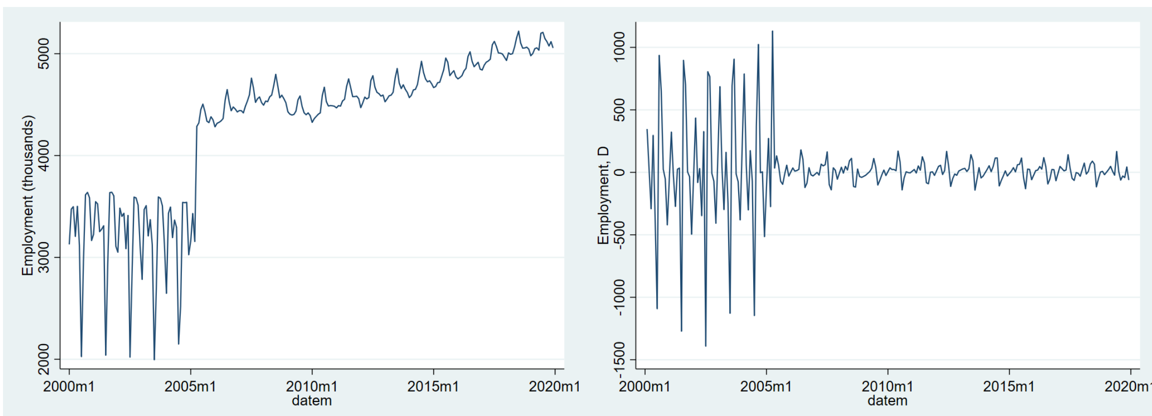


(a) With trend

(b) De-trended

According to the ADF test with twelve lags, the number of employed people in the agricultural sector does contain a unit root process. One can also see that the variable is trending downwards, and therefore I used the first difference as it is stationary, which can be seen in 3.2. The same procedure was performed for employment in Sweden, where the information criterion suggested twenty-three lags. It was also de-trended by taking the first difference. It is noticeable from figure 3.3 that the data of employment for the whole of Sweden suffers more of the change in the definition of employment than employment in the agricultural sector, figure 3.2. As the data is far from optimal, it is hard to understand why it differs so much in the data before and after the change of definition of employment. Therefore, one could anticipate that the regressions with employment for the whole of Sweden as dependent variable, could cause some spurious results.

Figure 3.3: Employment in Sweden



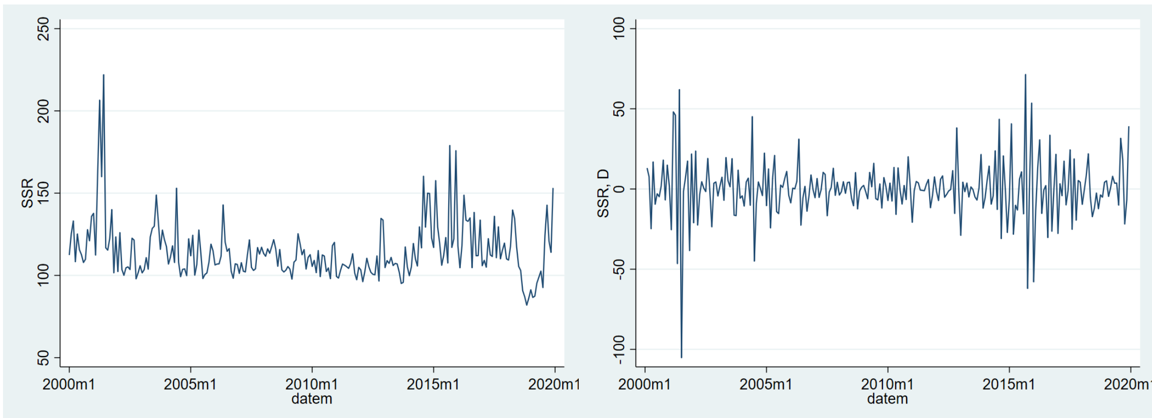
(a) With trend (b) De-trended

3.2.2 Independent Variables

For the SSR, I firstly considered the aggregated data as a sort of mean for all variables and then look at each SSR individually. The aggregated SSR is fluctuating; see figure 3.4, indicating seasonal dependence as one can assume. When testing for a unit root process with three lags, the null hypothesis was rejected, indicating that the process is stationary. According to figure 3.4, it seems like the aggregated SSR is higher than 100 which would imply that we are 100 percent self-sufficient, however this is not the case. The reason for this is that the volume of grains, which is produced and consumed, is much higher than for the rest of the agricultural goods and, thus the aggregated SSR has a bias towards the grains.

Secondly, looking at the disaggregated SSR one can divide them into three different groups, grains, dairy products, and meat, etc. as the data looks differently. To start with, the grains viewed in figure 3.5, fluctuates highly in some periods, probably due to shocks in the price or production. The data of grain production is only presented yearly, as mention in section 3.1. This makes the within-year variation of these SSR's smaller since the production data is constant for each year. Therefore, I

Figure 3.4: Aggregated Self-Sufficient Ratio



(a) With trend (b) Detrended

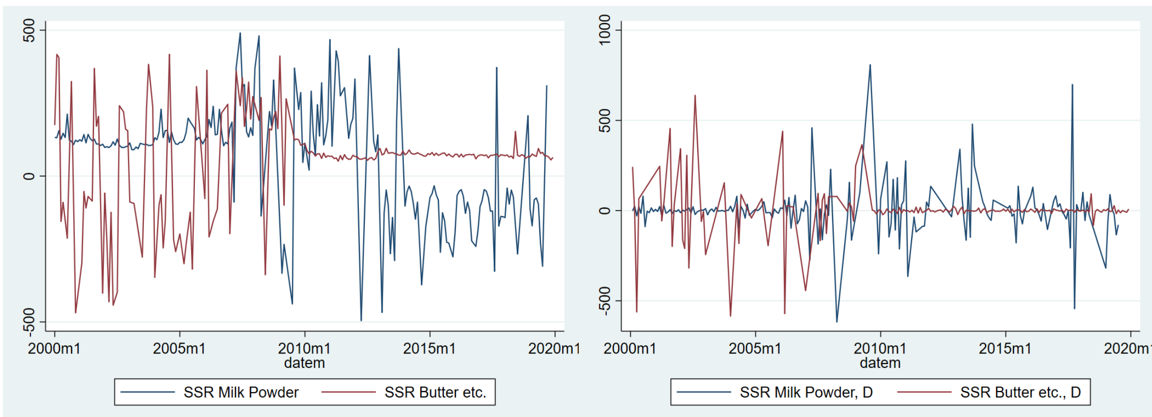
Figure 3.5: Grains Self-Sufficient Ratio

(a) With trend (b) Detrended

investigated the impact of SSR of grains on employment separately. From the ADF test with four lags for wheat, three for rye, and one for barley, it was concluded that neither of them included a unit root.

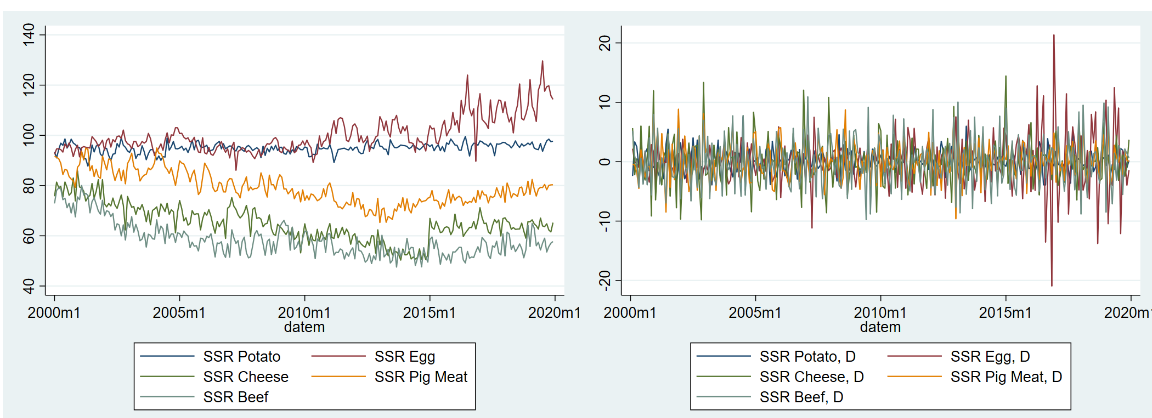
Thirdly, considering the group of dairy products, which consists of the SSR of milk powder and butter and other milk fats. Looking at figure 3.6, it is noticeable that SSR of milk powder is highly volatile during the first ten years, and the SSR of butter is highly volatile during the last ten years. If one looks closer to the data, it shows that the production of the butter has slowly increased over the last two decades, in addition to that, the ratio between import and export has shifted. In early 2000 Sweden exported much more butter than we imported, and around 2010 it balanced out. For milk powder, the production has decreased over the past twenty years; however, both the import and export of milk powder have increased. The null hypothesis of the existent of a unit root was rejected by the ADF test with twenty lags for butter, respectively, two for milk powder. If one only looks at the graphs, these SSRs suggest that there has been a change in consumer behavior over the past two decades.

Figure 3.6: Dairy Self-Sufficient Ratio



(a) With trend (b) Detrended

Figure 3.7: Meat and etc. Self-Sufficient Ratio



(a) With trend (b) Detrended

Lastly, lets look at the third group: meat etc. in figure 3.7. The development of the SSR of beef, cheese, and pig meat has been similar over the past twenty years, with a slight decrease. The SSR of eggs, on the other hand, has increased, whereas SSR of potato seems quite stable. It is worth noting that the production data of potatoes has the same structure as the grains and was therefore, treated as such. When doing the ADF tests on these variables with seven lags for eggs, twenty-five for potato, fifteen for beef, and thirteen for both cheese and pig meat, it was concluded that they all consist of unit roots, and therefore the first difference was used.

3.2.3 Estimating the Time Series Model

I wanted to analyze the relationship between the self-sufficiency of agricultural goods and employment in the agricultural sector. Furthermore, I divided the data into monthly panel data to control for monthly specific effects. I used the differenced data of all variables since beef, cheese, eggs, employment, employment in the agricultural sector, pig meat, and potato contained unit-roots. Even though not all variables contained unit-roots, I choose to use differenced data to make the interpretation of the results easier. To account for omitted variables, I decided to include GDP, population size, producer price index (PPI), and the exchange rate between EURO and SEK since they all measures effects that are thought to affect employment. All these control variables were confirmed to have a unit root using the ADF test with several lags chosen by an information criterion and were therefore de-trended by the first difference. With this in mind and the fact that I was interested in the effect of self-sufficiency of agricultural goods on employment in the agricultural sector, I decided to use the following three equations, where *d.Y'* represents the differenced employment and employment in the agricultural sector, *d.ssr´i'* represent the different SSRs and *d.X'* represents the differenced control variables exchange rate, GDP, population, and PPI.

$$d.Y_t' = a_t + \beta d.ssr_t + \beta d.X_t' + \epsilon_t \tag{3.2}$$

$$d.Y_t' = a_t + \beta d.ssrch_t + \beta d.ssrbe_t + \beta d.ssrpi_t + \beta d.ssreg_t + \beta d.ssrbu_t + \beta d.ssrmi_t + \beta d.X_t' + \epsilon_t \tag{3.3}$$

$$d.Y_t' = a_t + \beta d.ssrwh_t + \beta d.ssrba_t + \beta d.ssrry_t + \beta d.ssrpo_t + \beta d.X_t' + \epsilon_t \tag{3.4}$$

To present as precise and correct results as possible, I decided to use a time series model with monthly specific effects to account for the seasonal dependence. However, as the data of production for the variables in equation 3.4 were only available yearly, they were estimated separately. The error terms in all equations were considered to be heteroscedastic, which was confirmed by a Breusch-Pagan/Cook-Weisberg test. To account for this, error terms were clustered following Hoechle (2007).

3.3 Results

I will here briefly comment on the results, and in the next chapter, I will discuss them. Results tables can be found in appendix A. In figure 3.8 one sees the result for equation 3.2 and result tables for equation 3.3 and 3.4 can be founded in appendix B, B.1 respectively B.2. The results reported in figure 3.8 suggests, that the aggregated SSR has no impact on agricultural employment what so ever. However it is suggested that if the growth of SSR increases with one percent, the growth of employment in Sweden increases by 2.24 percent.

Figure 3.8: Result Equation 3.1

VARIABLES	D.empagr	D.emp
D.ssr	-0.00844	2.240**
	(0.0402)	(1.119)
D.eurorate	-6.851	-197.2
	(6.227)	(173.5)
D.gdp	2.60e-08	0.00225
	(6.75e-05)	(0.00188)
D.ppi	0.693	42.93
	(1.265)	(35.25)
D.pop	-0.000432	-0.00353
	(0.000389)	(0.0108)
Constant	2.637	26.15
	(2.606)	(72.58)
Observations	220	220
R-squared	0.013	0.039
Number of Years	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

When looking at figure B.1 (see appendix), there are some significant results. It is suggested that the SSR of cheese has a positive impact on employment in the agricultural sector, whereas the SSR of beef and eggs have a negative impact. Furthermore, it suggested that the SSR of butter has a positive and highly significant impact on overall employment. Lastly, when looking at grains, see figure B.2 in the appendix, there is no significant impact on employment in the agricultural sector. However, the SSR of barley has a positive impact on overall employment.

Chapter 4

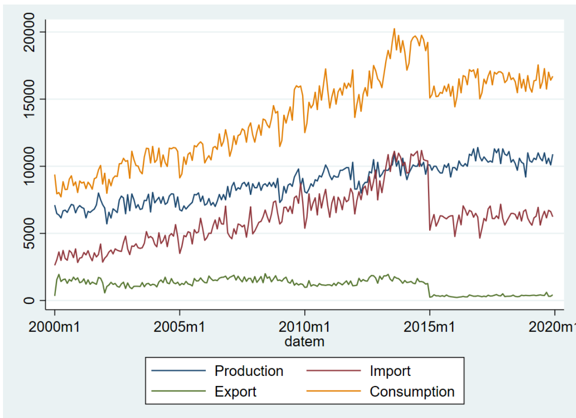
Discussion

4.1 Regarding the results

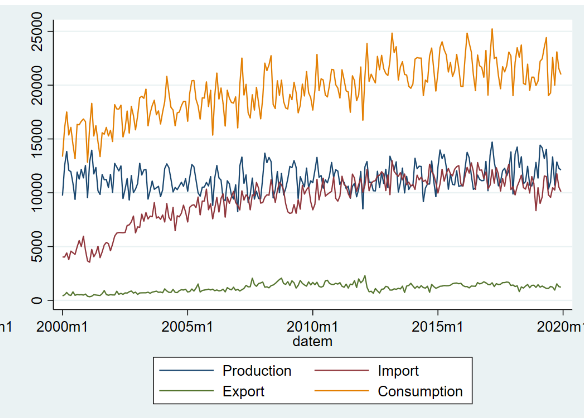
The results presented in this paper suggest that there exists little or no connection between the degree of food self-sufficiency and employment in the agricultural sector. When taking the disaggregated data into regard, some connections between SSR and employment in the agricultural sector can be noted. It is only the SSR's of cheese, beef, and egg that have an impact. This can be explained by the consumption behavior of all three goods. In the case of cheese, see figure 4.1a, the consumption has been increasing steadily for the last 20 years, however, in 2015 there was a large negative shock probably due to the phase-out of milk quotas in April 2015 (EC 2008), which affected the import and export but not the production. If one instead focuses on beef, see figure 4.1b, it is clear that the increased consumption has to lead to an increased import, as the production of beef for the past 20 years has been stable. Lastly, looking at figure 4.1c, one can see that the decreasing consumption of eggs has forced down the production to the extent that some of the production in late 2019 had to be exported.

It is also suggested that the aggregated SSR and the disaggregated SSR of barley and butter have a significant impact on employment overall. Although one can ask how trustworthy these results are. As mentioned above, the data on employment in Sweden is not ideal and it can be questioned whether the results are reliable. In my opinion it is doubtful that the aggregated SSR has an impact on the overall employment without affecting the agricultural sector. Certainly not such great impact as suggested by figure 3.8. Hence I would like to argue that the results reported for the aggregated SSR's impact on overall employment can be considered as spurious results. When it comes to the disaggregated SSR of barley and butter, it shows the same patterns as for the disaggregated SSRs discussed above, that it is consumption that drives the process. In figure A.2a in the appendix, one can see that the production of barley has been fairly constant over the past 20 years and when the consumption in Sweden has decreased, the export increases. As for butter, see figure A.2b in the appendix, the production is rather stable and as consumption changes, Sweden either export or

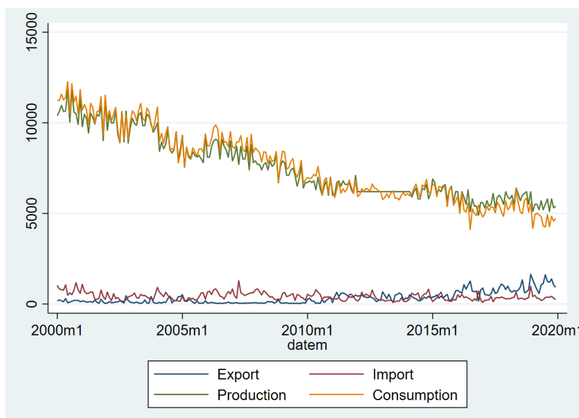
Figure 4.1: Share of Consumption



(a) Cheese (tons)



(b) Beef (tons)



(c) Egg (tons)

import to satisfy the demand.

These results shows that the agricultural sector is driven by the demand of agricultural goods. For this reason, one can argue that the approach held by the Federation of Swedish Farmers (Nordenskjöld et al. 2016), based on the Input-Output model by Lindberg (2016), and the Ministry of Enterprise and Innovation's (Ministry & Innovation 2017) food strategy is problematic. Insistently trying to increase the production will do no good for the employment in the agricultural sector. This is in line with the results of Kummu et al. (2020) and Brunstad et al. (2005), that high-income countries, as Sweden depend more on trade than on domestic production when it comes to food, which is not that surprising. As Gullstrand & Jörgensen (2016) points out, it can be clarified by the laws of Engel and Bennett. This explains why food self-sufficiency is not a desirable goal for richer countries. As the population's income increases, they change their consumer behavior and spend a smaller portion of their income on food. In the meantime, the consumers still want to diversify their diets, and due to lower relative prices in other parts of the world, the result is then less self-sufficiency and a higher portion of imported food. As follows, and as argued by Clapp (2017), there are cases when food self-sufficiency is a desirable goal for a country, and Sweden does not fit among them.

4.2 Regarding employment and self-sufficiency

As mentioned in the previous section, self-sufficiency does not seem to promote employment in the agricultural sector. What would then actually increase employment in the agricultural sector? The easy answer is that we, the consumers, could increase employment in the agricultural sector if we change our consumption by buying more locally and domestically produced food. However, the law of Engel remains, and therefore it is not realistic to believe that consumers will change their behavior overnight. Although, things might be changing if one is to believe the Swedish Environmental Protection Agency. They held a competition where two teams were to present solutions to tackle the challenges with food security in the future. According to the winning team, (Boethius et al. 2020) the value of locally produced food will increase, and in addition to that, they present a tool, the Nutrient Resilience Map, which will decrease the amount of imported food. The basic idea behind the Nutrient Resilience Map is self-sufficiency but on a much smaller scale than discussed before. Boethius et al. (2020) presents five principles as the base of their tool, cultivate yourself, cultivate, support local producers, aim at regional self-sufficiency, and lastly, trade between regions. All this sounds very promising, but it is dependent on a structural change in the consumers' behavior.

Another possibility to increase employment in the agricultural sector would be production. Karlsson & Röös (2019) presents an alternative regional food system for the Nordic based on *"organic production, avoided food-feed competition*[1] *and agriculture that is self-sufficient in bioenergy"*. According to them, the Nordic could feed its future population and more by adopting their food production, which would utilize leftover streams and reduce livestock production. However, Karlsson & Röös (2019) points out that this would involve large changes in diets compared with today's consumption patterns, and one can ask whether consumers would adapt accordingly.

I believe that it comes down to changing the consumers' behavior and valuation of food if one wants to increase employment in the agricultural sector. The policies, imposed to do so, must be long-term and focusing on changing behavior, I would suggest the following policies. Firstly, increase the number of hours of home economics in school and focus more on the consumption of food. By doing so, the knowledge of food and food production would increase, and the children will gain a deeper understanding of how their consumption affects the world that we live in. Secondly, increase the size of food labeling and impose a new label of locally produced food. If the knowledge among consumers increases, so will the demand for more information about food. Today Sweden has a variety of food labeling indicating whether the specific product can be considered a *good environmental choice*. If those labels were visually bigger than today, the information would be easier to obtain. Lastly, I

[1] Food-feed competition refers to the two alternative uses for edible cops, direct consumption by humans or livestock.

would suggest that public procurements should promote diets consisting of locally produced food for schools, elder care, and preschools. If these policies were imposed, I believe it would change the perception of food and, hopefully, break Engel's law.

4.3 Regarding limitations and future research

Before concluding, I would like to mention some limitations regarding this paper. The agricultural sector is at the forefront when it comes to productivity enhancement. With new technology, productivity has increased dramatically, and work that took a week 50 years ago can today be achieved in one day. As much as I would like to control for productivity, there exists no appropriate measure as such. Mechri et al. (2017) presents a review of productivity and efficiency measurement in agriculture and discusses the difficulties in finding an appropriate measure. According to them, the U.S. Department of Agriculture's approach can be seen as a golden standard; however, a Swedish counterpart does not exist. Therefore, to fully understand the linkage between employment in the agricultural sector and self-sufficiency, it would be a good start to develop a similar approach in Sweden. Furthermore, it would be appropriate to investigate consumer behavior concerning food and whether or not it is possible to change it towards a more locally produced approach.

Chapter 5

Conclusions

The objective of this paper was to investigate whether an increase of Sweden's degree of self-sufficiency by increasing the production would increase employment in the agricultural sector, as suggested by the Federation of Swedish Farmers and the Ministry of Enterprise and Innovation. In order to do so, I have critically discussed the concept of self-sufficiency and raised questions regarding the plausibility of discussing self-sufficiency in Sweden. The reason for this, as mentioned in chapter 2, is that previous research has shown that the benefits of a high degree of self-sufficiency do not apply to high-income countries. In addition to that, I have discussed the issues regarding the Input-Output model by Lindberg (2016), that is used by the Federation of Swedish Farmers (Nordenskjöld et al. 2016), which is that it does not account for the opportunity cost, due to the assumption of no substitution among inputs. Lastly, I presented my estimations of the impact of self-sufficiency on employment and reasoned that the few significant results were connected to consumption rather than production. Thus, I argue that the concept of self-sufficiency should be left unmentioned when discussing employment in the agricultural sector. In my opinion, one should focus on changing the behavior of consumers by increasing the number of hours of home economics in school, increase the size of food labeling and impose a new label of locally produced food and that public procurements should promote diets consisting of locally produced food. These policies would strive to change the consumer's behavior and their perception of food as it is consumption that determines the degree of self-sufficiency and not production, which policymakers and interest groups should keep in mind if they want to promote lively rural communities in Sweden.

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Appendix A

Graphs

Figure A.1: Self-Sufficiency Ratio of Milk Powder

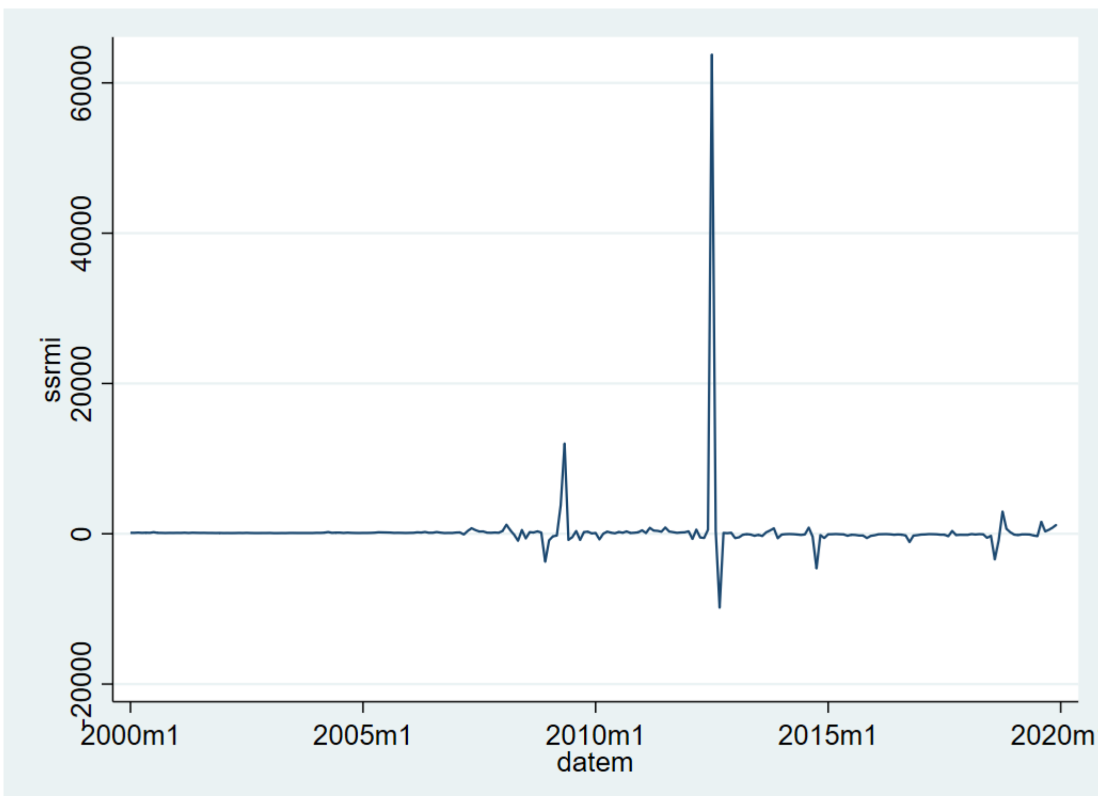
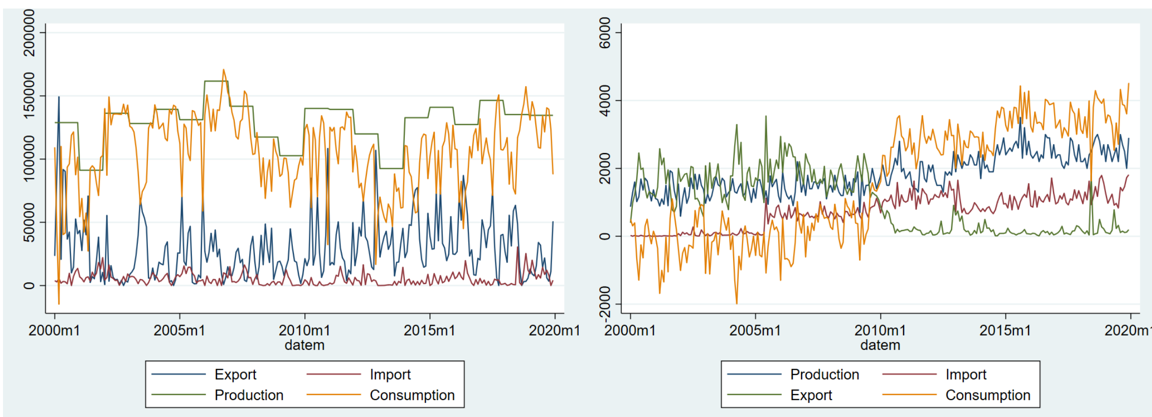


Figure A.2: Share of Consumption



(a) Barley (tons)

(b) Butter (tons)

Appendix B

Result Tables

Figure B.1: Result Equation 3.2

VARIABLES	D.empagr	D.emp
D.ssreg	-0.396*	1.541
	(0.219)	(3.704)
D.ssrmi	-0.000888	-0.0820
	(0.00750)	(0.127)
D.ssrbu	0.00571	0.593***
	(0.00764)	(0.129)
D.ssrch	0.832***	-4.490
	(0.312)	(5.274)
D.ssrpi	-0.0682	-5.845
	(0.463)	(7.820)
D.ssrbe	-0.802**	0.837
	(0.343)	(5.798)
D.eurorate	-19.99*	105.8
	(10.54)	(178.0)
D.gdp	-4.51e-05	-0.00144
	(9.47e-05)	(0.00160)
D.ppi	-0.0714	-5.278
	(1.736)	(29.33)
D.pop	-0.000338	-0.00695
	(0.000601)	(0.0102)
Constant	3.922	87.97
	(4.480)	(75.70)
Observations	113	113
R-squared	0.203	0.235
Number of Years	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure B.2: Result Equation 3.3

VARIABLES	**D.empagr**	**D.emp**
D.ssrba	0.00815	0.908*
	(0.0180)	(0.518)
D.ssrry	0.000735	-0.234
	(0.00894)	(0.258)
D.ssrwh	0.000833	0.00878
	(0.00991)	(0.286)
D.ssrpo	-0.392	-14.23
	(0.384)	(11.08)
D.eurorate	-3.013	-153.6
	(6.382)	(184.1)
D.gdp	3.70e-06	0.00210
	(7.10e-05)	(0.00205)
D.ppi	1.883	51.20
	(1.352)	(39.01)
D.pop	-0.000381	0.00313
	(0.000423)	(0.0122)
Constant	2.116	-6.539
	(2.889)	(83.37)
Observations	195	195
R-squared	0.028	0.052
Number of Years	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1