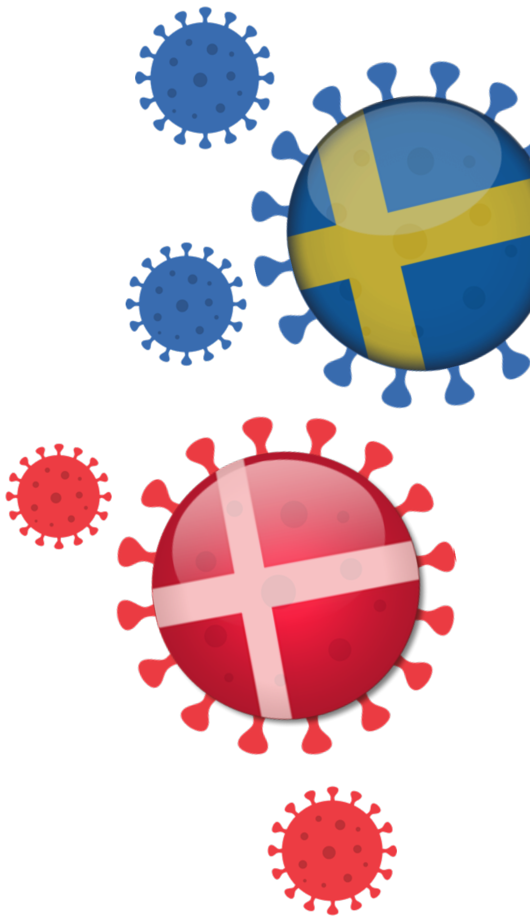
UNEMPLOYMENT AS A CONSEQUENCE OF COVID-19

A comparative study between Denmark and Sweden



Copenhagen Business School - Master's Thesis
MSc Applied Economics and Finance
May 17th, 2021

Michelle Overgaard Hansen
Student Number: 110762
Supervisor: Karl Harmenberg

Number of characters: 151,325
Number of pages: 72 (66.5 standard pages)

Abstract

This paper examines the consequence of the COVID-19 pandemic on unemployment in Denmark and Sweden throughout 2020. As Denmark and Sweden relied on different strategies to cope with the pandemic, hereunder differences in government restrictions and subsidies, the paper investigates whether one strategy was more optimal than the other in terms of labor market impact. To do this, the paper relies on both a theoretical and an empirical investigation.

The effect of the pandemic on unemployment is analyzed theoretically through the Diamond-Mortensen-Pissarides model. The results indicate that Denmark experienced a lower impact on the labor market, as the shock to GDP was lower, resulting in a dampened shock to productivity and job separations. Furthermore, the theoretical effect in Denmark was alleviated by the fact that the matching productivity, k, is higher than in Sweden. After the theoretical investigation, the impact is examined empirically through difference-in-differences regressions. These conclude that the 'treatment' imposed by the Danish government was optimal in relation to keeping unemployment low during the pandemic. Thereby, the empirical investigation confirms the theoretical inference, concluding that the labor market impact in Denmark was significantly lower than in Sweden.

Through a discussion, the paper argues that the 'treatment' effect apprehends both Denmark's stringent policies, as well as its implementation of subsidies and expansionary fiscal policy. The difference in labor market impact is, however, also attributed to the fundamental differences between Denmark and Sweden, as shown in the theoretical model. This comprises the higher matching productivity in Denmark, corresponding to a lower unemployment duration. Further, the difference in labor market impact can partly be attributed to Sweden's exports being more dependent on international fluctuations. The paper contends that other differences, hereunder differences in industry composition or the use of monetary policy, are not significant in explaining the difference in labor market impact during the pandemic. Thereby, the difference in unemployment impact is ultimately attributed to the differences in (i) restrictions, (ii) subsidies, (iii) expansionary fiscal policy, (iv) exports, and (v) matching productivity.

Overall, the paper concludes that Denmark's COVID-19 policies, entailing more severe restrictions and more extensive subsidies have, to some extent, mitigated the pandemic's impact on the labor market. Nevertheless, these differences cannot explain the entire discrepancy in the unemployment impact, as the disparities between Denmark and Sweden further comprise other mechanisms.

Table of Contents

Chapter 1

1. Introduction

This paper investigates the consequence of the COVID-19 pandemic on unemployment in Scandinavia throughout 2020. To combat the complications of COVID-19, countries have taken different approaches to limit the adverse effects on both national health and their domestic economy. Some countries, like Denmark, have imposed a very restrictive lockdown strategy to limit the contagion within its borders. Other countries, like Sweden, have kept most of the society open and thus, allowed for a higher level of economic activity. In addition to this, there have been variations in government subsidies. This paper aims to compare the impact on unemployment in Denmark and Sweden during the COVID-19 pandemic to conclude which approach has been most successful in alleviating the unemployment impact in 2020.

To analyze how the pandemic has affected unemployment, the paper relies on both a theoretical and an empirical perspective. The theoretical perspective is presented through the Diamond-Mortensen-Pissarides model, which gives an insight into the theoretical effect on the labor market of a shock to productivity and job separations. Subsequently, the paper presents an empirical investigation conducted by using weekly data on unemployment and furlough, as well as the monthly unemployment rate. By running three separate differences-in-differences regressions, the paper infers whether treatment (here, the policies imposed in Denmark) has had a significant positive or negative effect on the labor market. The initial hypothesis is that Denmark, the treatment group, has experienced a more considerable shock to unemployment, as its stricter policy measures have implicated a more notable reduction in economic activity.

Conferring to Olsen & Pedersen (2015), the research question will be presented according to three problem layers: problem field, problem issue, and problem statement.

1.1 Problem Field

The problem field consists of an empirical case concerning unemployment in Denmark and Sweden from Q1-2020 to Q4-2020. Unemployment is an essential factor to analyze, as a low unemployment rate is one of the main targets for governmental policies. A high level of unemployment can result in a loss for society, both in terms of lower GDP, lower tax revenues and a higher cost of unemployment benefits (Sørensen, 2020). Therefore, it will often be highly prioritized by the government to maintain a low unemployment rate. Furthermore, unemployment is a good measure of the economy's general performance (Case, Fair, & Oster, 2017). Thus, by considering which of the two countries has performed best in terms of unemployment, I can infer which country has kept the economic performance high during the pandemic.

The labor markets in Denmark and Sweden are similar in many ways (Deloitte, 2015), making a comparison between the two during a pandemic recession ideal for investigating as a natural experiment. Both countries have high labor force participation and extensive unemployment benefits. Furthermore, both countries have historically had a low unemployment rate compared to the EU average. Sweden has, however, had some difficulties with a higher unemployment rate in the past decades (OECD Data, 2021a). Additionally, it is relevant to note that Denmark has a flexicurity system[1], implicating that firing and hiring of workers is easier than in Sweden (Fuller, 2004). Thus, this difference can potentially lead to disparities in labor market impacts.

Besides the labor markets characteristics, the countries' initial encounter with the pandemic is also similar. Sweden reached 100 infected on March 6th and Denmark on March 10th. Since then, the total number of infected has increased with different velocities over the path of 2020. As of December 31st, 2020, the number of accumulated infected was 437,379 in Sweden and 164,116 in Denmark (Our World in Data, 2021). This corresponds to 4.22% and 2.82% of the country's population, respectively. Assuming that each country's testing rates are relatively similar infers that Sweden has a higher proportion of infected than its neighboring country, likely stemming from the country's choice of lighter strategic initiatives. Whether the difference in strategy has also resulted in different labor market impacts will be investigated throughout this paper.

Overall, the paper aims to contribute to existing research by comparing unemployment between two Scandinavian countries during 2020 and attempt to explain which factors can rationalize the differences in unemployment impact amid a pandemic recession. As the paper examines unemployment in time of a global recession (The World Bank, 2020), it will primarily be relating to

[1] Flexicurity is a welfare model that entails flexibility for employers (easy hiring and firing), as well as security for employees (i.e., unemployment benefits).

research on cyclical unemployment. This thesis does, however, distinguish from past research, as a global crisis caused by a pandemic is novel and therefore, research relating to this specific area is limited. Despite the fact that the world has experienced pandemics in the past, none have impacted the economics of the entire world to the same severity, at least in the past century.

1.2 Problem Issue

As mentioned above, Denmark and Sweden have pursued different strategies as a response to the COVID-19 pandemic. Due to the lack of prior research within this specific area, there was no way to know which approach would negatively impact the unemployment levels in each country most. Now, roughly a year later, it is possible to infer at least the short- and medium-term consequences of each strategy. Hence, this analysis might infer the optimal strategy for a given country in the event of a similar occurrence in the future. According to Olsen & Pedersen (2015), the problem can be characterized as a handling problem, considering that a country's strategic decisions can potentially limit the shock to the labor market.

1.3 Problem statement

Based on the problem field and problem issue, the paper presents the following problem statement:

How has the COVID-19 pandemic impacted unemployment in Denmark and Sweden, respectively, and which factors can any potential differences be attributed to?

The thesis aims to answer the problem statement through the following sub-questions:

- How can the impact of COVID-19 on the labor markets be explained theoretically through the Diamond-Mortensen-Pissarides model?
- Which of the two countries has experienced the highest impact on the labor market based on empirical evidence?
- How can disparities between Denmark and Sweden explain potential differences in the labor market impact throughout the pandemic?

Chapter 2

2. Delimitations

While writing this paper, the world is still amid the COVID-19 pandemic, and thus, the paper will be outdated evanescently. Consequently, the thesis only comprises 2020 and hence, does not account for any occurrences, policies, or strategies that the countries might experience or pursue after 31/12/2020. This further entails that the paper does not investigate the long-term impact on unemployment in Denmark and Sweden. Moreover, the delimitation implies that the lasting consequences of government subsidies (hereafter synonymous with compensation) are not accounted for. The paper merely considers the significance of government subsidies while these were in effect but is unable to deliberate the long-term impact on unemployment of a termination in the government support.

To understand the dissimilarities between Denmark and Sweden during the pandemic, government restrictions and compensation will be discussed. However, due to the scope of this paper, not all details will be encompassed. Firstly, the policies will be considered broadly and through a national scope. The paper merely provides a general overview of each country's conduct during the COVID-19 pandemic, but each change in restrictions and compensation over the year will not be accounted for. As each country has revised its approach to the virus several times, it would be convoluted and inapt to justify each country's distinct actions. Further, the paper only considers compensation on a general level, such that it does not study industry-specific impacts in depth.

Lastly, this thesis only accounts for the consequence of the COVID-19 pandemic on the labor market. Thus, the health perspective of society will be out of scope. If a given strategy proves to be less harmful to the labor market, it does not mean that this approach is the optimal choice from a health standpoint or that the strategy is medically justifiable. Furthermore, the thesis does not account for other economic concerns or fiscal impacts, such as the consequence of compensation on the government budget and the long-term risk of a budget deficit. While this is another interesting aspect to consider, it is not a significant concern in Denmark or Sweden, as their public finances are healthy and as the countries have a low amount of debt prior to 2020 (Hansen & Hansen, 2020; Danielsen, 2020). For this reason, the thesis focuses on the impact on economic activity and the corresponding effect on the labor market, without discussing the impact on, or the limitations of, the public finances.

Theoretical and statistical delimitations, limitations, and assumptions will be discussed throughout the paper.

Chapter 3

---

3. COVID-19 Policies

In this section, the strategies pursued by Denmark and Sweden during the COVID-19 pandemic will be presented. This is potentially a good starting point to understand why the effect on unemployment might have differed in the two countries. As mentioned in the delimitations section, the COVID-19 policies are presented broadly.

3.1 Restrictions

3.1.1 Denmark

On March 11th, 2020, the Danish Prime Minister, Mette Frederiksen, stated in a press conference that many parts of the Danish society would shut down to limit the contagion (Statsministeriet, 2020a). From March 13th onwards, this entailed that public universities and schools were shut down and that companies were advised to send workers home to work remotely. Further, there was a ban to assemble more than 100 people (Statsministeriet, 2020a). On March 18th, the lockdown was constricted to the closing of, e.g., all public malls, hairdressers, and restaurants (Statsministeriet, 2020b). Also, the assembly ban was lowered to maximum 10 people, restraining many cultural events such as concerts.

Since March 2020, restrictions have been revised several times to either a looser or a tighter policy. In the fall, large parts of society opened up with several precautions such as a demand for face masks in all indoor places with public access, a closing time of 10 p.m. for all bars and restaurants, as well as no selling or serving of alcohol after 10 p.m. (Statsministeriet, 2020c). On December 9th, several municipalities were again shut further down, schools were closed, many employees continued to work remotely, and restaurants again had to close fully for in-restaurant dining (Statsministeriet, 2020d). Finally, on December 16th, it was announced that Denmark would again enter a lockdown with the closing of all liberal professions, schools, and non-essential retails shops (Statsministeriet, 2020e).

Overall, the Danish government has taken stringent precautions to limit the spread of the COVID-19 virus. Thus, the country has chosen to take on an apparent ‘lockdown’ strategy that entails legal restrictions rather than mere recommendations. Concerning tourism and the closing of borders, Denmark closed for all foreign travel from March 14th (Statsministeriet, 2020a). Opening of the borders began on June 15th, where entry was allowed for Norwegian, Icelandic, and German tourists (Statsministeriet, 2020f). Since then, the country has gradually opened up, first for EU countries and since, for several non-EU countries.

3.1.2 Sweden

Unlike in Denmark, the Swedish Prime Minister, Stefan Löfven, has not enforced a complete lockdown. Instead, the Swedish population has experienced several restrictions. These include an assembly ban starting at 500 people in March, since restricted to 50 people and lastly, to a maximum of eight people in November (Krisinformation, 2020a). From December 24th, 2020, a limit of maximum four people per table at restaurants was enforced. Like Denmark, Sweden has also imposed restrictions on serving alcohol after 10 p.m., which was later revised to 8.p.m (Krisinformation, 2020a). While the Danish schools have been shut down several times and for all grade levels, the Swedish schools have stayed open for most of the pandemic. However, secondary schools were closed in December (Wyatt, 2020).

Concerning restrictions on tourism, Sweden has generally had a limited border control compared to Denmark. On March 17th, Sweden closed its borders for travelers from outside the EU. On December 22nd, this decision was intensified to include travelers from Denmark and the UK, which was imposed to prevent the spread of COVID-19 mutations (Polisen, 2021).

Besides the abovementioned regulations, Sweden has mainly relied on voluntary social distancing. According to the Government Offices of Sweden (2020), "people in Sweden have a high level of trust in government agencies," which entails that "a large proportion of people follow government agencies' advice." Therefore, the Swedish government has assessed that further legislative prohibits would not be necessary. Instead, the government has recommended to keep distance, use hand disinfection, work remotely, and staying home if sick (Krisinformation, 2020b).

Table 1 provides an overview of the social distance laws in each country. As described above, Denmark's restrictions have been more severe than those in Sweden, at least for most of 2020.

	Denmark	Sweden
Closing of primary schools & lower	Yes	No
Closing of secondary schools & higher	Yes	Yes
Closing of restaurants, bars, hairdressers, etc.	Yes	No
A requirement of a mouth guard in public areas	Yes	No
Working remotely	Yes	Yes
Cancellation of public events	Yes	Yes
Restrictions on gatherings	Yes (>10)	Yes (>8)
Closing of borders	Yes	Non-EU, UK, and Denmark

Table 1: COVID-19 Restrictions in Denmark and Sweden (2020).

3.2 Subsidies

Another difference between Denmark and Sweden during the pandemic comprises financial support to firms. This aspect of the pandemic has received less attention. Still, it is vital to consider, as it impacts firms' resources and thereby also unemployment. As wage compensation is the most significant subsidy in monetary terms (Erhvervsstyrelsen, 2021), this will be the focus for comparison. Further information on subsidies is provided in Appendix A.

3.2.1 Denmark

Denmark has provided around DKK 26.6 billion in extra subsidies to support industries throughout 2020 (Erhvervsstyrelsen, 2021). Among the compensation is compensation for fixed costs, compensation for revenue, wage subsidies ('lønkompensation'), compensation for canceled events, as well as compensation for the travel and culture industry. Additionally, the government has offered liquidity aid by prolonging the time allowed for payment of, e.g., government taxes and VAT (BDO Danmark, 2021).

Of the total compensation distributed, the wage subsidies account for 47.7% (Erhvervsstyrelsen, 2021). This compensation was offered to eligible firms from March to August and again from December. For firms closed due to restrictions, compensation was also granted for November (BDO Danmark, 2021).

To receive wage compensation, firms have to offer their regular salaries to employees and refrain from firing workers due to the pandemic. Furthermore, firms have to send at least 30%, or 50 employees, on furlough (BDO Danmark, 2021). The government covers a maximum of 75% of the wage for full-time permanent employees and 90% for employees paid by the hour, with a maximum of DKK 30,000 per employee per month. Workers have to contribute by taking up to five unpaid days off at the start of their furlough. As of January 2021, applications for wage compensation had been approved for around 283.222 people. This corresponds to DKK 12.7 billion in wage compensation during 2020 (Erhvervsstyrelsen, 2021).

The wage compensation scheme generally compromises Denmark's flexicurity agreements, as the flexibility of firms to fire workers freely is partly deterred by the government.

3.2.2 Sweden

Sweden has also offered economic aid to firms, including compensation for revenue decline, compensation for fixed costs, and wage subsidies ('korttidsarbete'). Data on the more precise allocation of the compensation is unattainable. Like Denmark, Sweden has also offered an extension to pay government taxes and VAT (Skatteverket, 2020).

Similar to Denmark, the Swedish government has imposed wage compensation to refrain firms from firing their employees. The wage compensation differs from Denmark's, as the Swedish scheme encourages a reduction in worker salaries (Tillväxtverket, 2020). Furthermore, the Swedish wage compensation allows for a reduction in the working time of 20%-80%, meaning that firms cannot send employees on full-time furlough. Each firm can maximally get a subsidy of SEK 44,000 (around DKK 32,000) a month per employee. Firms can receive the subsidy for six months, with a possible extension for another three months. There are different levels of reduction in working hours and salary, e.g., reduced working hours of 40% will result in a reduced salary of 6%, whereas the government will grant 30% of the salary and the firm will take the remaining loss of 4% (Tillväxtverket, 2020).

Overall, the subsidies offered by Denmark and Sweden appear similar. As shown in Appendix A, the central subsidies provided have the same intentions of supporting firms and their employees. Nevertheless, it is difficult to determine each subsidy's precise effect and provide a clear comparison of the consequence of government support in each country. According to Lønstrup (2020), the subsidies in Denmark have been more supportive, as these have saved many companies from bankruptcy during 2020. Conversely, Sweden has experienced an increase in bankruptcies compared with the previous year, likely stemming from the fact that compensation in Sweden has not supported firms to the same extent as in Denmark. As Sweden has not actively ordered companies to close operations, this could implicate that they do not have an obligation to compensate by the same means as the Danish government.

In relation to wage compensation, there are two main differences to account for. In Denmark, all workers on wage compensation are sent on full-time furlough, whereas workers in Sweden are on part-time furlough, with a maximum working time reduction of 60-80%.[2] Furthermore, the Swedish furlough model results in wage cuts for employees, whereas the Danish model requires that the furloughed are granted their full salary. Like the difference in restrictions, these differences can potentially explain differences in unemployment impact between Denmark and Sweden during the pandemic.

Ultimately, the paper infers that Denmark's approach to the pandemic was based on a severe lockdown with ample subsidies. Oppositely, Sweden opted for an approach entailing fewer restrictions and less extensive subsidies. Of course, this is a very simplified inference. Still, initial speculation indicates that the labor market impact might be more substantial in Denmark, as the economic activity was likely hit harder in this nation due to strict policies. Oppositely, it could be conjectured that the unemployment in Sweden was impacted more due to less compensation and a wage compensation scheme only allowing firms to send workers on part-time furlough, as well as a reduction in workers' wages.

This paper aims to understand the overall impact of the pandemic on unemployment in each country, thereby inferring which factors can explain the difference in labor market impact. In the next section, the theoretical foundation for this investigation will be introduced.

[2] In Sweden, the maximum permitted work reduction was 60% for the majority of 2020, with the exception of May, June and July, where the maximum reduction was 80% (Tillväxtverket, 2020).

Chapter 4

---

4. Theoretical Foundation

In this section, the general theory behind unemployment will be introduced. Furthermore, recent research within more specific areas will be presented, and knowledge gaps will be defined.

4.1 Diamond-Mortensen-Pissarides Model

To theoretically explain and understand the changes in unemployment during the COVID-19 pandemic, the paper relies on the Diamond-Mortensen-Pissarides model (hereafter, the DMP model), commonly referred to as the search and matching model. Other non-Walrasian unemployment models include the so-called traditional approach, which works with the basic theory of supply and demand. In this model, the wage is set at the intersection of the supply and demand curve. This also means that there will be full employment in theory and that there must exist some force that keeps wages high, e.g., union wages, for unemployment to exist (Romer, 2019).

As the traditional model does not consider heterogeneity and search frictions, and as it considers the labor market as a whole, it is insufficient to model reality. Therefore, the more modern approach through the DMP model is more suitable. Unlike the traditional method, the DMP model operates based on the idea that search frictions exist in the market due to heterogeneity in workers and firms. Thus, finding the right match between a vacancy and a worker takes time. These market frictions can partly explain why unemployment exists. The model is set in continuous time as in Pissarides (2000). A discrete version of the model is presented in Appendix F.

4.1.1 Assumptions of the Model

The model assumes that there is a range of workers, which is normalized to 1. These workers can either be *employed* or *unemployed*. Employed workers receive a wage, $w(t)$, for producing output, y. Unemployed workers receive unemployment benefits of $b \geq 0$. All workers are risk-neutral and the discount rate is $r > 0$.

Regarding the firm, the model assumes that a given job can be either *vacant* or *filled*. When a firm posts a vacancy, it involves an exogenous cost $c > 0$, regardless of whether this vacancy is filled or not. Further, there is a free entry of new firms, such that the number of jobs is endogenous. A filled job results in output, y, and labor costs of $w(t)$. If a job is instead vacant, there are no output nor labor costs.

Since search frictions exist, the model is not perfectly competitive, and thus, it will take time before workers and jobs match up. The Cobb Douglas matching function of the model is shown below:

$$M(t) = kU(t)^{1-\gamma}V(t)^{\gamma} \tag{1}$$

The matching function is increasing in $U(t)$ and $V(t)$. $U(t)$ denotes the stock of unemployed workers, and $V(t)$ denotes the stock of vacant positions. In this model, γ signifies the matching efficiency, whereas k denotes the matching productivity.

The change in the number of employed, $\dot{E}(t)$, is found as the number of new matches, minus the number of exogenous job separations, λ, in the existing matches. This builds on the assumption that there is a constant participation rate in the market. The change in the number of employed is:

$$\dot{E}(t) = kU(t)^{1-\gamma}V(t)^{\gamma} - \lambda E(t) \tag{2}$$

Similarly, the change in unemployment is described by:

$$\dot{U}(t) = \lambda(1 - U(t)) - kU(t)^{1-\gamma}V(t)^{\gamma} \tag{3}$$

The matching function is approximated to exhibit constant returns to scale in empirics, as this is a fair assumption based on empirical evidence (Romer, 2019). Based on this, a ratio of vacant positions to unemployed workers can describe the labor market tightness:

$$\theta = \frac{V(t)}{U(t)} \tag{4}$$

A high labor market tightness makes it easier for workers to find a job and vice versa. To denote the probability that a worker will find a job or that a vacancy will be filled, the job finding rate, $a(t)$, and the vacancy filling rate, $\alpha(t)$, are ideal. These are found by the number of matches, divided by the number of unemployed or vacancies, respectively. The equations are shown below:

$$a(t) = \frac{kU(t)^{1-\gamma}V(t)^{\gamma}}{U(t)} = kU(t)^{-\gamma}V(t)^{\gamma} = k\theta(t)^{\gamma} \tag{5}$$

$$\alpha(t) = \frac{kU(t)^{1-\gamma}V(t)^{\gamma}}{V(t)} = k\frac{V(t)^{\gamma-1}}{U(t)^{\gamma-1}} = k\theta(t)^{\gamma-1} \tag{6}$$

Both the worker and the firm are better off in the case of a match, as both parties would otherwise need to resume searching. Therefore, the model assumes that all meetings lead to a match. This does, however, not mean that the wage is determined at once. The salary needs to be high enough to incentivize the worker to take the job, but low enough to incentivize the firm to fill the position. The wage is determined through Nash bargaining, where the parameter ϕ denotes the worker's bargaining power and $1 - \phi$ represents the firm's bargaining power.

4.1.2 Conditions for Equilibrium

The conditions for equilibrium in the model will now be presented. $V_E(t)$ is the present value of the lifetime utility of being employed at time t, whereas $V_U(t)$, $V_F(t)$ and $V_V(t)$ are the present values of the lifetime utilities of a worker being unemployed, a job being filled, and a job being vacant at time t, respectively. The returns to being employed and unemployed are shown below:

$$rV_E(t) = w(t) + \dot{V}_E(t) - \lambda\big(V_E(t) - V_U(t)\big) \tag{7}$$

$$rV_U(t) = b + \dot{V}_U(t) + a(t)\big(V_E(t) - V_U(t)\big) \tag{8}$$

The returns to having a filled and vacant job position are:

$$rV_F(t) = y - w(t) - c + \dot{V}_F(t) - \lambda\big(V_F(t) - V_V(t)\big) \tag{9}$$

$$rV_V(t) = -c + \dot{V}_V(t) + \alpha(t)\big(V_F(t) - V_V(t)\big) \tag{10}$$

A worker's surplus from matching is the difference between being employed and unemployed: $V_E(t) - V_U(t)$. Likewise, a firm's surplus from a match is the difference between filling a job position and having a vacant job position: $V_F(t) - V_V(t)$. Considering the workers' bargaining power ϕ and the equations shown above, the Nash bargaining assumption can be described as:

$$V_E(t) - V_U(t) = \frac{\phi}{1-\phi}[V_F(t) - V_V(t)] \tag{11}$$

By inserting equations (7)-(10) and solving for wages, this yields the following Nash bargaining solution for salaries in steady state:

$$w = b + \frac{\phi(y-b) * (r+\lambda+a)}{(r+\lambda+\phi a+(1-\phi)\alpha)} \tag{12}$$

4.1.3 Steady State Equilibrium

To determine the equilibrium employment, the model assumes that the economy is in a steady state. This means that $\dot{V}(t)$ and $\dot{E}(t)$ are zero, such that the present values of the lifetime utility, and the employment level are constant. This implicates that the number of new matches is equal to the number of job separations. Lastly, the job-finding rate and the vacancy-filling rate are constant. Based on the fact that the number of new matches and the number of job separations are equal ($\lambda E = kU^{1-\gamma}V^{\gamma}$), the unemployment in equilibrium can be derived from equation (3):

$$U = \frac{\lambda}{\lambda + k\theta^{\gamma}} \tag{13}$$

Similarly, the job creation curve is found by combining equations (9) and (10):

$$y - w - \frac{(r+\lambda)c}{k\theta^{\gamma-1}} = 0 \tag{14}$$

The job finding rate and the vacancy filling rate can be derived in steady state, again using the idea that the number of matches and separations are equal:

$$a = \frac{\lambda E}{1-E} \tag{15}$$

$$\alpha = k^{(1/\gamma)} * (\lambda E)^{\frac{(\gamma-1)}{\gamma}} * (1-E)^{\frac{1-\gamma}{\gamma}} \tag{16}$$

By solving the model through the beforementioned conditions and assumptions, the equilibrium level of employment in steady state is such that:

$$rV_V = -c + \alpha(V_F - V_V) = 0 \tag{17}$$

Substituting for V_F, V_V and wages, the equation becomes:

$$rV_V = -c + \frac{(1-\phi)\alpha}{(\lambda + r + \phi a + (1-\phi)\alpha)} * (y - b) = 0 \quad (18)$$

Equation (18) shows the net present value of posting a vacancy. When the benefits and costs of posting a vacancy are equal, the incentive to post a new vacancy will be zero. Thus, the free-entry condition indicates that no firm will enter or exit the market when $rV_V = 0$. When this is the case, the market will have reached steady state (Romer, 2019). As seen in the equation, the value of having a vacancy decreases in the cost. Further, the value changes through the remaining exogenous parameters: $y, b, \lambda, \phi,$ and r, as these either impact the value of a vacancy directly or through the wage. a and α are endogenous and will therefore be determined inside the model.

4.1.4 The Beveridge Curve

To understand the steady state equilibrium in empirics, the Beveridge Curve can pose a relevant tool. This curve depicts a negative relation between the vacancy ratio (V) and the unemployment rate (U). Each point on the curve illustrates an unemployment-vacancy combination that results in a steady state, as the inflows and outflows from unemployment in each moment are equal (Blanchard & Diamond, 1989). The curve is based on the theoretical derivation in equation (13).

As the curve shows a negative relation between unemployment and vacancies, a relatively high vacancy rate indicates a low unemployment level and vice versa. The idea of the curve is that in an economic cycle, the unemployment and vacancy combination will move along the Beveridge Curve. Thus, in the case when the unemployment rate is high, and the number of vacancies is low, it can be argued that the economy will likely be in a recession.

The curve's position in relation to the origin shows how efficient the market is in reallocating employees, i.e., low structural or frictional unemployment. Thus, the closer the curve is to the origin, the more efficient is the labor market, as this indicates a lower unemployment rate per number of vacancies. Overall, the coexistence of vacancies and unemployment in the diagram can be explained by the presence of search frictions and the continuation of job creation and job destruction (Blanchard & Diamond, 1989). The diagram can be extended to include the job creation curve, as shown in equation (14). The intersection of the two curves illustrates the (U, V) combination in a given equilibrium.

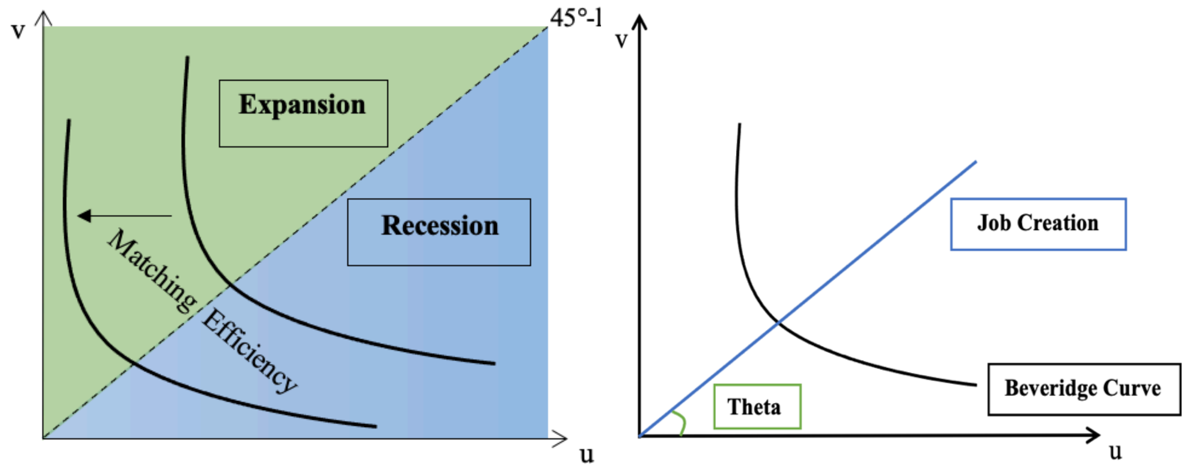


Figure 1: Beveridge Curve and Job Creation Curve.

An empirical Beveridge Curve for Denmark and Sweden is provided in Appendix N.

4.1.5 Criticisms of the model

Several criticisms can be raised against the standard version of the DMP model. First of all, the model does not account for on-the-job searching, meaning that the number of jobseekers is assumed to equal the number of unemployed. Thus, the model does not capture the transition of employed persons between jobs or that firms can potentially replace an employee with another (Romer, 2019). This is attributed to the fact that the model only considers exogenous separations. Moreover, the model is simplified to include only a small degree of heterogeneity and does not distinguish productivity between workers. An ideal extension of the model would be to presume uncertainty in each worker's productivity, thus accounting for the fact that not all meetings lead to a match in actuality.

Furthermore, the model's search process is portrayed in the model as random, whereas in reality, much of the workers' search for a job is directed by their interests and actions. Including this in the model would likely contemplate the reality more precisely. Also, including the assumption that wages are, to some extent, posted rather than bargained from scratch would be more realistic.

While many of the abovementioned criticisms can be solved by extending the model, this paper will operate around the simplified version. There will, however, be drawn on an endogenous version of the model, which is presented in the following section.

4.1.6 Endogenous Separations

To add to the model, the DMP framework will now be extended to include endogenous separations, as in Mortensen & Pissarides (1994). In this version of the model, firms can choose to destroy the match when idiosyncratic productivity changes.

The setup of the model is somewhat different from that of exogenous separations. Each worker's productivity is now $y\varepsilon$, where y denotes the general productivity (as in the exogenous model) and ε is a parameter considering an idiosyncratic component. The idiosyncratic component draws on a general distribution, $F(\varepsilon)$, and an idiosyncratic shock arrives at a Poisson rate, λ. The shock is persistent and independent of the economy's aggregate state (Mortensen & Pissarides, 1994). Once a shock arrives, this will impact worker productivity, which will then leave the firm with a decision of continuing production at the new productivity level or destroying the job. The idiosyncratic productivity, ε, can be interpreted as having a value between 0 and 1.

As in the exogenous model, the change in unemployment can be described as the number of separations minus the number of new matches. However, job separations should now be seen as endogenous. Thus, this is found by the fraction of firms hit by an idiosyncratic shock, λ, multiplied by the probability that the shock is below the reservation productivity, $F(R)$.

$$\dot{U} = \lambda F(R) * (1 - U(t)) - U(t)^{1-\gamma} V(t)^{\gamma} \qquad (19)$$

As in the previous model, the number of separations equals new matches in steady state. Hence, the steady state unemployment in the endogenous separations model can be derived from equation (19):

$$U = \frac{\lambda F(R)}{\lambda F(R) + \theta^{\gamma}} \qquad (20)$$

Corresponding to equation (17) in the exogenous model, the following equation indicates that firms will create jobs until $rV_V = 0$. The difference is that the value of having a filled job is now dependent on an idiosyncratic component, ε.

$$rV_V = -c + \alpha(V_F(\varepsilon) - V_V) = 0 \tag{21}$$

The endogenous model is mainly incorporated in the thesis with the aim of presenting the idea that in reality, a job separation occurs based on a decision made by either a worker or a firm. In relation to the pandemic, this is a particular important distinction, as the government was able to influence the job separation rate by incentivizing firms to keep the match rather than to separate from the workers. For the majority of the paper, the exogenous version will be used for reasons of simplification. Still, I believe that it is important to recognize the distinction between the job separation rate in the DMP model and the firing process in reality.

4.2 Literature Review

4.2.1 The Search and Matching Model

The modern search and matching model described above was introduced in Mortensen & Pissarides (1994) almost 30 years ago. The model is based on ideas that are even older, such as those presented in Diamond (1982), Mortensen (1982), and Pissarides (1985). Like mentioned, the model builds on the idea that search frictions exist in the market, thus differentiating from previous models. While the model is well-recognized and accepted within modern macroeconomics, it does encompass various flaws. Due to this, several papers have raised criticisms against the standard model, as it cannot capture a precise reaction from empirical shocks to productivity and job separations.

Shimer (2005) presents the argument that a productivity shock only results in a minor movement along the Beveridge curve, as lower wages captivate most of the shock, which ultimately reduces the effect on vacancies and unemployment. Thus, this results in lower volatility than in empirical evidence (Shimer, 2005). Likewise, he argues that an increase in the separation rate has a minimal impact on labor market tightness, as a significant shock to job separations results in a counterfactual positive correlation between unemployment and vacancies (Shimer, 2005). While an increase in the job separation rate initially disincentivizes companies to post vacancies and increases unemployment, the decrease in vacancies puts a downward pressure on the wage. Thus, this will again incentivize vacancy creation, thereby reversing a decrease in the labor market tightness. It is relevant to note that Shimer (2005) works with a dynamic version of the DMP model, why his criticism cannot be directly compared to the static version used in parts of this paper.

To solve the problems presented by Shimer (2005), several papers have suggested modifications or extensions of the DMP model. First of all, Shimer (2005) suggests substituting the Nash bargaining assumption with a different wage mechanism. Using a mechanism in which wages are rigid will amplify the shock to vacancies and unemployment. Other attempts to improve the model include Hagedorn & Manovskii (2008), who argue that altering the model's calibration can solve the issue. They find that setting a very high value of unemployment benefits can create amplification in the model, as this increases the volatility in unemployment and vacancies. Costain and Reiter (2008) further criticize this idea by arguing that this makes the model too responsive to unemployment benefits. Instead, Pissarides (2009) argues that the problem can be solved by implementing fixed training costs per worker, resulting in higher unemployment volatility while maintaining high wage flexibility in new matches.

All in all, the papers find that the model can be amplified by either decreasing the profit margin for firms (Hagedorn & Manovskii, 2008; Pissarides, 2009) or by introducing rigid wages (Shimer, 2005).

More recent research comprises Fujita & Ramey (2012) and Coles & Kelishomi (2018). Fujita & Ramey (2012) evaluate how the DMP model's ability changes when an endogenous separation rate is incorporated into the model. The findings suggest that an endogenous separation rate with on-the-job search allows for replicating the Beveridge curve and increases the model's unemployment volatility. However, despite an endogenous separation rate, adequate volatility is still not generated in the job finding rate (Fujita & Ramey, 2012). Coles & Kelishomi (2018) relax the assumption of free entry and find that this leads to inelastic vacancy creation. This results in a decrease in vacancies when unemployment increases, thus allowing for Beveridge curve dynamics. Hence, this solves one of the issues presented in Shimer (2005). Several of the abovementioned papers are later used for inspiration in calibrating the model's parameters in this paper (Section 5.2.1.1).

Despite the criticisms, the DMP model is acknowledged within the field of macroeconomics. Furthermore, it can describe the overall functions of the labor market and provide intuitive comparative statics. For this reason, the model will be the main theoretical foundation in this paper. While the abovementioned extensions can solve some of the model's issues, this paper relies on the simplified version. Still, it should be kept in mind that the standard version of the DMP model exhibits several problems with depicting reality, mainly pertaining to the cyclical component of unemployment.

4.2.2 The COVID-19 Pandemic

Bernstein, Richter & Throckmorton (2020) use the DMP model to explain the impact of COVID-19 on unemployment. The paper uses a shock on the job separation rate, λ, to model the pandemic's economic impact in the United States. This exercise shows that a positive job separation shock lowers a firm's incentive to post a vacancy, as long as firms expect lasting job destruction and as the number of unemployed is relatively low. The paper finds that the unemployment peaks around two months after the shock and is expected to return to the pre-Covid rate around a year later (Bernstein et al., 2020).

Other papers have investigated the impact of COVID-19 through a more empirical approach. Andersen, Hansen, Johannesen, & Sheridan (2020) analyze transaction data in Scandinavia to see how government restrictions have impacted consumer spending. They find that Denmark's consumer spending decreased to 27% below the counterfactual during the first seven weeks after the lockdown was initiated. They further conclude that a small part of the reduction in spending could be correlated with the severity of government constraints on economic activity but that most of the impact stems from the virus itself (Andersen et al., 2020).

Kong & Prinz (2020) further investigate the consequences of the pandemic. This paper examines the effect of non-pharmaceutical interventions on unemployment in the United States. In the article, Google search data is used as a proxy for the change in unemployment. The paper concludes that state-level policies and restrictions cannot significantly explain the economic decline. They find that of the unemployment increase in weeks 11 and 12, only 12.4% can be attributed to the state-level restrictions (Kong & Prinz, 2020). Similarly, Lin & Meissner (2020) study the impact of stay-at-home policies on unemployment and find that states with restrictive policies do not have a higher unemployment increase than states without policies.

Also, papers on historical pandemics can pose relevant. While both the economy and the current pandemic differ from 100 years ago, it is not irrelevant to consider that there might be similarities and lessons to be learned from studying the past. Correia, Luck & Verner (2020) find that the 1918 Flu resulted in a sharp fall in US states' economic activity. Further, the paper concludes that the interventions and restrictions imposed in some cities did not result in worse downturns. Oppositely, the findings suggest that states with more abrupt and severe interventions could alleviate the consequences of the pandemic to the economy (Correia et al., 2020).

Lastly, Juranek, Paetzold, Winner & Zoutman (2020) focus on the effect of the COVID-19 pandemic on the Scandinavian labor markets. The study uses data from all 56 regions in the Scandinavian countries to study unemployment differences during the first months of the pandemic. The study concludes that the pandemic severely impacted all of the Scandinavian countries. Further, it concludes that the unemployment impact in Sweden was significantly lower than that of its neighboring countries, suggesting that less intervention is ideal in limiting the impact on the economy in the very short term. The study concludes that the Swedish labor market seems to be impacted with a delay of 2 to 3 weeks compared to the other Scandinavian countries (Juranek et al., 2020). The study reports the impact up to week 21 of 2020, and thus, this thesis aims to build on previous findings.

While the abovementioned papers touch upon various consequences of the pandemic, it seems that the impact is mainly considered in the very short term. Furthermore, the papers appear to have contradicting results. Thus, there is a knowledge gap, both concerning the impact in the longer term and in relation to concluding something definite on interventions during a pandemic. Therefore, this paper aims to challenge and build on previous results by considering the pandemic’s consequences over an extended period. The paper will draw on the above research to compare results and rationalize impacts over the year. As this paper simply compares the overall implications of severe restrictions versus lighter restrictions, it takes on a more general scope than papers such as Kong & Prinz (2020), which focuses on individual interventions and their daily impact.

A very recent report by Bougroug, Kjos & Sletten (2021) was published through Statistics Norway in April 2021. The report investigates the economic impact on the Scandinavian countries during the first year of the COVID-19 pandemic. As my thesis and the report by Bougroug et al. (2021) have been written independently and simultaneoulsy, I find it interesting to investigate whether our findings overlap, or whether there are dissimilarities. This thesis will touch upon the main findings by Bougroug et al. (2021) in the analysis, with the aim of concluding whether my findings support the newest literature or whether this thesis offers a different perspective.

Chapter 5

5. Methods

To examine potential differences in unemployment in Denmark and Sweden during the pandemic, the paper relies on several investigations. The methodology behind the research will be presented below.

5.1 Research Approach

Following a quantitative approach, this thesis aims to use theoretical and empirical perspectives to answer the research question.

The theoretical foundation, which I introduced previously in the paper, relies on the DMP model. This model will be used to provide a theoretical understanding of the labor market impacts in each country during the pandemic. The theoretical part of the analysis will be conducted using comparative statics, which will serve as a base for impulse response functions. Furthermore, a dynamic version of the model will be created using linear approximation in Dynare. The results of the theoretical analysis will be held up against empirical findings to investigate whether the model can explain the empiric effects on unemployment during the pandemic. Overall, the theoretical part of the paper seeks to use a descriptive level of knowledge to provide an overview of the effect of a shock to the labor market, but further comprises explanatory research as the model helps explicate which factors the effect encompasses.

The empirical part of the paper relies on empirical observations, which are first examined to get an initial understanding of the unemployment in each country. Thereafter, difference-in-differences regressions will serve as a quantitative investigation, where statistical results will be drawn to conclude the labor market impact. This will help deduce whether there is a significant difference between the effect on unemployment in the two nations and thereby indicate which approach was most optimal from a labor market perspective. Thereafter, the results of the theoretical and empirical investigation will be compared and discussed, after which the results will be linked with findings in the existing literature. Lastly, a discussion of the underlying reasons behind the results will be presented.

The paper uses an application-oriented research method, as it deals with a practical problem. The investigation was conducted based on an ad hoc approach, where I acted as a reflective practician to use newly acquired knowledge to continuously improve the research question. The research is based on critical rationalism, as it is constructed based on a realistic ontology and relies mainly on quantitative methods (Holm, 2018). Furthermore, the paradigm corresponds well to the paper, as it aims to use empirical observations to falsify the initial hypothesis. A hermeneutical approach is drawn on in parts of the paper, as the thesis seeks to explain not only the difference in unemployment but also the reasons hereof. Unlike critical rationalism, a hermeneutical approach relies on a subjective epistemology (Holm, 2018). For this part of the analysis, the paper draws on a qualitative discussion.

The research in the paper is based on both an inductive and a deductive approach. A deductive approach is used in the theoretical part of the paper, where the DMP model explicates the impact on unemployment during COVID-19. Thereafter, an inductive approach is used to investigate empirical data with the aim of developing a conclusion as to which approach to the pandemic is most optimal from a labor market perspective. The empirics of the paper rely primarily on written secondary sources with high reliability and validity. Correspondence with Tillväxtverket and Danmarks Statistik was used to confirm essential definitions and retrieve records that were not publicly available. The process for collecting data is described in section 5.3, whereas the modeling approach is described below.

5.2 Models

The paper relies on a theoretical DMP model and an empirical difference-in-differences approach to apprehend unemployment during the COVID-19 pandemic. I will now present the procedure for using these models.

5.2.1 Theoretical Macroeconomic Model: The Diamond-Mortensen-Pissarides Model

To conclude on the theoretical labor market impact, the paper introduces an exogenous shock to the DMP model. This shock is modeled through the productivity, y, and the exogenous job separation rate, λ. As argued by Shimer (2005), it seems that labor market fluctuations are more often explained by shocks to productivity than to the job separation rate.

The effect of each shock on the labor market is obtained through comparative statics and impulse response functions. Whereas comparative statics make it possible to derive the general impact on the job finding rate and unemployment, the impulse response functions show the theoretical effect on unemployment in a more intuitive way.

5.2.1.1 Calibration of Parameters

To create impulse response functions, the shocks to productivity and the job separation rate are modeled through the quarterly change in real GDP.[3] The model's exogenous variables are calibrated externally by using evidence from independent literature, as shown in Table 2.

Parameters	**Source of Shock**	
	$\boldsymbol{y}$	$\boldsymbol{\lambda}$
Matching efficiency, γ	0.5	0.5
Bargaining power of workers, ϕ	0.5	0.5
Job separation rate, λ	Sweden: 0.0278 Denmark: 0.033	Stochastic
Cost, c	0.2	0.2
Unemployment benefits, b	0.7	0.7
Interest rate, r	0.01	0.01
Matching productivity, k	Sweden: 0.42 Denmark: 0.78	Sweden: 0.42 Denmark: 0.78
Productivity, y	Stochastic	Sweden: 1.078 Denmark: 1.051

Table 2: Calibration of Parameters in DMP Model.

The matching efficiency is set to 0.5, as this is considered by Petrongolo & Pissarides (2001) to be inside the "plausible range for the empirical elasticity on unemployment" (2001, p. 390). It is in the lower-bound of their range, thereby considering that the value estimated by Blanchard & Diamond (1989) is relatively lower. Workers' bargaining power, ϕ, is set to 0.5, as this is often used in literature, although there is no evidence. Thereby, the surplus going to the firm $(1-\phi)$ is also 0.5. As the matching efficiency and the surplus going to the firm are equal, the Hosio's condition is fulfilled, meaning that the decentralized equilibrium is efficient (Romer, 2019). Had the matching

[3] Real GDP is normalized to 1 (in Q1-2020) and is a proxy for $y * E$ in the model. Thus, the quarterly value for y is found by GDP/E. Similarly, the shock to λ is found by setting the employment rate $E = GDP/y$ and solving for the corresponding value for λ in each quarter.

efficiency been smaller than the firm's surplus, too many vacancies would be created and vice versa. The separation rate is set to 0.033 in Denmark, and 0.0278 in Sweden, representing that jobs last for around 7.5 and 9 years, respectively (OECD Stats, 2019). The higher separation rate in Denmark can be attributed to flexicurity.[4] The cost of posting a vacancy is set to 0.2, thus approximating the values estimated by Shimer (2005) and Fujita & Ramey (2012). The unemployment benefits or value of outside leisure is set to 0.7, corresponding to Coles & Kelishomi (2018) and Fujita & Ramey (2012). This is selected based on the fact that both countries have high unemployment benefits. Furthermore, a high value of unemployment benefits is essential in achieving volatility in the model, as discussed by Hagedorn & Manovskii (2008).

The discount factor is set to $0.96^{1/4}$ to simulate a 1% real interest rate per quarter. Lastly, the matching productivity, k, and the productivity, y, are internally calibrated to match empiric data. Denmark has a higher matching productivity to resemble a low unemployment rate, despite a high job separation rate. The three endogenous parameters (E, a, and α) do not have a constant value but are instead determined through the exogenous values. The equilibrium employment is calculated by solving the level of E in which the value of having a vacancy is zero for different levels of productivity or job separations. That is, the above exogenous parameters are inserted in equation (18) together with values of y and λ for each quarter of 2020 (which are found based on the GDP decline). The level of E which solves the equation is then determined through linear programming, using the problem solver feature in Microsoft Excel.

A dynamic version of the model is solved through a linear approximation in Dynare. Unlike the static model described above, the dynamic model is based on a discrete version of the DMP model, which is presented in Appendix F. The static and dynamic models rely on the same parameter values.

5.2.2 Empirical Econometric Model: Difference-in-Differences Regressions

After a theoretical perspective is presented through the DMP model, an empirical approach will be introduced to further understand the COVID-19 impact on unemployment in Denmark and Sweden.

---

[4] A high separation rate essentially indicates that more people are getting laid off. As it is easier to fire people in Denmark due to flexicurity, this corresponds to a high job separation rate. However, a high exogenous job separation rate also implies that firms are less willing to post vacancies due to high uncertainty of a match vanishing. This implication is incorrect in empirics, as easy hiring and firing likely results in firms that are willing to post even more vacancies, as this allows for higher flexibility. Therefore, the empirical effects are not captured precisely in the model, as the DMP framework does not account for this distinction.

To do this, the paper relies on a quasi-experimental approach in the form of difference-in-differences (hereafter, DiD) regressions. The regressions are coded in 'R', and the coding is shown in Appendix K.

5.2.2.1 The DiD Model and Its Assumptions

The DiD model studies the difference between a 'control'-group and a 'treatment'-group over time (Stock & Watson, 2015). Thus, the model can estimate a treatment effect by comparing the difference pre- and post-treatment in the treatment and the control group (Stock & Watson, 2015). Due to the double differencing in the model, the outcome captures both state and time fixed effects. The DiD regression is conducted based on a balanced panel dataset, meaning that it contains data on several units at several points in time (Stock & Watson, 2015).

In this paper, three separate DiD regressions will be estimating the effect of the 'treatment' imposed by the Danish government in the form of severe policies and subsidies. The first regression estimates the effect using weekly unemployment inflow, as this is high-frequency data that allows for increased transparency and high interpretability. As the weekly data does not consider the unemployment outflow, a supplementary regression is based on the monthly unemployment rate, thus considering the net effect. Lastly, a model using the weekly furlough stock is studied, as this conveys an additional perspective on the consequence of treatment on the labor market.

The assumptions of the DiD model are similar to those of a standard OLS model, including that residuals have a mean of zero and that they are normally distributed. Moreover, there must be no perfect collinearity or heteroskedasticity in the model, the regression must be linear in its parameters, and all regressors must be independent (Wooldridge, 2013). If these assumptions hold, the OLS estimators will be unbiased and consistent. The premises are further discussed in Appendix B. Generally, the assumption of independent regressors is violated in DiD regressions, as all entities are studied twice (pre- and post-treatment). This problem is typically dealt with through cluster-robust standard errors.

Lastly, the DiD model assumes that a parallel trend is present in the treatment and control group, such that the change in the control group over time can serve as a proxy for the counterfactual change in the treatment group (Wing, Simon, & Bello-Gomez, 2018). If this is not the case, the regression model will have an endogeneity problem (i.e., the assumption that the error term has an expected value of zero is violated), and the causal inferences will be invalid.

5.2.2.2 Criticisms of the Model

As discussed by Goodman-Bacon & Marcus (2020), using DiD regressions for researching the impact of policy responses during the pandemic can be problematic. As mentioned above, it is vital to assume that Sweden's unemployment reflects how unemployment would have evolved in Denmark if it had not initiated a lockdown. A violation of this assumption would lead to biased DiD estimates (Goodman-Bacon & Marcus, 2020). Therefore, the paper tests for a parallel trend before conducting the DiD regressions.

To test the parallel trends assumption, the paper uses both a graphical interpretation and a hypothesis test. The hypothesis test uses a t-stat to conclude whether the following null hypothesis can be rejected, thereby concluding whether the difference in the slope of the two lines is significant.

$$H_0: b_D - b_S = 0 \tag{22}$$

$$H_1: b_D - b_S \neq 0 \tag{23}$$

The null hypothesis states that the difference in the slopes of the trendlines for Denmark and Sweden, respectively, is zero. Thus, rejecting the null hypothesis would indicate a significant difference between the two lines, and therefore, a parallel trends assumption would not hold. The testing of the parallel trends assumption is conducted in chapter 7.

Other potential problems include the fact that it is difficult to disentangle the policies in Denmark and Sweden, such as to conclude that on an exact date, Denmark initiated a lockdown and strict policies, whereas Sweden did not. Instead, the government policies have been changed a lot over the period, and in some occurrences, the policies of the treatment and control groups have been very alike. Thus, it is likely that Sweden is not an optimal control group for Denmark. Additionally, it is impossible to control the behavior of the population in each country. Thus, even though the control group has not experienced a lockdown, the Swedish population may have taken on voluntary distance measures. This problem could be a threat to the internal validity, considering that the issue is a potential failure to follow treatment protocol, leading to bias in the OLS estimators. Further, it is essential to note that the regression cannot generalize the optimal approach for all countries in potential future pandemics.

As the regression only considers two countries, it is nonrepresentative, making it a possible victim of external validity.

Despite these disadvantages of relying on a DiD model to identify the causal effect between policies and unemployment or furlough, it is likely that the model can infer some valuable information about the intervention during a pandemic recession. As a DiD approach includes a control group, the model is more valuable than methods such as time-series designs or before-and-after comparisons (Goodman-Bacon & Marcus, 2020). A DiD can be good evidence for providing direction to policymakers, as long as researchers use it cautiously. Conversely, if the model is biased and leads to the wrong conclusions, it can be problematic for policymakers to rely entirely on this model's outcome. Therefore, the model will be used simply as an insinuation, and the conclusions drawn from the model will be drawn with caution.

Lastly, it is important to note that the effects of the COVID-19 policies are not entirely isolated, as the treatment effect can be affected by noise from other factors, potentially leading to endogeneity. While the paper tests for a parallel trend before the treatment, it is uncertain whether the countries would continue to have the same trend, even if they had imposed the same restrictions. This means that the time fixed effect might not accurately represent the counterfactual change in Denmark. Hence, a major weakness of this analysis is that it cannot definitely be concluded that the severeness in restrictions and subsidies are the main drivers of the difference in unemployment. Instead, other factors might partly explain why the countries would react differently to the COVID-19 shock, despite of the fact that Denmark and Sweden had a parallel trend prior to the pandemic. This potential dispute will be discussed in chapter 8.

5.2.2.3 Setup of the Model

The regression model is set up like shown below:

$$y = \beta_0 + \beta_1 dP + \beta_2 dT + \delta_1 dP * dT + \epsilon \qquad (24)$$

As mentioned above, the paper contains three separate DiD regressions. y is the dependent variable, which is either (i) the weekly unemployment inflow per 100,000 inhabitants, (ii) the monthly unemployment rate, or (iii) the weekly furlough stock per 100,000 inhabitants. In all three regressions, dP is a dummy, which indicates whether an observation is within the lockdown period (1) or before the lockdown period (0).[5] dT is a dummy, which indicates whether a country is in the treatment group (1 – Denmark) or the control group (0 – Sweden). Finally, δ_1 measures the treatment effect, which is found by taking the difference of the averages pre- and post-treatment for the treatment group and then subtracting the difference of the averages pre- and post-treatment for the control group:

$$\widehat{\delta_1} = (\bar{y}_{2,T} - \bar{y}_{1,T}) - (\bar{y}_{2,C} - \bar{y}_{1,C}) \tag{25}$$

By having a treatment- and control group, it will be possible to infer the difference between the two strategies and their impact on unemployment during the COVID-19 pandemic. As discussed earlier, the initial hypothesis is that employment was more negatively impacted in Denmark due to more severe restrictions. Thus, I expect the treatment effect to be significant and positive. However, the conjecture is contested by the fact that Sweden had less substantial government support, which could ultimately lead to a higher labor market impact than Denmark. If this turns out to be the case, then the treatment effect is instead significant and negative.

The DiD models will be estimated using robust standard errors, thereby protecting against bias due to potential heteroskedasticity in the model. Ideally, cluster-robust standard errors should be used, as these allow for both heteroskedasticity and correlation in the residuals within clusters, but assume that residuals between clusters are uncorrelated (Stock & Watson, 2015). That is, these standard errors deal with the violation of the independent regressors assumption. In this paper, cluster-robust standard errors are not used, as the number of clusters (2) is too small, which would lead to standard errors that are biased towards zero (Rokicki, Cohen, Fink, Salomon & Landrum, 2018; Bertrand, Duflo & Mullainathan, 2004). For this reason, the paper merely relies on unclustered robust standard errors. The consequence of this is discussed in Appendix B. To deal with the concern, it would have been optimal collect data on a regional level, such that the observations would be divided into a larger number of clusters. Therefore, this must serve as another limitation to the paper.

In the next section, the data collection process is presented. The data is used to provide an overview of the labor market situation in each country and to conduct the regressions introduced above.

[5] The lockdown period is defined as any date after March 13th, 2020, as this was the day that 'treatment' started in Denmark.

5.3 Data Collection

The paper defines unemployment as:

"people of working age[6] who are without work, are available for work and have taken specific steps to find work" (OECD Data, 2021a)

To investigate unemployment in Denmark and Sweden, several measures are used for comparison, hereunder the monthly unemployment rate, the weekly unemployment inflow, and the weekly furlough stock. Additionally, the paper uses survey data on vacancy rates to draw up an empirical Beveridge Curve for each nation, as presented in Appendix N. As discussed by Hansen & Sievertsen (2016), there is no apparent connection between the vacancies reported in survey data and those posted on public employment services. This flaw must be kept in mind when analyzing the Beveridge Curve.

5.3.1 Monthly Unemployment Rate

The monthly unemployment rates presented in this paper are based on Eurostat's Labour Force Survey (LFS), as this is the most suitable for international comparisons. Furthermore, this measure considers unemployed people that are not entitled to unemployment benefits (e.g., due to spousal income) and students, unlike alternative measures such as gross unemployment or net unemployment (Danmarks Statistik, n.d.). It is, however, essential to note that the LFS measure is entitled to some statistical uncertainty, as it is a sample-based proximity.

The unemployment rate is measured as a percentage of the total labor force in each country, whereas the labor force is defined as the total number of unemployed plus those in employment. The LFS monthly unemployment rates were collected from OECD Data (2021a) and are seasonally adjusted to account for seasonal trends in the data. It is important to consider that the change in the unemployment rate is not directly conforming to the change in the number of employed individuals. Instead, the unemployment rate is affected by the inflow and outflow from the labor force. Thus, it could be relevant to consider the pension structure and demographics of each country, to determine whether the change in the labor force is comparable over time. As this is out of the scope of this paper, I simply assume a constant labor force participation in both countries.

[6] The Labor Force Survey considers people in the ages 15-74 as being of working age.

5.3.2 Weekly Unemployment Inflow

The paper uses data on weekly unemployment inflow to get a more transparent overview of the unemployment dynamics. The inflow is calculated per 100,000 population (based on Appendix C). The weekly data is used to gain insight and conduct a difference-in-differences (DiD) regression, making the data valid in explaining any potential differences in labor market impact.

Data was collected for 2020 to analyze the pandemic's impact on weekly unemployment inflow in Denmark and Sweden, respectively. Furthermore, pre-COVID-19 data was gathered to understand the trend in each country before the pandemic. For Sweden, weekly unemployment data was collected for 2019, whereas the data for Denmark was based on an average for 2015-2019. While it would have been optimal to have conforming pre-treatment data for the two countries, such was unfortunately not available. Thus, this weakness will impact the empirical analysis results and, therefore, must be kept in mind when drawing conclusions.

A limitation of using weekly unemployment inflow is that this measure cannot explain the direct impact on the unemployment rate, as there is no data available on the weekly unemployment outflow. Hence, a potential increase in the number of matches can equalize an increase in the number of separations, leaving the unemployment rate unchanged, assuming a constant labor force participation. Therefore, the empirical investigation does not rely on the weekly unemployment inflow alone but is held up against the regression on the monthly unemployment rate. Still, it must be seen as a shortcoming that unemployment outflow is not directly drawn on in the analysis.

The weekly data on unemployment inflow for Denmark was collected from Danmarks Statistik, and the data for Sweden was collected from Arbetsförmedlingen. I assured that the two databases have corresponding definitions and measures for the weekly inflow. Thus, in both countries, the weekly unemployment inflow is based on the number of people who have actively registered as unemployed. It is worth noting that this data cannot directly be compared to the LFS unemployment rate, as it is measured differently. One significant difference is that the LFS unemployment rate includes students, whereas these have a low incentive to register as unemployed and are likely not a part of the weekly inflow data. The same goes for workers who have signed a contract but have not yet started working at their new job. Due to these differences, it is seen as a strength that the paper includes both measures in the empirical analysis.

5.3.3 Weekly Furlough Stock

To account for the fact that Denmark and Sweden offer work compensation schemes that allow firms to send workers on furlough, this is adjusted for in the analysis. As the weekly inflow to furlough was not available for Denmark, the paper instead relies on the stock of furlough per 100,000 population. The number of people on furlough is calculated to account for differences in the reduction of working hours (i.e., the furlough stock will be calculated in full-time equivalents), as the Danish furlough system results in a 100% reduction in working hours, whereas the Swedish furlough system allows for a maximum decrease of 60-80%. By doing this, the data will be directly comparable between countries.

As precise data pertaining to the average reduction in working time in Sweden is unretrievable, the paper assumes that the average decrease in working hours was 60%. It is argued that this gives a reasonable indication, as this was the reduction in working hours for more than half the individuals in Sweden, according to correspondence with Tillväxtverket. Still, it is worth noting that this is simply an indication, and that the data is susceptible to the assumption, why reliable results cannot be drawn from this data alone. The results are likely biased upwards, as 60% was the maximum allowed reduction for most of the year, thereby implicating that the other half of the furloughed had their working hours reduced by less than 60%.

The data on furlough was gathered from Erhvervsstyrelsen in Denmark and Tillväxtverket in Sweden. Collecting comparable data for Denmark and Sweden was a long process entailing e-mail correspondence and phone calls, which were essential in retrieving the data, specifically from Sweden. While the data collection turned out to be cumbersome, it is vital that this data be included in the thesis. The reason for this is that people sent on furlough would possibly have been unemployed if government subsidies had not been offered (and kept the job separation rate artificially low). Also, as furlough agreements were provided for the majority of 2020, it remains uncertain how firms and employees will manage the situation after the different compensation schemes are no longer offered.

It is worth noting that a premise for receiving the Swedish furlough data was recognizing the fact that the data quality of this is relatively poor. That is, the numbers are initially estimated numbers and are not precise as the Danish data.

5.3.4 Background data

In addition to the quantitative data collection, data on the countries' government policies and trajectories in the pandemic were also gathered. This collection was based on different articles (through, e.g., Infomedia) and press conferences, which helped provide an overview of each country's situation. The sources all passed a reliability check, and therefore, most of the external sources are from public authorities, respected news media, and well-accepted statistical databases. Moreover, each source was inspected with a critical mindset, and unreliable or questionable sources were excluded.

Concerning theoretical contributions, a networks approach was used to gather highly ranked or current, trustworthy, and relevant research articles. To discover the pertinent literature, databases such as Scopus and Web of Science were used to make informed decisions in relation to data retrieval. The approach entailed a viewing of papers' references and citations, making it possible to systematically gather research articles that were within the same field, and discover research articles which were highly classified. In relation to newer articles, it was deemphasized whether a given paper had a high number of citations, considering that very new papers are less likely to be cited extensively. For this reason, a contents approach was used to gather current research publications on the pandemic's impact. Various analyses from banks (e.g., Nordea) or analyst agencies (e.g., Bisnode, Danmarks Statistik and SCB) were used to retrieve data that is relevant for the paper's discussion on determinants of the unemployment impact. Lastly, OECD Data was used to gather data on the change in GDP throughout 2020, which was essential in modeling the theoretical shock.

5.3.5 Reliability, Validity & Adequacy

As mentioned above, it was highly prioritized that the data and sources used in the paper exhibit high reliability, thereby mitigating problems concerning bias (Carmines & Zeller, 1979). Still, as mentioned previously, several of the datasets are exposed to potential quality issues. This includes the fact that sample-based measures are entitled to statistical uncertainty and that other data (hereunder, the stock of furlough) is still preliminary and not yet definitively confirmed. Since the LFS is based on a representative sample, the reliability of this measure is likely not an issue. In relation to the stock of furlough, there is a potential risk that this measure does not exhibit perfect reliability, as the paper lacks evidence on the assembly of these estimates. Nevertheless, the risk of unreliability was kept in mind throughout the data collection process. Furthermore, any remaining suspicions are discussed above and will be kept in mind throughout the analysis.

Besides, as discussed by Carmines & Zeller (1979), it is essential that the data has a high degree of validity, meaning that the data accurately represents what it is intended to. Therefore, the data collection process filtered out data sources that were less relevant for this exact investigation, thereby relying only on the most recent and valuable data available. Some measures, such as the vacancy rate, might be measured through undependable techniques. Therefore, it is possible that this measure does not exemplify the exact aspect it is intended to. Conclusions will consequently not be drawn from this measure alone. Further, as will be discussed in the analysis, data concerning unemployment duration is outdated, making it invalid in accurately representing the current employment turnover. Therefore, this measure will be disregarded as an imperative source.

Lastly, it is crucial to consider adequacy, as it is problematic to conclude on too little data. In this paper, many different data sources and unemployment measures were drawn on with the aim of gathering enough data to make a deliberate conclusion. Still, a significant weakness of this paper is that it only draws on data from two countries, making it difficult to conclude something definite about unemployment during a pandemic. Therefore, the conclusions in this paper are used to give an indication but cannot be a one-size-fits-all solution to deviate from any potential future unemployment impacts.

Chapter 6

6. Theoretical Analysis

I will now present the theoretical part of the analysis. As mentioned previously, the impact on unemployment in Denmark and Sweden will first be investigated using the DMP model.

6.1 Comparative statics

Before presenting the impulse responses, the effect on unemployment of a shock to the economy will be explained theoretically.

6.1.1 Shock to Productivity

The COVID-19 pandemic can be modeled as a negative shock to productivity, y. When workers' productivity decreases, the firms' incentive to post vacancies shrinks, as hiring an additional worker is no longer as valuable. This effect is seen in Equation (18). As argued by Shimer (2005), a decrease in productivity implicates a fall in workers' wages, which mitigates the effect on vacancies and unemployment in the dynamic model. To mathematically derive the effect of a productivity shock, equations (18) and (15) are differentiated with respect to a, E and productivity. The derivation of the comparative statics is shown in Appendix D. These indicate that a negative productivity shock decreases the incentive to post vacancies, leading to a negative impact on the labor market tightness, θ. This implies a lower job finding rate, a and a lower employment rate, E.

6.1.2 Shock to Job Separations

Alternatively, the COVID-19 pandemic can be simulated as a positive shock to the job separation rate, λ. When the exogenous job separation rate increases, a firm will be less willing to hire a worker, as there is higher uncertainty of a match vanishing. Due to this, firms will post fewer vacancies, which decreases the labor market tightness, θ. A lower labor market tightness results in a decrease in the job finding rate, a, and thereby a decline in employment, E. Like above, the mathematical derivation of the comparative statics is provided in Appendix D. It is relevant to note that while an increase in the job separation rate initially disincentivizes firms to create vacancies, the decrease in vacancies puts a downward pressure on the wage. Furthermore, the increase in unemployment increases the vacancy filling rate. Thus, this will again incentivize vacancy creation, thereby reversing a decrease in the labor market tightness (Shimer, 2005). This effect is, however, only relevant in a dynamic model.

Corresponding to the comparative statics, the COVID-19 pandemic resulted in a decrease in the labor market tightness, θ. This is shown through the Beveridge Curve in Appendix N, where it is evident that the points move towards a combination of higher unemployment and fewer vacancies. Overall, this resembles the theoretical effect of a shock to productivity and job separations.

As the general effects of shocks to productivity, y, and the job separation rate, λ, have been introduced, I will now present impulse response functions that are created based on a steady-state analysis. These will be used to show the theoretical impact of COVID-19 on the unemployment rate in Denmark and Sweden. Thereafter, a dynamic model will be introduced to consider the dynamics of a real-world environment.

6.2 Impulse Response Functions

Impulse response functions constructed based on the DMP model will now be composed. The calibrated parameters are shown in Table 2. As mentioned, the shocks to both productivity and the job separation rate are mirrored in the change in GDP. The change in unemployment is then calculated throughout 2020 based on the steady state equilibrium conditions.

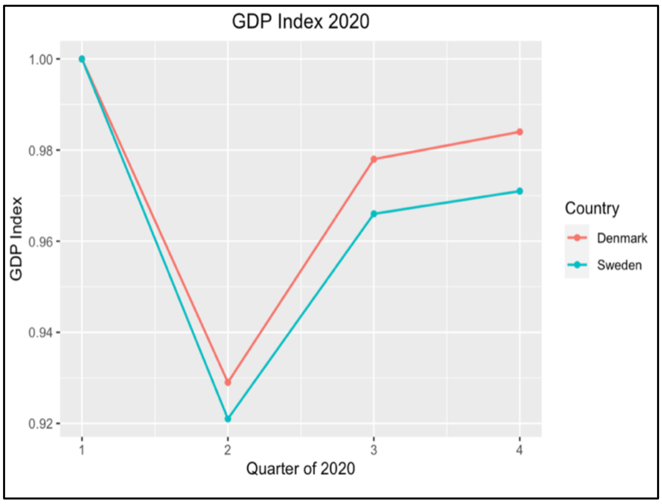


Figure 2: Real GDP Index 2020.
Data retrieved from OECD Data (2021b).

As shown in Figure 2, the economic activity in 2020 decreased dramatically in both Denmark and Sweden. Initially, it seems surprising that the economic activity was impacted more in Sweden than in Denmark, considering that Denmark's government restrictions were more severe. Besides the fact that Sweden experienced a more considerable decline in GDP, the trajectory of the impact in the two countries appears similar.

It is worth noting that the paper uses Q1-2020 as a GDP baseline and thus, the GDP change does not capture the first two weeks of the shock (as the pandemic "began" in mid-March in the Scandinavian countries). This must be seen as a drawback of the simulation. Further, it is worth noting that an assumption that the pandemic instead "began" in January of 2020 (i.e., using Q4-2019 as the baseline value or comparing the GDP year-on-year) would lead to an entirely different implication, such as those presented in Bougroug et al. (2021) and Nielsen (2021). While the GDP in Denmark declined from Q4-2019 to Q1-2020, the GDP in Sweden stayed relatively constant (OECD Data, 2021b). Thus, including this quarter in the analysis makes Sweden appear more successful, as they managed to mitigate the GDP impact altogether in this period.

While there are different opinions on the matter, I argue that using Q1-2020 as a baseline is most accurate. Looking at the impact on consumer spending (Appendix M) and unemployment inflow (Figure 11), it is apparent that the substantial effect in Scandinavia is not observed before March 2020. Furthermore, exports increased in Sweden from Q4-2019 to Q1-2020, whereas the GDP was essentially unchanged (SCB, 2021). These findings make it questionable whether the effects of the pandemic had yet transpired in Scandinavia. For this reason, I argue that it is less reliable to depend on Q4-2019 as the GDP baseline value, as this captures effects between Q4-2019 and Q1-2020, which are likely independent of the pandemic. Conversely, the effects captured after Q1-2020 will undoubtedly be related to the consequences of COVID-19.

Lastly, using Q1-2020 as a baseline corresponds to the paper's empirical investigation, where the treatment date is set to March 13th, as this is the start date of the COVID-19 policies in Denmark. Nevertheless, it is vital to recognize that the results are highly dependent on individual assumptions, why concluding something definite about the labor market impact is challenging.

The impact of the shock to real GDP on unemployment will now be scrutinized.

6.2.1 Shock to Productivity

An impulse response is constructed through a steady-state analysis based on the GDP decline in each country. As shown in Figure 3, the theoretical model suggests a similar labor market impact in Denmark and Sweden. However, in accordance with the higher effect on GDP, the labor market impact in Sweden is larger.

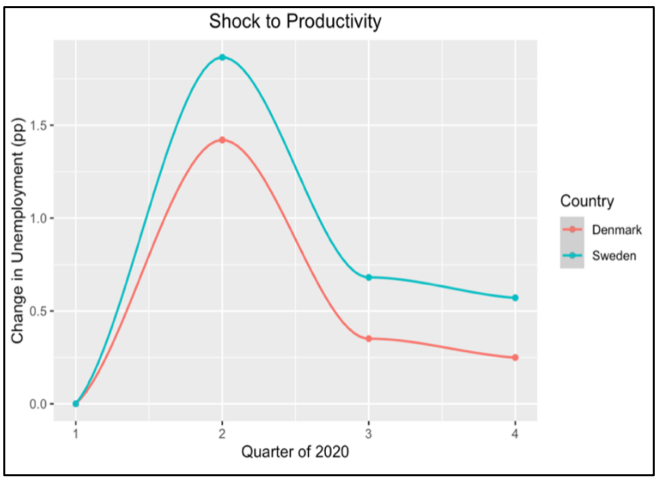


Figure 3: Impulse Response of Shock to Productivity.

As argued above, the difference in impact on unemployment is partly attributed to the difference in the size of the productivity shock. Furthermore, as Sweden has a lower matching productivity, k, this entails that the unemployment outflow is lower than in Denmark. For this reason, a productivity shock has a higher impact on unemployment in Sweden. The fact that Sweden has a lower job separation rate, λ, means that the impact is somewhat alleviated compared to Denmark. However, as the difference in this parameter's calibration is relatively minimal, the matching productivity, k, ultimately has a more significant effect.

The differences in the calibrated values for the matching productivity, k, and job separation rate, λ, are attributed to the fact that Denmark has a higher employee turnover. This makes sense, considering that flexicurity entails easier hiring and firing of workers. As mentioned above, the fact that there are generally more match separations in Denmark does not amplify the shock significantly. Instead, having a low matching productivity and a severe productivity shock results in an impact on the labor market in Sweden that is higher than in Denmark.

As shown in Appendix E, the job finding rates and the vacancy filling rates are higher in Denmark than in Sweden. In the initial steady state, Denmark has an unemployment duration of around four and a half months, whereas Sweden has an unemployment duration of slightly above nine months. Similarly, the model estimates that it takes approximately three months to fill a vacancy in Denmark and six months in Sweden. After the shock to productivity, the job finding rate decreases, and the vacancy filling rate increases in both countries. The precise theoretical effects on each endogenous parameter throughout the shock are shown in Appendix E.

Comparing the model's findings with empirical data, it becomes evident that the two do not correspond. According to Hobijn & Sahin (2007), the average unemployment duration is around ten months in Denmark and four and a half months in Sweden. This would, however, imply that Denmark has a high inflow to unemployment but a low outflow, leading to a high counterfactual unemployment rate. The mismatch can be explained by the fact that the data gathered by Hobijn & Sahin (2007) is from the 1980s and 1990s, where the unemployment rate in Denmark was higher than in Sweden (OECD Data, 2021a). This results in data that is not valid for this investigation. Thus, it is fair to assume that the present unemployment duration is relatively lower in Denmark, as indicated by the DMP model.

Overall, the paper argues that the DMP model can capture the most significant effects on the job finding and vacancy filling rates. It is, however, difficult to validate how precise these measures are compared to empirics, as the available sources are based on outdated records. Therefore, the calibrations' primary aim was to match the empiric steady state unemployment rate and the size of the GDP shock, which likely came at the expense of precise job finding and vacancy filling rates.

6.2.2 Shock to Job Separations

To model the impact as a shock to the exogenous job separation rate, λ, the model is again constructed through a steady-state analysis based on the real GDP change.

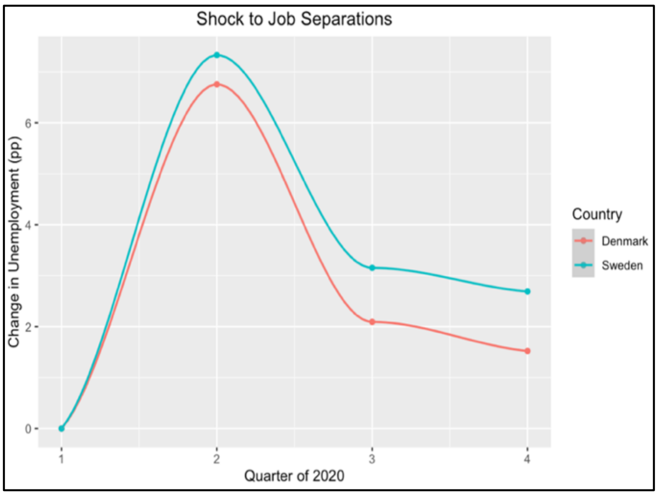


Figure 4: Impulse Response of Shock to Job Separations.

As seen in Figure 4, the shock to the job separation rate results in a much more amplified reaction than the previous impulse response. While the two models agree that the shock has a more significant effect on unemployment in Sweden, this model implies a similar impact at the beginning of the pandemic, after which the difference in impact between the countries is more pronounced.

To explain the difference in the effect on the labor market in the two countries, it is again noted that the shock to Sweden is more prominent, as the GDP decrease was more severe in this country. Therefore, this leads to a higher unemployment impact. As Denmark has a higher separation rate, λ, in the initial steady state, this parameter stays highest in Denmark throughout the shock. However, the impact on Denmark's labor market is less severe, as the willingness to post vacancies is kept high by the matching productivity parameter, k. Furthermore, as y was calibrated to be higher in Sweden, this entails a lower employment rate for a given GDP level. Therefore, this parameter intensifies the shock to unemployment in Sweden.

The model estimates job finding rates and vacancy filling rates similar to those of the previous model. The estimates of all endogenous variables are provided in Appendix E.

6.2.3 Concerns with the Theoretical Model

As the DMP model used as a basis for the impulse response functions is used in its simplest form, several issues can be raised in relation to depicting reality. Therefore, it is likely that the impact on unemployment in the model does not match the empirical data.

First of all, the model assumes an exogenous job separation rate, λ. This means that the split of a match occurs without the decision of the worker or the firm. In the model, this implicates that firms with a higher job separation rate will be more reluctant to post vacancies because having a filled job results in a high uncertainty of a potential match separation. As mentioned previously, the job separation rate, λ, was calibrated to be higher in Denmark to capture the lower employment duration. However, this calibration suggests that firms in Denmark are less willing to post vacancies. In reality, flexicurity entails that both hiring and firing workers is easier, meaning that Danish firms are likely more inclined to post vacancies than in Sweden. Therefore, this is an issue with the simplified version of the DMP model, as it is not able capture this distinction.

Furthermore, in the case of the pandemic, the job separation rate has been influenced by the government in an attempt to keep the job separation rate low. As shown earlier, this was done through wage compensation. Furthermore, the government has offered additional subsidies, which have potentially mitigated firms from going bankrupt, thereby keeping workers from losing their jobs. The fact these interventions are not accounted for in the model might imply that the unemployment rate was impacted differently. For one thing, the GDP proxy is likely not successful in depicting the unemployment impact, as the artificially low job separation rate possibly kept the impact on unemployment down. As there were more substantial subsidies in Denmark, this would imply that a shock to GDP would be less influential in this country. This could likely explain an overestimation in the model of the impact on the labor market.

Another flaw of the model is that the calibration of parameters was kept relatively simple. It could be argued that during the pandemic, the calibrated parameter for unemployment benefits, b, should have been tuned. The reason for this is that many workers were sent on furlough and thereby were given work compensation. Additionally, the unemployment insurance was increased in Sweden during the pandemic, such that the unemployed got a higher rate in the first 100 days of unemployment (Regeringskansliet, 2020). Considering that there is no accurate measure for the number of people receiving this benefit and as the parameter, b, captures many other factors such as leisure, it would not be justified to tune this parameter accurately. Instead, the model is simplified to only tuning the shocks to y and λ.

Lastly, the model used is static, meaning that it does not account for the dynamics of reality. The model assumes that the market immediately reaches a new steady state, which could be problematic in accurately representing empirics. Furthermore, the model assumes a persistent shock, whereas a dynamic model would consider that the shock is temporary. Also, the impulse responses only depict the first four quarters, meaning that there is no way of determining when the countries will be back to the pre-COVID-19 level. Although the model has some weaknesses, it has likely still been successful in explaining the overall impact. To conclude whether this is the case, the results of the impulse responses will be compared with the empiric data.

6.2.4 Comparing with Empirics

The theoretical impact on unemployment will now be compared to empiric data. Looking at empirics, it is concluded that the impulse response function with a productivity shock captures the overall impact on unemployment relatively well. It is, however, concluded that the impulse response function depicts a more immediate shock to unemployment than what is seen in empirics. The model in Figure 3 shows an unemployment increase of around 1.4 percentage points for Denmark and 1.9 percentage points for Sweden between Q1 and Q2. In contrast, this effect was not seen until Q3 in empirics. This is attributed to the fact that the model assumes an economy that immediately reaches a new steady state, whereas, in reality, it will take time for the market to adjust to the change in productivity.

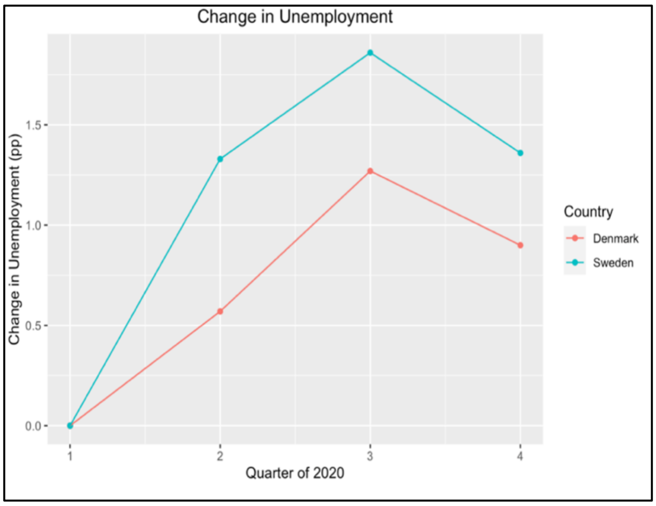


Figure 5: Empiric Impact on Unemployment.
Data retrieved from OECD Data (2021a).

Concerning the model that simulates a shock to the job separation rate, the paper finds that this model overestimates the impact on unemployment. The impulse response suggested an increase of around 6-8 percentage points for each of the two countries (Figure 4), whereas the actual effect is just around 1-2 percentage points at the peak (Figure 5). Thus, it seems that the productivity, y, can explain more of the impact on unemployment than the job separation rate, λ, as this provides more precise estimates. The model in Figure 4 further entails the same problems mentioned above, as the effect is too immediate compared with empirics.

6.2.5 Shock to Productivity & Job Separations

To obtain a DMP model that resembles reality more precisely, this thesis aims to construct a static model with a simultaneous shock to productivity and job separations. As discussed above, it seems that the shock to productivity can explain and capture more of the change than the shock to the job separation rate. Therefore, the new model assumes an immediate shock to productivity and introduces a job separation shock later in the model. This will delay the steady state effect, thereby imitating reality more precisely.

The model assumes that the shock to productivity accounts for half of the shock to GDP and that the shock to the job separation rate accounts for a sixth of the shock. This then entails that the furlough schemes and subsidies absorb the last third of the shock to GDP, thereby not directly impacting the unemployment rate. This assumption is based on the fact that job separations in Denmark were successfully kept low during the pandemic (Bennedsen, Larsen, Schmutte, & Scur, 2020). For Sweden, the shock to job separations instead accounts for one-fifth, thereby accounting for the fact that the subsidies in Sweden likely did not absorb as many job separations as in Denmark. This is based on the finding that bankruptcies in Denmark were kept lower than in Sweden compared to 2019 (Lønstrup, 2020; Bisnode, 2021a; Bisnode, 2021b).

Comparing Figure 5 with Figure 6, the thesis concludes that the model with a shock to both productivity and job separations, where the effect on the latter is delayed, captures the impact on unemployment more precisely than the previous models. For one thing, the effect is now less amplified, as the new model accounts for the fact that the government kept the job separation effect low. Furthermore, the model indicates that the impact does not die out until Q4. Still, the model is a static model, why it still has several of the flaws discussed previously. For one thing, the model underestimates the effect in some of the periods – specifically in Q3 for Denmark and Q4 for Sweden. For this reason, a dynamic model will now be constructed to compare the outputs.

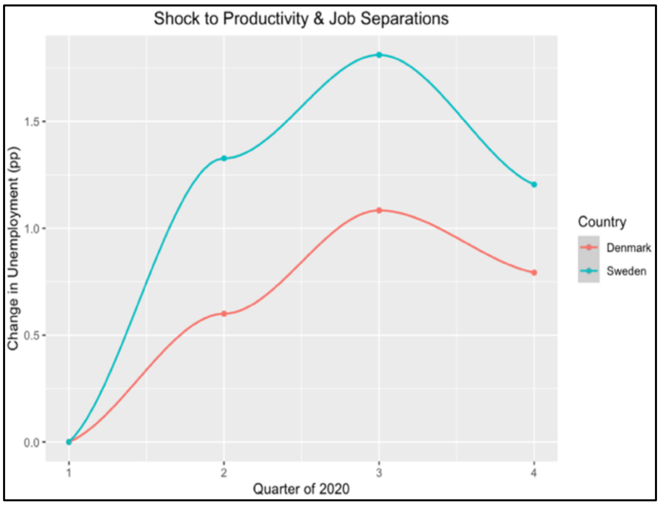


Figure 6: Impulse Response of Shock to Productivity and Job Separations.

6.2.6 Dynamic Model

To account for the weakness that the above models are static, a dynamic impulse response function is created through a linear approximation using Dynare. The model uses identical calibrations as the static models and assumes a shock to productivity. The size of the shock is assumed to be 0.1 standard deviations for both countries, thereby not accounting for the difference in the size of the GDP shock. Further, the model is based on the DMP version in discrete time, which is presented in Appendix F. Oppositely, the models shown above were based on an assumption of continuous time.

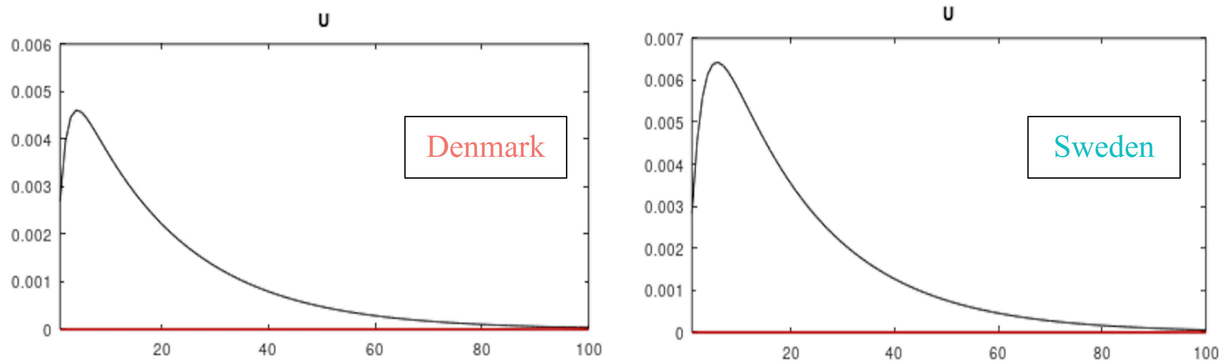


Figure 7: Dynamic Impulse Response Function of Shock to Productivity (Dynare Output).

Overall, the model composed through Dynare leads to the same conclusion as the models coded in Excel, as well as the comparative statics derived in Appendix D. A shock to productivity results in an increase in unemployment, a decrease in the job finding rate, and an increase in the vacancy filling rate. Furthermore, the model agrees that Sweden's unemployment impact is more considerable, even when assuming that the productivity shock was identical in Denmark and Sweden. This confirms that at least a part of the difference in unemployment impact is not due to the shock itself but is also explained by the difference in the parameters, k, and λ, as discussed previously. The Dynare output is shown in Appendix G, where the dynamics of all endogenous parameters are revealed. Similarly, the Dynare code is provided in Appendix H.

As indicated by Shimer (2005), it seems that the shock in the dynamic DMP model is quite condensed compared to the actual unemployment impact. Figure 7 suggests that a 10% decrease in productivity results in an unemployment increase of 0.4 to 0.65 percentage points. In reality, as shown in Figure 5, the impact was about three times as large. Furthermore, the model suggests that the economy will be back to the pre-COVID-19 level in around 22 years, which seems highly unlikely. The estimate by Bernstein et al. (2020) presented earlier is more realistic, also for European countries.

The result can be attributed to the equation added in the Dynare coding (Appendix H, line 38) to explain how y evolves. If the steady state's weight was set to a higher proportion (i.e., a lower shock persistence), then the effect in the model would decline faster. This would, however, result in a trade-off as the effect of the shock would be less severe, meaning that the labor market impact would be even farther from empirical evidence than in the model presented above. An example of this is provided in Appendix I, where the effect dies out much faster and more realistically, but which then compromises an impact on unemployment that is much too small. Overall, the models above are used to compare the two countries, whereas the implications of the size and length of the shock should be recognized as relatively imprecise, due to the high and improbable shock persistence.

I leave the theoretical effect of a dynamic shock to the job separation rate for further research. To compose such a model, a discrete version of the DMP model (Appendix F) should be coded in Dynare, which then composes the appertaining impulse responses. Like concluded by Shimer (2005), the dynamic model with a shock to job separations results in a labor market tightness that is essentially unchanged, meaning that the model does explain not reality very precisely. As shown in Appendix N, the empirical Beveridge Curve presents a labor market tightness that changes as response to the COVID-19 shock, why a theoretical model with no volatility in the labor market tightness would not succeed in explaining the empirical effects.

6.3 Sub-Conclusion on Theoretical Findings

Overall, the theoretical analysis concludes that the unemployment impact during the pandemic was most severe in Sweden. By working with the Diamond-Mortensen-Pissarides model, I have ultimately learned that the difference in unemployment is attributed to three different factors: (i) the shock to GDP was more significant in Sweden, (ii) the subsidies in Sweden did not absorb as much of the shock to unemployment, and (iii) the difference in calibrated parameters (i.e., k) amplified the impact on unemployment in Sweden, as confirmed by the dynamic model. The first two points indicate that Sweden's approach might have been less optimal compared to Denmark. In contrast, the last point suggests that the Sweden's initial position generally magnified the impact on the labor market. It is worth noting that the decrease in GDP cannot fully be accredited to the COVID-19 policies, as the decrease could have been influenced by other factors throughout the pandemic. This effect will be discussed in chapter 8.

Chapter 7

---

7. Empirical Analysis

As the theoretical idea behind the impact of the COVID-19 shock on the labor market has been presented, I will now conduct an empirical analysis to challenge the theoretical indication. By combining different analytical approaches, it will be clear whether the unemployment impact during the pandemic was more severe in one country. Furthermore, as the theoretical and empirical analyses draw on different perspectives and different data sources, it is valuable to incorporate both approaches in the analysis to be able to make a deliberate inference about unemployment during a pandemic recession.

7.1 Empirical Observations

Before presenting the DiD regression results, a general overview will be given to the unemployment in each country to provide a comparison with initial and intuitive justifications.

7.1.1 Unemployment Rate

Prior to the pandemic, the unemployment rate was 4.9% in Denmark and 7.2% in Sweden (OECD Data, 2021a). Before accounting for the pandemic, it was expected that Denmark's unemployment rate would decrease around 0.2 percentage points (European Commission, 2019). In contrast, the unemployment rate in Sweden was expected to increase by 0.2 percentage points (Arbetsförmedlingen, 2019). Once the pandemic hit, these expectations were quickly demolished. By the end of 2020, the unemployment rate in Denmark had increased by 0.9 percentage points to 5.8%, whereas the unemployment rate in Sweden had risen by 1.5 percentage points, thereby ending at a rate of 8.7%. As seen in Figure 8, both countries experienced a more considerable temporary increase in the summer of 2020. Still, they managed to decrease the unemployment level to some extent in the second half of the year.

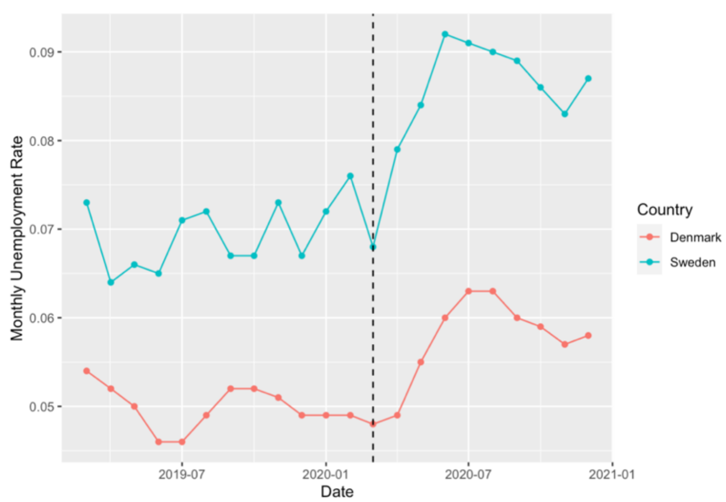


Figure 8: Unemployment Rate Before and During the COVID-19 Pandemic. Data retrieved from OECD Data (2021a).

7.1.2 Weekly Unemployment Inflow

While the change in the unemployment rate throughout the year gives an overall indication of each country's situation, looking at the number of unemployed per 100,000 inhabitants provides a better overview of the splits in matches during the crisis compared to previous years.

Figure 9 shows that Denmark has a prominent peak following the lockdown measures initiated in the spring of 2020 (week 11). However, after around five weeks, the number of new weekly unemployed returns to the same trend as seen in the 2015-2019 average with only minor peaks.

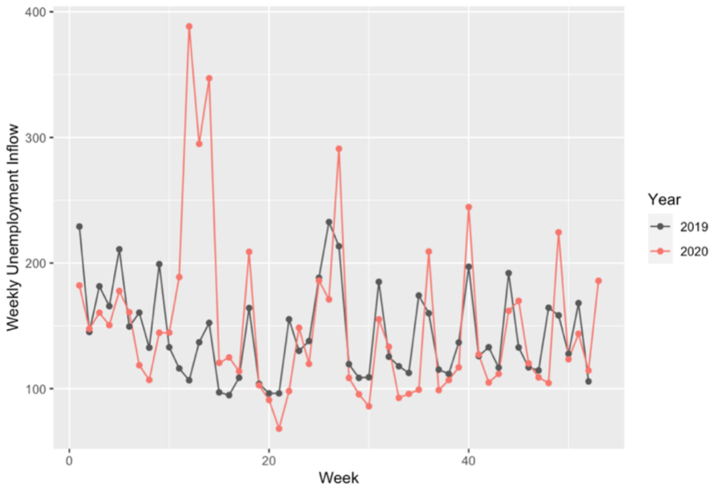


Figure 9: Weekly Unemployment Inflow in Denmark (per 100,000 population). Data retrieved from Danmarks Statistik (2021a).

In Sweden, the peak in the spring of 2020 is much smaller than in Denmark, with around 250 unemployed per 100,000 inhabitants in week 14.

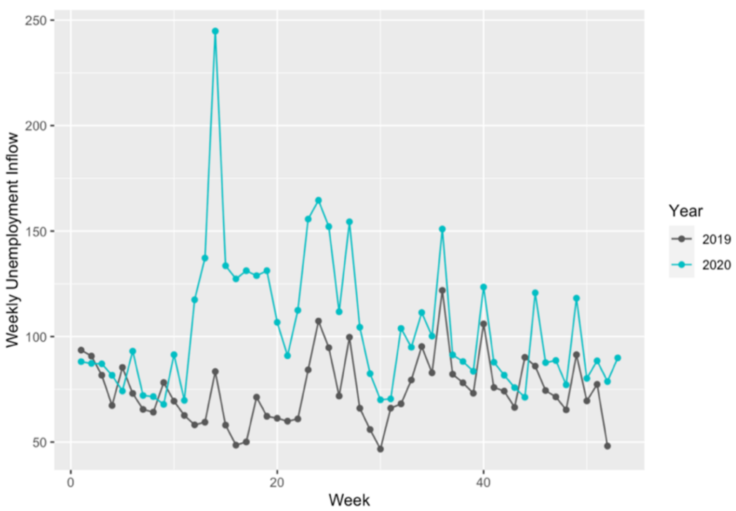


Figure 10: Weekly Unemployment Inflow in Sweden (per 100,000 population). Data retrieved from Arbetsförmedlingen (2021).

Unemployment in Sweden is, however, above the 2019 trend until around week 30. Thus, the number of match separations in Sweden seems to be less severe at the start of the pandemic but takes longer to reach the same weekly level as the previous year.

Overall, the analysis indicates that the weekly unemployment inflow has increased more in Sweden than in Denmark. By taking the average of the weekly unemployment inflow before the pandemic, it is concluded that this average has risen by 8.48% in Denmark. In contrast, the average unemployment inflow in Sweden has increased by 42.72%. It is, however, essential to note that the figures do not account for the number of new matches in the period, why the data cannot be used to deduce the exact impact on the total unemployment level.

It is worth mentioning that the unemployment inflow is generally higher in Denmark, also prior to the pandemic (see Figure 11). Drawing on the theoretical framework, this corresponds to Denmark having a higher job separation rate, λ. As discussed above, Denmark has succeeded in keeping its unemployment rate relatively low despite this inflow. This is attributed to Denmark's relatively high matching productivity, k, which likely stems from the fact that Denmark is effective in activating the unemployed to alleviate high degrees of structural unemployment (Bjørsted, 2015). According to Bjørsted & Olsen (2021), Denmark has succeeded in reemploying a large part of workers (36.4%) who were laid off as a consequence of COVID-19 in Q2-2020.

Figure 11: Weekly Unemployment Inflow in Denmark and Sweden (per 100,000 population). Data retrieved from Danmarks Statistik (2021a) and Arbetsförmedlingen (2021).

7.1.3 Weekly Furlough Stock

Besides the direct impact on unemployment, it is vital to consider the number of furloughed in each country. Figures 12 and 13 conclude that the weekly stock of furlough was highest in Sweden per 100,000 population for the majority of 2020. As mentioned previously, this measure accounts for the fact that workers in Sweden were only sent on part-time furlough, and thus, the number of people on furlough were calculated in full-time equivalents.

The result indicates that the work compensation in Sweden was used more intensively, which could imply that the furlough scheme in Sweden was more successful in saving jobs. However, this could also indicate that the economy in Sweden was hit harder than in Denmark. Thus, if Sweden had not introduced wage compensation, the unemployment impact might have been relatively more severe. As mentioned previously, the introduction of furloughs in both countries can be seen as an attempt by the respective governments to keep matches intact during the pandemic and thereby keep the job separation rate, λ, low. By sending workers on furlough, the match temporarily dissolves but is not permanently destructed, as seen with the unemployment inflow.

In Denmark, the first employees were sent on furlough in week 11 of 2020. Figure 12 indicates that the number of furloughed was kept high until around week 28, whereafter the stock of furloughed decreased to less than half. Looking at the weekly unemployment inflow for comparison, it seems that there is a peak around the same period, which could indicate that part of the outflow from furlough resulted in inflow to unemployment. The other significant decrease in the stock, seen around week 36, also corresponds to a spike in the weekly unemployment inflow in Figure 9.

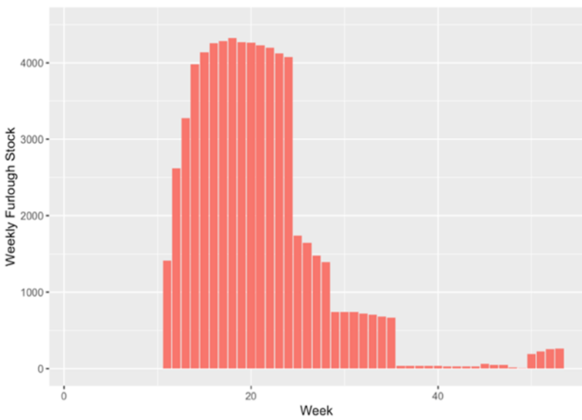


Figure 12: Weekly Stock of Furlough in Denmark (per 100,000 population). Data retrieved from Erhvervsstyrelsen (2021).

For Sweden, the first inflow to furlough was in week 12 of 2020, just a week after the first furloughed in Denmark. Based on the assumption that the average furloughed in Sweden had a reduction in working hours of 60%, the figures conclude that Denmark had a higher proportion of furloughed individuals until around week 25. Thereafter, the number of furloughed individuals in Sweden was higher, as the terms to apply for wage compensation in Denmark changed. Overall, the average number of furloughed is a bit higher in Sweden than in Denmark. As mentioned previously, the data is susceptible to the assumption of the average reduction in working hours in Sweden. As shown in Appendix L, the situation looks quite different when assuming an average working hour reduction in Sweden of, e.g., 35%.

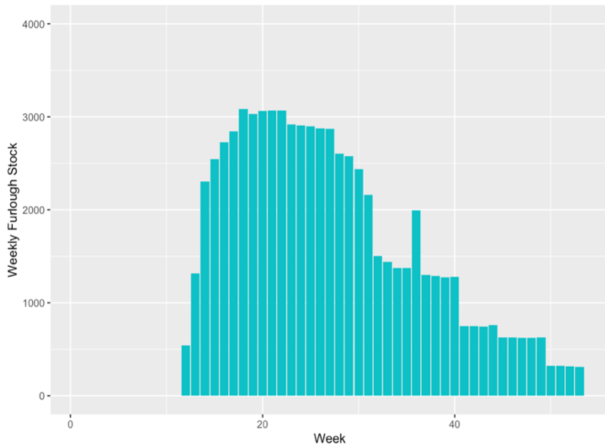


Figure 13: Weekly Stock of Furlough (FTE) in Sweden (per 100,000 population).
Data retrieved from Tillväxtverket (personal correspondence).

7.2 Difference-in-Differences Regressions

To identify whether there is a significant difference in unemployment impact during the pandemic, three simple DiD regressions will be estimated. The three regressions will consider the weekly unemployment inflow, the monthly unemployment rate, and the weekly furlough stock, respectively, to capture different aspects of the labor market. The coding of the DiD regressions is provided in Appendix K.

The descriptive statistics used for inputs in the regression models are shown below. The pre-treatment period in the weekly data ranges from week 11 in 2019 to week 10 in 2020, whereas the post-treatment ranges from week 11 to week 53 in 2020. Correspondingly, the pre-treatment period in the monthly data entails March 2019 to February 2020, whereas the post-treatment period starts in March 2020 and ends in December 2020.

Variable	Denmark	Sweden
Weekly unemployment inflow (per 100,000 population)		
Pre-treatment average	139.51	75.40
Post-treatment average	151.34	109.12
Monthly unemployment rate (in percent)		
Pre-treatment average	4.99%	6.94%
Post-treatment average	5.72%	8.49%
Weekly furlough stock (per 100,000 population)		
Pre-treatment average	0	0
Post-treatment average	1536.88	1675.74

Table 3: Descriptive Statistics of Regression Inputs.

7.2.1 Testing for Parallel Trends

As mentioned in section 5.2, one of the most crucial assumptions for a DiD model is that the treatment and control groups have a parallel trend. That is, if treatment had not taken place, the unemployment would have evolved parallelly in Denmark and Sweden. The assumption can be assessed in several different ways, hereunder graphical interpretation and a t-test. Both of these techniques use the pre-treatment data to evaluate the trend in each country.

To assess the common trend graphically, the unemployment measures are plotted over one year for Denmark and Sweden. A linear trendline is then added to the data points for each country, which presents the trend in unemployment.

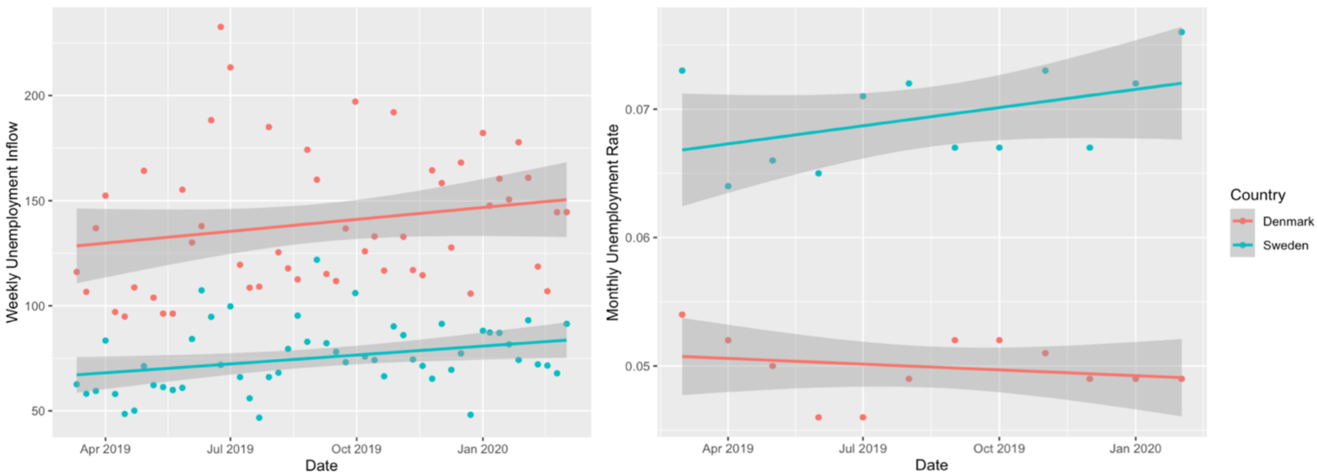


Figure 14: Pre-treatment Trend in Weekly Unemployment Inflow & Monthly Unemployment Rate.

The visual assessment shown in Figure 14 indicates a clear parallel trend between Denmark and Sweden in the weekly unemployment inflow. Oppositely, the figure suggests that the trend in the monthly unemployment rate might be different. Whereas the Swedish unemployment rate has had a positive trend pre-treatment, it seems that the slope for Denmark is slightly negative. However, as the graphical representation makes it difficult to conclude whether the difference in slope is significant, the assumption is further examined through a hypothesis test.

Based on the calculations shown in Appendix J, it is concluded that both the monthly unemployment rate and the weekly unemployment inflow exhibit a parallel trend between the two countries. For the weekly unemployment inflow, the p-value is 0.705, meaning that the null hypothesis that there is no difference between the two slopes cannot be rejected. Thus, the difference between the lines is not statistically significant, and it is fair to assume that the parallel trend requirement is fulfilled. The p-value for the hypothesis test on the monthly unemployment rate is 0.107, and thus, the difference between the slopes is close to being significant at the 10% level. Therefore, there is a higher risk of violating the parallel trends assumption in this model than in the weekly unemployment inflow model.

Concerning the weekly furlough stock, a test for a common trend is not necessary, as neither Denmark nor Sweden offered this type of wage compensation prior to the pandemic. Therefore, it is inevitable that the two would have exhibited a parallel trend of 0.

7.2.2 DiD: Weekly Unemployment Inflow

A DiD regression is conducted for the weekly unemployment inflow. The regression model is presented in the methods section, whereas the results are shown below. Robust standard errors are used to assure that the standard error estimates are unbiased in the case of potential heteroscedasticity.

	Dependent variable:
	Weekly Unemployment
Treatment Effect	-21.889^{*}
	(12.968)
Time Dummy	33.718^{***}
	(5.572)
Country Dummy	64.104^{***}
	(5.010)
Intercept	75.403^{***}
	(2.201)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4: Regression Output – DiD on Weekly Unemployment Inflow.

As shown in Table 4, the model exhibits a treatment effect of -21.889, which is significant at the 10% level. Based on the parallel trends assumption, this infers that if Sweden had imposed the same policies as Denmark, the increase in their weekly unemployment inflow would be diminished by around 22 people in the post-treatment period. Hence, the outcome suggests that Denmark's COVID-19 policies were superior to Sweden's. The country dummy shows the difference in weekly unemployment between the two countries before the treatment. Thus, it is seen that the average weekly unemployment inflow was 64.1 units higher in Denmark than in Sweden pre-treatment. The time dummy shows the difference between pre- and post-treatment for the control group, meaning that the average weekly unemployment inflow in Sweden increased by 33.7 people.

It is important to remember that Denmark's and Sweden's pre-treatment data differ, as conforming data was not available. Due to this drawback of the model, it is concluded that the exact prediction of -21.889 might not be precise. Still, the result suggests that treatment was optimal from a labor market perspective in the medium term. Appendix O shows a counterfactual of the weekly unemployment inflow in Denmark, had the country not selected treatment. Further, it shows the change in weekly unemployment inflow in both countries from pre- to post- treatment.

As mentioned in the literature review, Juranek et al. (2020) find that the impact on unemployment was more severe in Denmark than in Sweden, looking at data up until week 21 of 2020. This corresponds to Figure 11, where the initial peak of weekly unemployment inflow is more extreme in Denmark than in Sweden. However, looking at data for the entire year of 2020, this paper finds that Denmark ultimately outperformed Sweden, as they managed to alleviate the consequence on unemployment overall. Thus, the findings contribute to the current literature by concluding on the effect in the longer term. The result corresponds to the initial observation that Denmark returns to its pre-COVID-19 trend faster than Sweden (see Figure 9) and thereby, mitigates the consequence on unemployment in the longer term.

It is worth noting that the theoretical section did not capture the effect in the very short term, as it deals with quarterly data and thus, cannot capture weekly effects. Furthermore, the theoretical simulation assumes a shock to GDP in Q2, meaning that week 11 and 12 of the shock are not accounted for. For this reason, the insinuation that the very short-term effect was more severe in Denmark is not present in the theoretical simulation. However, considering that this paper aims to conclude the effect of the entire year, it is argued that this is not a significant concern but is, nevertheless, something to keep in mind.

7.2.3 DiD: Monthly Unemployment Rate

The regression output using the monthly unemployment rate is shown in Table 5. This concludes a treatment effect that is negative and significant at the 5% level. The interpretation is that the increase in Sweden's unemployment rate would have been lessened by 0.8 percentage points, if the country had followed the same COVID-19 policies as Denmark. Thus, the results indicate that 'treatment' was more successful in mitigating the labor market impact than no treatment. Like explained above, the country dummy infers the average difference in unemployment between Denmark and Sweden before the pandemic. Similarly, the time dummy shows the difference between pre- and post-treatment for the control group, inferring that the unemployment rate in Sweden increased by 1.5 percentage points on average.

	Dependent variable:
	Monthly Unemployment
Treatment Effect	-0.008^{**}
	(0.003)
Time Dummy	0.015^{***}
	(0.002)
Country Dummy	-0.019^{***}
	(0.001)
Intercept	0.069^{***}
	(0.001)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 5: Regression Output – DiD on Monthly Unemployment Rate.

Appendix O shows the change in the monthly unemployment rate for the treatment- and control groups, and the counterfactual from pre-treatment to post-treatment.

Overall, the results of the regression indicate the same conclusion as the regression on weekly unemployment inflow. The treatment effect is negative, meaning that Denmark's choice of more severe lockdowns and excessive subsidies resulted in a dampened impact on the unemployment rate. This falsifies the initial hypothesis. It does, however, correspond well with the findings of the theoretical section. Furthermore, the suggestion that imposing restrictions impacted the labor market positively corresponds to the findings by Correia et al. (2020). Oppositely, the results differ from the findings by Juranek et al. (2020), Kong & Prinz (2020) and Lin & Meissner (2020), who all concluded that restrictions either caused a negative impact on the labor market or that there was no significant impact of imposing restrictions in the short term. Thus, the findings above are interesting, as these suggest that there are opposing effects of each approach, depending on the time frame considered.

Again, it is relevant to note that attributing the treatment effect to the choice of government policies is highly dependent on the parallel trends assumption. As shown previously, the assumption of a parallel trend in the monthly unemployment rate was diffident. Furthermore, as discussed in the methods section, there is no certainty that Denmark and Sweden would have continued to follow the same trend after treatment, even with identical COVID-19 policies. Consequently, the regression results can only be used to give a weak indication of the treatment effect.

7.2.4 DiD: Weekly Furlough Stock

To conduct a DiD regression on the weekly furlough stock, the paper takes on a similar approach as Juranek et al. (2020). Assuming that each furloughed person accounts for the same in Denmark and Sweden would lead to a bias in the results, as Sweden allows for part-time furloughs. For this reason, the number of furloughed is adjusted to account for the permitted reduction in working hours per employee.

	Dependent variable:
	Weekly Furlough Stock
Treatment Effect	-138.864
	(303.143)
Time Dummy	1,675.740***
	(155.403)
Country Dummy	0.000
	(0.000)
Intercept	0.000
	(0.000)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 6: Regression Output – DiD on Weekly Furlough Stock (60%).

Based on the assumption that an average furlough in Sweden results in a working hour reduction of 60%, it is concluded that the treatment effect is negative and insignificant. Hence, a conclusion cannot be drawn with any certainty. Still, the result weakly suggests that the average number of people on furlough has been lower in Denmark than in Sweden. Nevertheless, the result is highly dependent on the assumption of the average working hour reduction in Sweden. As the assumption possibly overestimates the number of full-time furloughs, this likely results in a treatment effect that is biased downwards.

The interpretation of the treatment effect is twofold. First of all, having many furloughed individuals can implicate that a country was hit harder by the pandemic. Like with the previous regression outputs, this would mean that Denmark was most successful, as the treatment effect is negative, implicating that the average number of people on furlough was lower than in Sweden. It could be argued that the people on furlough would essentially have been unemployed if there was no work compensation. Thus, the interpretation is that the pandemic has hit Sweden harder, as the average full-time equivalent furloughs per 100,000 population is higher than in Denmark.

Oppositely, a high number of furloughed could indicate that the government was more successful in saving jobs, ultimately leading to a lower impact on unemployment. Thus, this could implicate that Denmark was, in fact, not as successful in its wage compensation as conjectured. As mentioned previously, Denmark did not offer wage compensation between August and November, which draws down the average furlough stock. Yet, the weekly furlough stock might not be an ideal measure to conclude on the success of each wage compensation scheme, as it is not able to capture the number of individuals on furlough. Therefore, using the weekly inflow to furlough would have been more optimal, as this would make the results directly comparable with the weekly inflow to unemployment.

A robustness check has been conducted in Appendix L, which makes it evident that the results above are susceptible to the assumption of the reduction in working hours in Sweden. Assuming an average decrease in working hours of the maximum limit (60%-80%) and 35%, respectively, the paper concludes that the treatment effect can be either insignificant and negative or significant and positive. Thus, it is worth noting that this part of the analysis is sensitive to an assumption behind the calculation of full-time equivalents, why no robust results can be drawn from this regression. For this reason, the regression on the weekly stock of furlough should be held up against the two previous regressions to conclude something definite.

7.3 Sub-Conclusion on Empirical Findings

Overall, the empirical analysis concludes that the unemployment impact was more notable in Sweden than in Denmark during 2020. Through DiD regressions on the weekly unemployment inflow and the monthly unemployment rate, I found treatment effects that were significant and negative. This indicates that Denmark's 'treatment' was most optimal, thereby suggesting that an approach with severe restrictions and subsidies was ideal from a labor market perspective. The empirical findings resemble the theoretical conclusion well, as both agree that the shock to the Swedish labor market was most critical.

Although a naïve approach to the empirical analysis concludes that Denmark's approach to the pandemic was optimal, the paper argues that the assumption of a parallel trend cannot be fully confirmed, as there is no certainty about the counterfactual change in unemployment after the shock. This implicates that the treatment effect might not successfully isolate the impact of the COVID-19 policies. Consequently, the empirical analysis simply concludes that unemployment during 2020 was impacted significantly more in Sweden than in Denmark, whereas the theoretical analysis and the discussion below will determine which factors the variation (and thereby, the 'treatment' effect) can be attributed to. The theoretical analysis indicated that the initial differences between Denmark and Sweden, hereunder the matching productivity, k, and the job separation rate, λ, could be partly responsible for the difference in unemployment impact. Furthermore, the paper argues that the difference in the GDP shock (seen in the theoretical analysis) might implicate features that are both dependent and independent of the COVID-19 policies imposed domestically.

Chapter 8

8. Discussion

The analysis concluded that the COVID-19 pandemic impacted the labor market in both Denmark and Sweden quite severely. Ultimately, the paper found that Denmark was able to keep the impact of the pandemic to unemployment lower than Sweden. This was seen in the theoretical investigation, where the shock to productivity and job separations was more severe in Sweden, thereby leading to a higher labor market impact. Further, the empirical DiD regressions concluded that the treatment effect was significant and negative, indicating that the 'treatment' imposed by the Danish government was optimal from a labor market perspective. This goes against the initial hypothesis that a lockdown would result in a more considerable shock to the economy and a higher negative impact on the labor market.

Still, as discussed previously, it remains unknown whether the labor market impact in each country was already destined, irrespective of the policies implemented domestically. This section aims to discuss the extent to which the difference in labor market impact can be attributed to COVID-19 policies, thereby discovering other possible drivers of the difference. Overall, there are two primary components in the investigation. One is to figure out which factors have implicated the larger shock to GDP in Sweden. The second is to examine which other features, hereunder subsidies and fundamental country differences, have mitigated the impact of the GDP shock on unemployment. While there are countless probable determinants of the labor market impact, I aim to discuss those that I find most significant and relevant in potentially explicating the discrepancy in the unemployment impact throughout 2020.

8.1 Determinants of Labor Market Impact

8.1.1 Restrictions

As mentioned throughout this paper, one of the significant differences between Denmark and Sweden during the pandemic has been government restrictions. These were presented in section 3.1, where the paper concluded that Denmark imposed severe restrictions, whereas the restrictions on economic activity in Sweden were limited. For this reason, a hypothesis was drawn up, which alleged that the labor market impact would be higher in Denmark.

Intuitively, it makes sense that when society is shut down, and people have fewer places to spend money, economic activity recedes. Still, as seen in the theoretical section, the GDP in Sweden was reduced more than in Denmark, despite Sweden having fewer restrictions and no closings of restaurants and stores. Concluding from both the theoretical and the empirical analysis, this also meant that Sweden's unemployment increased more than Denmark's. The question remains whether this gives rise to the conclusion that imposing restrictions proved to be an optimal approach or whether the effect on GDP is attributed to other factors.

Drawing on Andersen et al. (2020), it is concluded that the initial impact on spending was quite similar in Denmark and Sweden, thus implicating that the decline in spending was mainly due to the virus itself and was, to some extent, independent of government restrictions. According to Dhaval Joshi, an investment strategist at BCA Research, a similar decrease in consumption can be attributed to the fact that "in a pandemic, most people will change their behavior to avoid catching the virus. The cautious behavior is voluntary, irrespective of whether there is no lockdown, as in Sweden, or there is a lockdown, as in Denmark" (Goldstein, 2020). Cekov, Pedersen, Isaksson & Koivu (2020) agree with Andersen et al. (2020) on the effect on consumption in the short term. However, they further conclude that spending in Denmark increased more rapidly than in Sweden, thereby suggesting that severe restrictions could "have led to a quicker normalization of consumer behavior" in the longer term (Cekov et al., 2020). The indication that countries with more stringent restrictions can recover faster resembles the findings of the effect of the 1918 Flu presented earlier (Correia et al., 2020).

Consumer spending for both countries throughout 2020 is presented in Figure 15. A more detailed graph is provided in Appendix M.

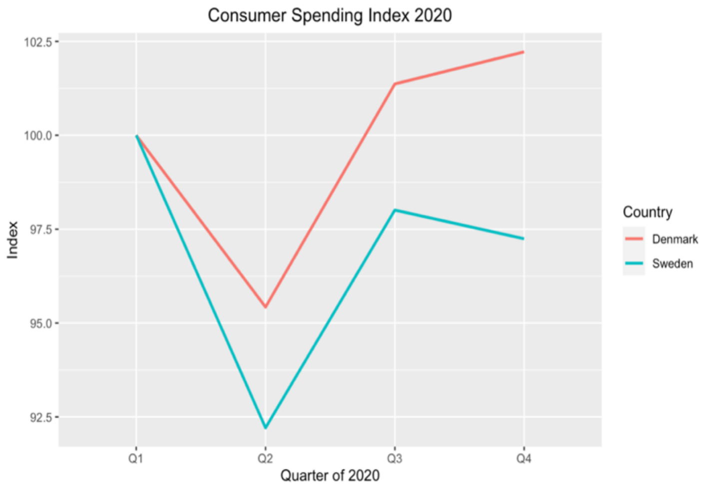


Figure 15: Consumer Spending in 2020.
Data retrieved from Danmarks Statistik (2021b) and SCB (2021).

While it may seem counterintuitive, the data indicates that Denmark's COVID-19 policies have resulted in a dampened negative impact on consumer spending. Consumption in Denmark was likely kept high during the periods of the year where the restrictive measures were eased. Oppositely, spending in Sweden was kept low throughout most of the year, as consumers followed the restrictions to the point and might not have felt safe to go out, even if allowed by law (Larsen, 2020). Thus, it seems that government control in Denmark has made consumers trust that economic activity was safe to the extent of the policies.

Additionally, as Bie (2020) argues, Sweden has not experienced the positive effect of a reopening. In theory, following the strategy that Sweden opted for results in a reduced impact on the economy, as the fluctuations are kept to a minimal, compared to that of a nation opting for a lockdown (Bie, 2020).

However, as discussed throughout this paper, this seems not to be the case in reality. Oppositely, as Danish consumers have been restricted in their economic activity in parts of 2020, they might have a larger urge to spend and consume, once the domestic restrictions are eased.

According to Google Community Mobility Reports (2021), the lockdown measures in Denmark have been successful in constraining the movement of individuals throughout the periods of year, where the strictest measures were imposed. However, based on Figure 16, it is seen that for the majority of the year, the mobility in retail and recreation was actually lower in Sweden. This could indicate that the arguments above are valid, as it appears that when the policies allow for it, Danes go out and spend their money more diligently than in Sweden. The retail and recreation sector comprises restaurants, cafés, shopping centers, theme parks etc. The baseline value is based on an average from January 3rd to February 6th, 2020 (Google Community Mobility Reports, 2021).

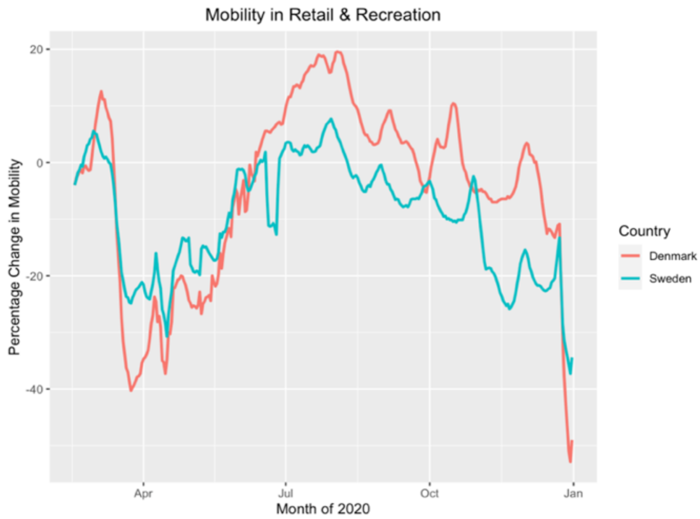


Figure 16: Change in Mobility in Retail & Recreation throughout 2020.
Data retrieved from Google Community Mobility Reports (2021).

As the proportion of consumers that have pursued internet shopping is very similar in Denmark and Sweden (PwC, 2020), the paper argues that this is not critical in explaining the difference in consumption patterns throughout the year.

Overall, the paper concludes that a severe decline in consumption during the pandemic was inevitable. Nevertheless, empirics show that spending in Denmark recovered faster and thereby, returned to normality sooner than in Sweden. Thus, this can partly explain the dampened shock to the Danish economy, implicating that the negative 'treatment' effect found in the DiD regressions can, at least partially, be attributed to the choice of severe policy measures. Hence, if Sweden had chosen to follow the same law enforcement as Denmark, it is likely that the shock to the labor market would be softened. Nevertheless, it is worth noting that this is simply an indication rather than a definite conclusion. Furthermore, it remains vital to discuss whether the difference in impact is entirely attributed to the difference in restrictions or whether other factors are similarly critical.

Besides its impact on consumer spending, restrictions have likely also impacted investments in each country. As shown in Figure 17, investments decreased more in Denmark than in Sweden during 2020 (Danmarks Statistik, 2021b; SCB, 2021). Thus, investments cannot explain why the GDP impact was higher in Sweden. The larger decrease in Denmark could potentially be attributed to the fact that Danish firms have experienced higher uncertainty in relation to the change in restrictions throughout the year and thus, have been more reluctant to invest. Nevertheless, it seems that the reopening effect in the fall of 2020 has positively impacted investments in the country. The way in which the respective governments incentivize firms to invest will be of vital importance in the coming years.

Figure 17: Investments in 2020.
Data retrieved from Danmarks Statistik (2021b) and SCB (2021).

8.1.2 Subsidies

While keeping spending high can help alleviate a decrease in GDP and thereby keep the shock to unemployment down, it is vital to investigate how the government has supported businesses from going bankrupt and, further, kept the job separation rate down through wage compensation. While this element is not captured directly in the GDP shock, it is an essential driver in easing unemployment during the pandemic.

As mentioned throughout the paper, Denmark and Sweden have offered wage compensation for most of 2020, which has generally resulted in an alleviation of the shock to unemployment. Denmark did not offer wage compensation between August and November, thereby resulting in an average stock of furlough lower than in Sweden. The additional subsidies in Denmark have, however, generally led to fewer bankruptcies than in Sweden, based on a comparison between 2019 and 2020 (Lønstrup, 2020; Bisnode, 2021a; Bisnode, 2021b). Correspondingly, the theoretical section suggested that the shock to Denmark seemed to be mitigated marginally more by subsidies than in Sweden. As this paper only comprises 2020, it remains uncertain if Denmark has been successful in alleviating insolvencies altogether or whether the effect will follow a termination of government subsidies.

Another important distinction between the subsidies in Denmark and Sweden is that workers must receive their full wage while on furlough in Denmark. Oppositely, the Swedish scheme encourages a decrease in worker salaries, which likely affected consumer spending for employees affected by wage cuts (Larsen, 2020). Hence, even though it seems that the Swedish furlough scheme, on average, has saved more jobs, it is likely that this had an amplifying effect on the decrease in spending. Therefore, the fact that spending does not normalize as quickly in Sweden as in Denmark is not necessarily due to differences in restrictions. Conversely, it could partly be because Swedish workers have less money to spend due to wage cuts for workers on furlough.

There are, however, other aspects of the Swedish furlough scheme, which seem optimal. First, the opportunity to decrease worker wages in Sweden might have resulted in a higher incentive for firms to keep workers employed, as a decrease in wages theoretically captivates some of the shock to unemployment. Thus, the indication that Swedish wages might have been less rigid means that the labor market impact could potentially have been softened in Sweden. Furthermore, as the Swedish furlough scheme allowed for part-time furloughs, this avoided complications in relation to firms pursuing an extended reduction in economic activity due to an obligation to send workers on full-time furlough or a requirement of furloughing at least 30% or 50 workers, as implicated by the Danish wage compensation. While Denmark still managed to keep the GDP shock lower than Sweden, this implication suggests that Denmark's approach might still have been suboptimal to some extent.

As mentioned previously, it is difficult to deduce the exact repercussion of the subsidies provided by Denmark and Sweden, respectively. Ultimately, the paper argues that the subsidies in Denmark have succeeded in alleviating the shock to unemployment marginally more than in Sweden, as these have mitigated the number of insolvencies in 2020. Therefore, this could partly explain why the unemployment impact in Sweden is larger. Nevertheless, as indicated by the DiD regression, it is likely that the difference in furlough between the two countries is insignificant and further, the aftermath of each compensation strategy is yet to be discovered.

8.1.3 Expansionary Fiscal Policy

Another difference between Denmark and Sweden during the pandemic comprises the use of expansionary fiscal policy. As established previously in the paper, both Denmark and Sweden have low government debt, which gives sufficient space for fiscal stimulus. Still, it seems that Denmark has used expansionary fiscal policy more considerably than Sweden, based on the fact that Denmark is the only Scandinavian country that has provided stimulus payments to support demand and keep economic activity high (Nielsen, 2021).

Denmark used different applications of expansionary fiscal policy in an attempt to stimulate the economy. One initiative offered DKK 1,000 to recipients of transfer income, e.g., people receiving unemployment benefits (Beskæftigelsesministeriet, 2020). According to Baker, Farrokhnia, Meyer, Pagel &Yannelis (2020), stimulus payments during the pandemic have been particularly successful in increasing consumption when these were provided to households of low income. Additionally, the Danish government paid out part of the frozen holiday pay accounting for 2.6% of GDP (Cekov et al., 2020), giving consumers additional cash to spend. According to Danmarks Statistik, the pay-out increased retail spending by around 8.2% (Danmarks Statistik, 2020). Therefore, this initiative might also explain why spending seemed to normalize faster in Denmark than in Sweden, thereby weakening the insinuation that the difference was merely due to restrictions.

Other parts of the expansionary fiscal policy in Denmark pertain to an increase in government spending in Q4-2020 (Danmarks Statistik, 2021b). Conversely, the government spending in Sweden was relatively unchanged throughout the year (SCB, 2021). Thus, the difference in GDP impact can further be attributed to the differences in government spending as an element of Denmark's expansionary fiscal policy. This suggests that the 'treatment' by the Danish government does not apprehend only restrictions and subsidies but is further attributed to the governments' use of fiscal policies. The government spending index throughout 2020 is shown in Figure 18.

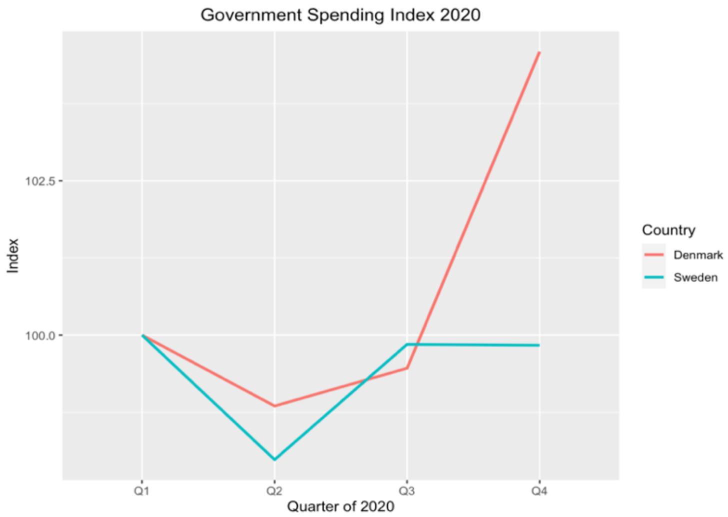


Figure 18: Government Spending in 2020.
Data retrieved from Danmarks Statistik (2021b) and SCB (2021).

8.1.4 Expansionary Monetary Policy

In relation to the use of monetary policy, it is argued that this is not a significant driver of the difference, as both countries have had a stable interest rate throughout the pandemic. Theoretically, Sweden has more options for independently using an expansionary monetary policy, as the country has a floating exchange rate. Still, both countries sustained an unchanged official bank rate of 0 throughout 2020 (Danmarks Nationalbank, 2021; Sveriges Riksbank, 2021), why the use of monetary policy is disregarded as a driver of the difference in impact to both the GDP and the labor market.

8.1.5 Industry Composition

This section aims to discuss whether there are substantial differences in each country's primary industries to deliberate whether this could be an essential factor in explaining the difference in labor market impact.

During the pandemic, the industries with the highest negative impact have been hotels, restaurants, and transportation (Damm, 2021). Thus, if a country has more labor employed in these sectors, it makes sense that unemployment in this country would also be more severely impacted. To test this assertion, Danish municipal data is used to decide if there is a linear relationship between the percentage of employed in sensitive sectors and the percentage of employed sent on furlough. As shown in Appendix P, the two exhibit a positive relationship. This suggests that a country's dependency on vulnerable sectors impacts the degree to which unemployment was affected during the pandemic. While this finding seems intuitive, it contradicts the findings by Karabarbounis, Laski, Lee & Trachter (2020). They conclude that there is no relation between unemployment and the share of employment in highly affected industries in US states.

According to Doerr & Gambacorta (2020), Denmark and Sweden have comparable employment in vulnerable sectors and a similar proportion of small firms. Thus, Doerr & Gambacorta (2020) conclude that Denmark and Sweden both have a low employment risk index. A similar conclusion is made when considering the value added in sensitive sectors. The value added from retail trade, hotels & restaurants, and air transport account for around 5.3% of value added in Denmark and 5.4% of value added in Sweden. Similarly, the percentage of the labor force employed in these sectors is alike (OECD Stats, 2010), thus presenting very similar labor market exposures. Overall, this offers the same indication as Doerr & Gambacorta (2020), i.e., one country being more vulnerable than the other in terms of the domestic shock to specific sectors cannot explain the difference in the unemployment impact.

8.1.6 Exports and Imports

The impact of COVID-19 abroad is another critical factor for the economy in both Denmark and Sweden since both countries are open economies, which are highly dependent on exporting goods. Thus, when world trade decreases significantly, this ends up having a significant influence on the economy in each country (Lønstrup & Lindholdt, 2020). Generally, the GDP in Denmark is more dependent on exports (58%) than in Sweden (48%) (OECD Data, 2021c). However, investigating each country's exports through an industry-specific perspective suggests that the exports in Sweden might have been more vulnerable than those in Denmark. This could help explain why the GDP shock was more considerable in Sweden, leading to a higher impact on the labor market. Helge Pedersen, a chief economist at Nordea, argues that Sweden is ultimately more exposed to international fluctuations, as its exports are highly dependent on industries that are more sensitive to the pandemic. This includes capital goods, cars, and investment goods in mining and forestry (Lønstrup & Lindholdt, 2020).

Further, it is relevant to discuss that Sweden has a floating exchange rate. This entails that a depreciation of SEK can lead to better competitiveness, as a weak currency theoretically increases the demand for Swedish products. According to Madsen (2011), the floating exchange rate helped Sweden during the financial crisis. Oppositely, COVID-19 has resulted in an appreciation of SEK against both EUR, USD and GBP. The strengthening of the currency is shown in Appendix Q. The implication suggests that a larger negative impact on Swedish exports could partly be attributed to the difference in the countries' exchange rate regimes, as the fluctuations in SEK can have hurt the demand for Swedish exports

Nevertheless, DKK also revalued vis-à-vis USD during 2020 (see Appendix Q), implicating that the only apparent difference is the Swedish appreciation against the EUR and potentially, the differences in the strengthening of the currencies against the GBP. Additionally, the devaluation of DKK against NOK could further implicate a mitigation of the impact on Danish exports, as Danish products became relatively cheaper for the Norwegian market.

As seen in Figure 18, the impact on exports was more severe in Sweden than in Denmark. Thus, these findings correspond well with the discussion above.

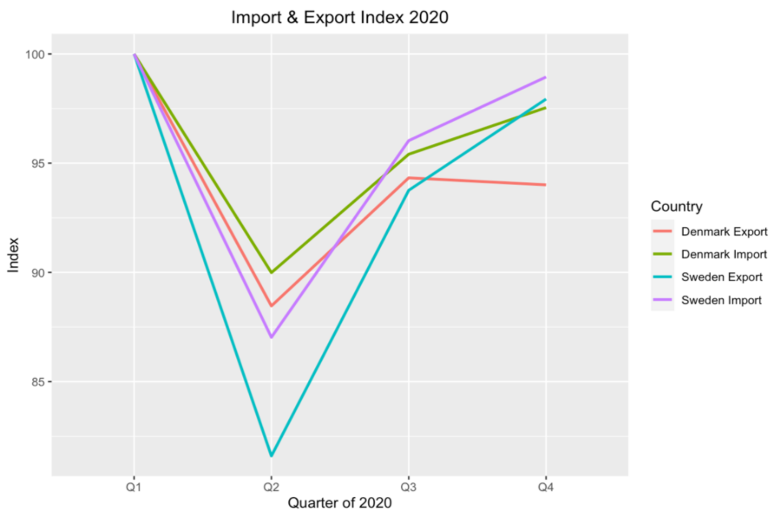


Figure 19: Decline in Imports and Exports (2020).
Data retrieved from Danmarks Statistik (2021b) and SCB (2021).

Overall, exports decreased more than imports in both countries, meaning that net exports were reduced. Due to the considerable decrease in Swedish exports in Q2, it is found that Sweden ultimately experienced the largest negative impact to net exports (Danmarks Statistik, 2021b; SCB, 2021). Therefore, this component of GDP can also be an essential variable in explaining the more considerable impact to the Swedish labor market.

8.1.7 Fundamental Differences

As explained in the theoretical analysis, the difference in calibrated parameters comprises the matching productivity, k, and the job separation rate, λ. Both of these parameters are higher in

Denmark than in Sweden, thus accounting for the fact that Denmark has a higher employment turnover. While the two parameters have opposing effects in the model, the paper ultimately found that the matching productivity offsets the effect of the job separation rate. This results in a dampened impact on the labor market during a shock, as the unemployment duration in Denmark is lower. As shown through the dynamic model in section 6.2.6, the fundamental differences between Denmark and Sweden led to a higher labor market impact in Sweden, even with the assumption of an identical shock to productivity. Therefore, a part of the unemployment impact during the pandemic must be attributed to the labor market's initial state, further suggesting that the 'treatment' effect is affected by factors that are independent of the COVID-19 policies.

As Larsen (2020) argues, there are likely cultural differences between the countries that could further explain the difference in impact. However, as the paper assumes that Denmark and Sweden are largely similar, it is out of the scope to analyze the countries' cultural differences. Still, it must be recognized that this is a potential driver of the difference in labor market impact, as cultural differences might partly explain disparities in consumer spending. Further, it could be relevant to discover the magnifying effects on consumption of an increase in unemployment, as well as potential disparities in consumer confidence throughout 2020. This could implicate that there are differences in consumers' motivation to spend and save, respectively, which could possibly further elucidate the faster normalization of spending in Denmark. Nevertheless, I leave the examination of further determinants of the unemployment discrepancy for future research.

Overall, the paper suggests that the negative treatment effect found in the DiD regressions can, at least partially, be attributed to the choice of COVID-19 policies. Hence, if Sweden had imposed the same COVID-19 policies as Denmark, it is likely that the negative labor market impact would be softened. Nevertheless, the paper argues that several other aspects, hereunder the use of expansionary fiscal policy, the dependency on exports, and the fundamental differences in the labor markets, are partly responsible for the divergence in unemployment impact. This suggests a violation of the parallel trends assumption, as Denmark would likely have experienced a lighter unemployment impact, irrespective of the domestic COVID-19 policies. Therefore, the paper argues that the coefficients in the DiD regressions are biased, as the time fixed effect is not representative of Denmark's counterfactual unemployment impact (i.e., the model comprises endogeneity). This implies that the treatment effect is biased downwards.

Despite of this, the paper argues that the effect of the COVID-19 policies can partly explain the discrepancy in the labor market impact throughout 2020, thereby suggesting that Denmark's approach to the pandemic was more successful than Sweden's in the medium term.

8.2 Further Research

This paper comprises 2020, why the pandemic's long-term effect is out of scope. Thus, it remains unknown how a termination of the government support will affect the labor markets and the respective GDPs in the years to come. While the discussion above indicated that Denmark has succeeded in keeping unemployment relatively low, partly due to a low number of bankruptcies compared to Sweden, it is uncertain whether this effect on the Danish labor market is simply pushed back to 2021 or later. Further, it remains uncertain how spending in Denmark and Sweden will evolve going forward. Data for 2021 can help infer whether the normalization of spending in Denmark was a reopening effect or whether the situation looks entirely different once the positive effect of the government's fiscal stimulus ceases. Thus, while this paper contributes to the existing literature by concluding the medium-term effect, further research is necessary to conclude on the overall success of each country's labor market during the pandemic.

Additionally, it is relevant to note that through a global scope, the impact to the Danish and Swedish economy has been very alike (OECD Data, 2021b). Thus, in the bigger picture, decisions concerning domestic restrictions and subsidies may not be paramount in explaining the effect of a pandemic to the labor market. Research on the effect in more countries is necessary to conclude on the extent to which government policies are significant drivers of the labor market impact during a pandemic. Furthermore, it is relevant to mention that the paper's indication that Denmark's COVID-19 policies were more successful than Sweden's does not imply that Denmark's approach was optimal. As previously discussed, there are pros and cons of each approach, and it is difficult to conclude which components of each strategy has been the main determination of the outcome.

Lastly, the results in this paper are highly dependent on assumptions, specifically in relation to the GDP baseline period. Therefore, the results merely provide an indication of the labor market impact based on my assumptions but should not be comprehended as a definite and solid conclusion of the aspect. Further, a delimitation of the paper comprises the effect of the COVID-19 policies on government debt. This aspect offers an important viewpoint, as one could conjecture whether

Denmark's strategy resulted in a more significant negative impact on the public finances compared to Sweden or vice versa. Investigating the consequences of each approach on the public finances could be a natural next step in this line of research, as this provides a different perspective in considering the fiscal consequences and limitations of the COVID-19 policies.

Chapter 9

9. Conclusion

The COVID-19 pandemic had a significant impact on the labor markets in Denmark and Sweden. Through a theoretical and empirical investigation, this paper concludes that the unemployment increase in Sweden was more substantial than in Denmark. During 2020, the unemployment rate in Sweden increased by 1.5 percentage points, whereas the unemployment rate in Denmark increased by 0.9 percentage points. The finding falsifies the initial hypothesis that the labor market impact would be more severe in Denmark due to their implementation of stricter COVID-19 policies. Further, the finding contributes to existing research by concluding on the labor market impact over an extended period, thereby contradicting the preceding results on the impact the very short term.

Based on the Diamond-Mortensen-Pissarides model, the paper formed impulse responses through a steady-state analysis. These indicated that the more considerable impact on the Swedish labor market could be attributed to a larger shock to productivity and job separations. However, through a dynamic version of the model, where the shock to productivity was assumed identical between the two countries, the paper found that the impact on unemployment in Sweden was still larger than in Denmark. This inferred that the higher unemployment impact in Sweden was partly anticipated, as the Danish labor market has a higher matching productivity, resulting in lower unemployment duration.

Through an empirical investigation, the paper concludes that Denmark's labor market impact was significantly lower than Sweden's, thereby confirming the theoretical inference. This was found through difference-in-differences regressions, which induced a treatment effect that was significant and negative. While this could suggest that the policies implemented by Denmark were most optimal from a labor market perspective, the paper argues that although Denmark and Sweden exhibited a common trend pre-COVID-19, there are likely differences between the countries that could have inferred a different labor market impact during the pandemic, irrespective of the imposed COVID-19 policies.

Through a discussion of potential drivers of the difference, the paper infers that the difference in labor market impact ultimately can be attributed to (i) the restrictive measures in Denmark resulted in a quicker normalization of consumer spending, (ii) the subsidies in Denmark had a larger effect in saving jobs, partly through fewer insolvencies, (iii) Denmark used more direct measures of an expansionary fiscal policy, (iv) Sweden's exports are more dependent on international fluctuations and (v) Denmark's labor market generally implies a higher matching productivity, resulting in a higher willingness to post vacancies and a lower unemployment duration. These factors can implicate the higher shock to Sweden in the theoretical simulation and justify the magnitude of the treatment effect in the empirical analysis.

Overall, the thesis concludes that an approach entailing more severe restrictions and more extensive subsidies can potentially mitigate the pandemic's impact on the labor market. However, the difference in labor market impact between Denmark and Sweden can further be attributed to additional elements. Moreover, the results are not externally valid, as the inference is merely based on data from two countries and only encompasses 2020. Therefore, further research is needed to conclude on the overall impact on the labor market of government interventions during a pandemic.

References

Andersen, A., Hansen, E., Johannesen, N., & Sheridan, N. (2020). Pandemic, shutdown and consumer spending: Lessons from Scandinacian policy responses to COVID-19. *arXiv: General Economics*.

Arbetsförmedlingen. (2019). *Arbetsförmedlingens arbetsmarknadsprognos 2019-2021.* Retrieved from: https://arbetsformedlingen.se/statistik/analyser-och-prognoser/arbetsmarknadsprognoser/riket/arbetsmarknadsprognos-2019-2021

Arbetsförmedlingen. (2021). *Veckostatistik om arbetssökande och lediga platser.* Retrieved from: https://arbetsformedlingen.se/statistik/sok-statistik

Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., & Yannelis, C. (2020). Income, Liquidity, and the Consumption Response to the 2020 Economic Stimulus. *Becker Friedman Institute*. doi: 10.2139/ssrn.3587894.

BDO Danmark. (2021, January 17). *Hjælpepakker og frister*. Retrieved January 25, 2021, from: https://www.bdo.dk/da-dk/kampagner/covid-19/hjaelpepakker/frister

Bernstein, J., Richter, A. W., & Throckmorton, N. A. (2020). COVID-19: A View from the Labor Market. *Federal Reserve Bank of Dallas*, doi: 10.24149/wp2010.

Bertrand, M., Duflo, E., & Mullainathan, S. (2004). How much should we trust differences-in-differences estimates? *The Quarterly Journal of Economics, 119*(1), 249-75. doi: 10.1162/003355304772839588.

Beskæftigelsesministeriet. (2020, August 17). *Folketinget vedtager et skattefrit engangstilskud på 1.000 kr. til ydelsesmodtagere*. Retrieved December 11, 2020, from: https://bm.dk/nyheder-presse/nyheder/2020/08/folketinget-vedtager-et-skattefrit-engangstilskud-paa-1000-kr-til-ydelsesmodtagere/

Bie, U. H. (2020, July 29). *Sverige snubler igen: Krisen kan blive langvarig*. Retrieved December 11, 2020, from Berlingske: https://www.berlingske.dk/oekonomi/sverige-snubler-igen-krisen-kan-blive-langvarig

Bisnode. (2021a). *Bisnodes Corona Index (Danmark)*. Retrieved April 11, from: https://www.bisnode.dk/kampagner/campaigns-q1-q2-2020/corona-index/

Bisnode. (2021b). *Bisnodes Corona Index (Sverige)*. Retrieved April 11, from: https://www.bisnode.se/kampanjer/campaigns-q1-q2-2020/corona-index/

Bjørsted, E. (2015, April 28). *Det svenske arbejdsmarked er ikke et godt forbillede for Danmark.* Retrieved from: https://www.ae.dk/sites/www.ae.dk/files/dokumenter/analyse/ae_det-svenske-arbejdsmarked-er-ikke-et-godt-forbillede-for-danmark.pdf

Bjørsted, E. & Olsen, F. (2021, March 21). *Dansk økonomi har klaret sig godt gennem år ét med corona.* Retrieved March 28, 2021, from: https://www.ae.dk/analyse/2021-03-dansk-oekonomi-har-klaret-sig-godt-gennem-aar-et-med-corona

Blanchard, O., & Diamond, P. (1989). The Beveridge Curve. *Brookings Papers on Economic Activity, 20*(1), 1-76. doi:10.2307/2534495

Bougroug, A., Kjos, Ø.K., & Sletten, P. (2021). Økonomisk utvikling gjennom Covid-19. *Statistics Norway.* Retrieved April 16, 2021, from: https://www.ssb.no/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/_attachment/450956?_ts=178ca845f00

Carmines, E. G., & Zeller, R. A. (1979). *Reliability and Validity Assessment.* Thousand Oaks, CA: SAGE.

Case, K. E., Fair, R. C., & Oster, S. E. (2017). *Principles of Macroeconomics.* Essex: Pearson Education UK.

Cekov, D., Pedersen, H., Isaksson, T., & Koivu, T. (2020, September 4). *Spending is back: Nordics lead the recovery.* Retrieved March 12, 2021, from: https://insights.nordea.com/en/economics/spending-is-back-the-nordic-recovery-from-coronavirus/

Coles, M. G., & Kelishomi, A. M. (2018). Do Job Destruction Shocks Matter in the Theory of Unemployment? *American Economic Journal: Macroeconomics, 10*(3), 118-36. doi: 10.1257/mac.20150040.

Correia, S., Luck, S., & Verner, E. (2020). Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu. *SSRN Electronic Journal.* doi: /10.2139/ssrn.3561560.

Costain, J. S., & Reiter, M. (2008). Business cycles, unemployment insurance, and the calibration of matching models. *Journal of Economic Dynamics and Control, 32*(4), 1120-1155. doi: 10.1016/j.jedc.2007.04.008.

Currell, G. (2015). *Scientific Data Analysis.* Oxford: Oxford University Press.

Damm, E. A. (2020, May 27). *Krisen ramte først omkring de store byer og i Midtjylland.* Retrieved from: https://www.ae.dk/sites/www.ae.dk/files/dokumenter/analyse/ae_krisen-ramte-foerst-omkring-de-store-byer-og-i-midtjylland_0.pdf

Danielsen, T. K. (2020, December 14). *Vi har råd til krisen - og til læssevis af nye hjælpepakker.* Retrieved December 5, 2020, from Finans: https://finans.dk/debat/ECE12621865/vi-har-raad-til-krisen-og-til-laessevis-af-nye-hjaelpepakker/?ctxref=ext

Danmarks Nationalbank. (2021). *Officielle Rentesatser.* Retrieved April 1, 2021, from: https://www.nationalbanken.dk/da/markedsinfo/officiellerentesatser/Sider/default.aspx

Danmarks Statistik. (2020). *Detailsalget stiger betydeligt efter udbetaling af feriepenge*. Retrieved from: https://www.dst.dk/da/Statistik/nyt/NytHtml?cid=30887

Danmarks Statistik. (2021a). *Nytilmeldte ledige pr. uge (EKSP02).* Retrieved from: https://www.statistikbanken.dk/EKSP02

Danmarks Statistik. (2021b). *Forsyningsblance, Bruttonationalprodukt (BNP), beskæftigelse mv. efter transaktion, prisenhed og sæsonkorrigering (NKN1)*. Retrieved from: https://www.statistikbanken.dk/nkn1

Danmarks Statistik. (n.d.). *Ledighedsbegreber*. Retrieved November 22, 2020, from: https://www.dst.dk/da/Statistik/dokumentation/metode/ledighedsbegreber

Deloitte. (2015). *International komparativ analyse: Ydelsessystemer, reformer og indsatser overfor ikke-arbejdsmarkedsparate borgere i fem lande.* Retrieved from: star.dk.

Diamond, P. (1982). Wage determination and efficiency in search equilibrium. *Review of Economic Studies, 49*(2), 217-227. doi: 10.2307/2297271.

Doerr, S., & Gambacorta, L. (2020). Covid-19 and regional employment in Europe. *BIS Bulletin, 16*. Retrieved from: https://www.bis.org.

Erhvervsstyrelsen. (2021, January 24). *Statistik for Kompensationsordninger*. Retrieved January 25, 2021, from Erhvervsstyrelsen: https://erhvervsstyrelsen.dk/statistik-kompensationsordninger

European Commission. (2019). *Økonomisk Prognose for Danmark og EU.* Retrieved December 2, 2020, from Europa-Kommissionen: https://ec.europa.eu/denmark/news/economic-forecasts-191107_da

Fujita, S., & Ramey, G. (2012). Exogenous versus Endogenous Separation. *American Economic Journal: Macroeconomics, 4*(4), 66-93. doi: 10.1257/mac.4.4.68.

Fuller, T. (2004, December 15). *The Workplace: Firing's easy in Denmark; so is hiring.* Retrieved from The New York Times: https://www.nytimes.com/2004/12/15/business/worldbusiness/the-workplace-firings-easy-in-denmark-so-is-hiring.html

Goldstein, S. (2020, June 27). *Sweden didn't impose a lockdown, but its economy is just as bad as its neighbors*. Retrieved December 10, 2020: https://www.marketwatch.com/story/sweden-didnt-impose-a-lockdown-its-economy-is-just-as-bad-as-its-neighbors-who-did-2020-06-25

Goodman-Bacon, A., & Marcus, J. (2020). Using Difference-in-Differences to Identify Causal Effects of COVID-19 Policies. *Deutsches Institut für Wirtschaftsforschung Berlin Discussion Paper*, *1870*, doi: 10.2139/ssrn.3603970.

Google Community Mobility Reports. (2021). *COVID-19 Community Mobility Reports.* Retrieved from https://www.google.com/covid19/mobility/

Government Offices of Sweden. (2020). *Strategy in response to the COVID-19 pandemic*. Retrieved December 26, 2020, from: https://www.government.se/articles/2020/04/strategy-in-response-to-the-covid-19-pandemic/

Hagedorn, M., & Manovskii, I. (2008). The Cyclical Behavior of Equilibrium Unemployment and Vacancies Revisited. *American Economic Review, 98*(4), 1692-1706. doi: 10.1257/aer.98.4.1692.

Hansen, M. L., & Hansen, J. S. (2020). *Coronavirus og de offentlige finanser.* Retrieved from CEPOS: https://cepos.dk/media/4658/coronavirus-og-de-offentlige-finanser.pdf

Hansen, N.-J. H., & Sievertsen, H. H. (2016). Measuring Vacancies: Firm-level Evidence from Two Measures. *arXiv: General Economics*. Retrieved from: https://arxiv.org.

Hobijn, B., & Sahin, A. (2007). Job-Finding and Separation Rates in the OECD. *Federal Reserve Bank of New York Staff Reports, 298.* doi: 10.2139/ssrn.1007476.

Holm, A. B. (2018). *Videnskab i virkeligheden: En grundbog i videnskabsteori.* Frederiksberg C: Samfundslitteratur.

Juranek, S., Paetzold, J., Winner, H., & Zoutman, F. (2020). Labor Market Effects of Covid-19 in Sweden and its Neighbors: Evidence from Novel Administrative Data. *NHH Department of Business and Management Science, 2020/8*. doi: 10.2139/ssrn.3660832.

Karabarbounis, M., Laski, R., Lee, J., & Trachter, N. (2020). The Effect of Lockdown Measures on Unemployment. *Federal Reserve Bank of Richmond*. Retrieved from: https://www.richmondfed.org.

Kong, E., & Prinz, D. (2020). The Impact of State Shutdown Policies on Unemployment During a Pandemic. *Journal of Public Economics, 189,* doi: 10.2139/ssrn.3581254.

Krisinformation. (2020a). *Official Information on the Covid-19 Pandemic: Restrictions and prohibitions*. Retrieved January 15, 2021, from: https://www.krisinformation.se/en/hazards-and-risks/disasters-and-incidents/2020/official-information-on-the-new-coronavirus/restriktioner-och-forbud

Krisinformation. (2020b). *Nya skärpta nationella råd.* Retrieved January 15, 2021, from: https://www.krisinformation.se/detta-kan-handa/handelser-och-storningar/20192/myndigheterna-om-det-nya-coronaviruset/nationella-rad

Larsen, B. (2020, October 21). *Birthe Larsen: Sverige og Danmarks coronanedlukninger var vidt forskellige, men økonomisk lander de meget ens.* Retrieved December 28, 2020, from Børsen: https://borsen.dk/nyheder/opinion/uafgjort-okonomisk-coronalandskamp

Lin, Z., & Meissner, C. M. (2020). Health vs. Wealth? Public Health Policies and the Economy During Covid-19 (Working Paper No. 27099). *National Bureau of Economic Research*, doi: 10.3386/w27099.

Lønstrup, A. (2020, June 26). *Svenske og finske konkurstal stikker af – i Danmark er det modsat*. Retrieved January 11, 2020, from: https://ctwatch.dk/nyheder/regulering/article12251922.ece

Lønstrup, A., & Lindholdt, D. V. (2020, April 17). *Trods skånsom coronastrategi står Sverige til hårdere økonomiske slag end Danmark*. Retrieved December 2, 2020, from: https://policywatch.dk/article12080752.ece

Madsen, P. G. H. (2011, February 14). *Sverige viser vejen til væksten.* Retrieved April 11, 2020, from: https://www.kl.dk/nyheder/momentum/2009-2017/2011/sverige-viser-vejen-til-vaeksten/

Miao, J. (2014). *Economic Dynamics in Discrete Time.* Cambridge: MIT Press.

Mortensen, D. T. (1982). The matching process as a noncooperative bargaining game. *The Economics of Information and Uncertainty*, 233-254.

Mortensen, D. T., & Pissarides, C. A. (1994). Job Creation and Job Destruction in the Theory of Unemployment. *The Review of Economic Studies*, *61*(3), 397–415. doi: 10.2307/2297896.

Nielsen, B. (2021, February 16). *Nye tal: Dansk økonomi er hårdere ramt af coronakrisen end de andre nordiske lande*. Retrieved February 18, 2021, from: https://finans.dk/okonomi/ECE12763281/nye-tal-dansk-oekonomi-er-haardere-ramt-af-coronakrisen-end-de-andre-nordiske-lande/

OECD Data. (2021a). *Unemployment rate.* Retrieved from OECD Data: https://data.oecd.org/unemp/unemployment-rate.htm

OECD Data. (2021b). *Quarterly GDP*. Retrieved from OECD Data: https://data.oecd.org/gdp/quarterly-gdp.htm

OECD Data. (2021c). *Trade in goods and services*. Retrieved from OECD Data: https://data.oecd.org/trade/trade-in-goods-and-services.htm

OECD Stats. (2010). *STAN Indicators*. Retrieved from OECD Stats: https://stats.oecd.org/Index.aspx?DataSetCode=STANINDICATORS#

OECD Stats. (2019). *Employment by job tenure intervals - average tenure*. Retrieved February 13, 2021, from OECD Stats: https://stats.oecd.org/Index.aspx?DataSetCode=TENURE_AVE#

Olsen, P. B., & Pedersen, K. (2015). *Problemorienteret projektarbejde - en værktøjsbog (4th ed.).* Frederiksberg: Samfundslitteratur.

Our World in Data. (2021). *Coronavirus Pandemic (COVID-19)*. Retrieved from: https://ourworldindata.org/coronavirus/country/sweden?country=SWE~DNK#citation

Petrongolo, B., & Pissarides, C. (2001). Looking into the Black Box: A Survey of the Matching Function. *Journal of Economic Literature*, *39*(2), pp.390-431. doi: 10.1257/jel.39.2.390.

Pissarides, C. A. (1985). Short-run dynamics of unemployment, vacancies, and real wages. *American Economic* Review, *75*, 676-690. Retrieved from: https://www.jstor.org.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory (2nd edition).* Cambridge: The MIT Press.

Pissarides, C. A. (2009). The Unemployment Volatility Puzzle: Is Wage Stickiness the Answer? *Econometrica, 77*(5), 1339-1369. doi: 10.3982/ECTA7562.

Polisen. (2021). *Travel to Sweden from outside EU during the corona outbreak*. Retrieved January 24, 2021, from: https://polisen.se/en/the-swedish-police/the-coronavirus-and-the-swedish-police/travel-to-and-from-sweden/

PwC. (2020). Nordic consumer trends: COVID-19, where next?. Retrieved March 7, 2021, from: https://www.strategyand.pwc.com/n1/en/media/pdf/Nordic-consumer-trends-2020.pdf-

Regeringskansliet (2020, January 14). *A-kassan förändras tillfälligt.* Retrieved January 19, 2021, from: https://www.regeringen.se/artiklar/2020/04/a-kassan-forandras-tillfalligt/

Rokicki, S., Cohen, J., Fink, G., Salomon, J. A., & Landrum, M. B. (2018). Inference with difference-in-differences when number of groups is small. *Med Care, 56*(1), 97-105. doi: 10.1097/MLR.0000000000000830.

Romer, D. (2019). *Advanced Macroeconomics.* New York: McGraw-Hill.

SCB. (2021). *Nationalräkenskaper.* Retrieved from: https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__NR__NR0103/

Shimer, R. (2005). The Cyclical Behavior of Equilibrium Unemployment and Vacancies. *American Economic Review, 95*(1), 25-49. doi: 10.1257/0002828053828572.

Skatteverket. (2020). *Temporary payment respite*. Retrieved January 26, 2021, from Skatteverket: https://skatteverket.se/servicelankar/otherlanguages/inenglish/businessesandemployers/startingandrunningaswedishbusiness/payingtaxesbusinesses/

Statsministeriet. (2020a). *Pressemøde om COVID-19 den 11. marts 2020*. Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-om-covid-19-den-11-marts-2020/

Statsministeriet. (2020b). *Pressemøde den 17. marts 2020.* Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-den-17-marts-2020/

Statsministeriet. (2020c). *Pressemøde den 23. oktober 2020 i Statsministeriet om COVID-19*. Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-den-23-oktober-2020-i-statsministeriet-om-covid-19/

Statsministeriet. (2020d). *Pressemøde den 7. december 2020*. Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-den-7-december-2020/

Statsministeriet. (2020e). *Pressemøde den 16. december 2020*. Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-den-16-december-2020/

Statsministeriet. (2020f). *Pressemøde den 29. maj 2020*. Retrieved from Statsministeriet: https://www.stm.dk/presse/pressemoedearkiv/pressemoede-den-29-maj-2020/

Stock, J. H., & Watson, M. W. (2015). *Introduction to Econometrics.* Essex: Pearson Education Limited.

Sveriges Riksbank. (2021). *Reporränta, in- och utlåningsränta*. Retrieved April 1, 2021, from: https://www.riksbank.se/sv/statistik/sok-rantor--valutakurser/reporanta-in--och-utlaningsranta/

Sørensen, J. G. (2020). *International Økonomi A*. Retrieved from Forlaget Columbus: https://iøa.ibog.forlagetcolumbus.dk/?id=174.

The World Bank (2020, June 8). *COVID-19 to Plunge Global Economy into Worst Recession since World War II.* Retrieved December 2, 2020, from: https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii

Tillväxtverket. (2020, January 11). *Korttidsarbete 2020*. Retrieved January 26, 2021, from Tillväxtverket: https://tillvaxtverket.se/om-tillvaxtverket/information-och-stod-kring-coronakrisen/korttidsarbete/korttidsarbete-2020.html

Wing, C., Simon, K., & Bello-Gomez, R. A. (2018). Designing Difference in Difference Studies: Best Practices for Public Health Policy Resrarch. *Annual Review of Public Health, 39*, 453-69. doi: 10.1146/annurev-publhealth-040617-013507.

Wooldridge, J. M. (2013). *Introductory Econometrics: A Modern Approach.* South-Western: Cengage Learning.

Wyatt, T. (2020, December 5). *Covid: No-lockdown Sweden to shut secondary schools for a month to combat second wave*. Retrieved January 11, 2021, from: https://www.independent.co.uk/news/world/europe/sweden-covid-schools-closed-lockdown-b1766304.html

List of Figures

List of Tables

Appendices

Appendix A: General Overview of Compensation Initiatives

	Denmark	Sweden
Wage compensation	Firms can send workers on full-time furlough. The government covers 75% of the monthly wage (max. DKK 30,000 per employee), whereas the firm covers the remaining part of the wage. The option is only offered to firms that send at least 30% or 50 employees on furlough and was offered to eligible firms from March to August and again from December. For firms which were closed due to restrictions, the compensation was also granted for November.	Firms can decrease working hours by 60%-80%. The government covers most of the salary (max. DKK 32,000), but both the firm and the worker must also cover part of the wage. This was offered to firms from March 2020 and for the remainder of the year.
Compensation for fixed costs	Compensation for fixed costs is offered to firms that have experienced a revenue decrease of at least 30%. The size of the subsidy is based on the share of the fixed costs and is dependent on the size of the firm's revenue decline. In the case of firms that have been fully closed due to restrictions, these can receive 100% compensation of fixed costs. The compensation was offered from March and throughout the rest of 2020.	Firms can apply for compensation for fixed costs for different periods from March to July (with possible extension for the remainder of 2020), if they have experienced a loss of revenue compared to 2019. The specific requirements differ in each period but is between a 30% and a 40% decrease in revenue. Furthermore, the firm must have had net sales of at least SEK 250,000 (DKK 180,000) in 2019.
Additional compensation	Payment deferral of VAT and taxes. 70% corporate loan guarantee.	Payment deferral of VAT and taxes. 70% corporate loan guarantee.

Source: *bdo.dk*, *verksamt.se* & *regeringen.se*

Appendix B: OLS DiD Assumptions

The regression is linear in its parameters.
As the independent variables are dummy variables, the dependent variable is by definition linear in each dummy variable.

Independence of regressors.
This assumption is often violated in DiD regressions, as panel data involves observing the same entity at multiple periods (before treatment and after treatment). Thus, it is necessary to account for this violation by e.g., using cluster-robust standard errors (Bertrand et al., 2004). In this paper, this is not an option as the sample size is too small. Therefore, it is important to note that the standard errors in these regression models might be biased, leading to a possible overestimation of the significance levels (Bertrand et al., 2004). The violation does, however, not affect the coefficients in the model.

There is no perfect collinearity.
Collinearity refers to a non-zero correlation between two regressors. Two regressors are perfectly collinear if the correlation between them is 1 or -1. As only one category was included in the regression, collinearity was avoided. That is, if a dummy for both treatment and control would have been included, this would have led to collinearity in the model.

The error term has an expected value of zero (i.e., exogeneity of the independent variables) and is normally distributed.
As long as the common trend assumption holds, it is fair to assume that the error term has an expected value of zero. However, when there is no common trend, an endogeneity problem will arise, as the error term is then correlated with the regressor. This means that the abovementioned assumption is violated. Therefore, the paper tests for this assumption to make sure that a common trend is present.

There is no heteroskedasticity in the model.
Heteroskedasticity-robust standard errors are used to account for potential heteroskedasticity in the model.

Source: *Wooldridge (2013)*

Appendix C: Average population in Denmark and Sweden per year

The following population data are used for calculating the weekly data for unemployment and furlough per 100,000 population.

For 2019, data for both Denmark and Sweden are based on an average from Q1 to Q4.
For 2020, data for Denmark is based on an average from Q1 to Q4, whereas data for Sweden is based on an average from Q1 to Q3.

POPULATION	2019	2020
Sweden	10,294,332	10,356,339
Denmark	5,814,855	5,827,543

Source: *scb.se* and *dst.dk*

Appendix D: Derivation of Comparative Statics

Shock to Productivity

The effects will be presented by differentiating equations (18) and (15) with respect to a, E and productivity.

Impact on the Job Finding Rate

As the calibration found that $\gamma = \phi = 0.5$, Equation (18) is simplified and rewritten as seen below. The derivation of the comparative statics assumes $k = 1$.

$$c = \frac{\frac{1}{a}}{\left(2(r+\lambda) + a + \frac{1}{a}\right)}(y - b)$$

$$c * \left(2(r+\lambda) + a + \frac{1}{a}\right) = \frac{1}{a}(y - b)$$

$$c * (2(r+\lambda) + a + a^{-1}) = a^{-1}(y - b)$$

Next, the equation is differentiated with respect to the parameters a and y:

$$c(1 - a^{-2})da = -a^{-2}(y - b)da + a^{-1}dy$$

Terms are then collected on the left-hand side, simplified and rewritten:

$$[c(1 - a^{-2}) + a^{-2}(y - b)]da = \frac{1}{a}dy$$

$$[c - ca^{-2} + ya^{-2} - ba^{-2}]da = \frac{1}{a}dy$$

$$\frac{da}{dy} = \frac{1}{a} * \frac{1}{[c - ca^{-2} + ya^{-2} - ba^{-2}]}$$

a^{-2} is then taken out in front of a parenthesis in the denominator on the right-hand side:

$$\frac{da}{dy} = \frac{1}{a} * \frac{1}{[c + a^{-2}(y - b - c)]} > 0$$

As the derivation is positive, this indicates that when there is a negative shock to productivity, the job finding rate decreases.

Impact on Employment
Next, the impact on employment of a decrease in output will be shown. To show this, Equation (18) will be used as a starting point and rewritten.

$$a = \frac{\lambda E}{1 - E}$$

$$a * (1 - E) = \lambda E$$

The equation is differentiated with respect to the parameters E, a and y. Furthermore, as the end result is $\frac{dE}{dy}$, the left-hand side is multiplied by $\frac{dy}{dy}$:

$$\frac{dy}{dy}(1 - E)da - adE = \lambda dE$$

$$\frac{da}{dy}(1 - E)dy - adE = \lambda dE$$

The terms are then collected, and $\frac{dE}{dy}$ is isolated on the left-hand side:

$$\frac{da}{dy}(1 - E)dy = (\lambda + a)dE$$

$$\frac{da}{dy}(1 - E) = (\lambda + a)\left(\frac{dE}{dy}\right)$$

$$\frac{dE}{dy} = \frac{da}{dy}\frac{(1 - E)}{(\lambda + a)} > 0$$

As the derivation is positive, this indicates that when there is a negative shock to productivity, employment decreases.

<u>Shock to Job Separations</u>

Impact on the Job Finding Rate
Again, Equation (18) is rewritten:

$$c = \frac{\frac{1}{a}}{\left(2(r + \lambda) + a + \frac{1}{a}\right)}(y - b)$$

The denominator is then moved to the lefthand-side:

$$c * \left(2(r + \lambda) + a + \frac{1}{a}\right) = \frac{1}{\alpha}(y - b)$$

The fraction on right-hand side is rewritten:

$$c * (2(r+\lambda) + a + a^{-1}) = a^{-1}(y-b)$$

The equation is differentiated with respect to a and λ:

$$c(1-a^{-2})da + 2cd\lambda = -a^{-2}(y-b)da$$

Collecting terms and simplifying:

$$c + a^{-2}(y-b-c)]da = -2cd\lambda$$

$\frac{da}{d\lambda}$ is then isolated to get:

$$\frac{da}{d\lambda} = -\frac{2c}{c + a^{-2}(y-b-c)} < 0$$

As the derivation is negative, this indicates that when there is a positive shock to job separations, the job finding rate decreases.

Impact on Employment

Equation (15) is rewritten as below:

$$a = \frac{\lambda E}{1-E}$$

$$a * (1-E) = \lambda E$$

The equation is differentiated with respect to employment, the job finding rate and the job separation rate, and expressions are collected:

$$(1-E)da - adE = \lambda dE + Ed\lambda$$

$$(1-E)da - Ed\lambda = (\lambda + a)dE$$

The equation is solved for $\frac{dE}{d\lambda}$:

$$(1-E)\frac{da}{d\lambda} - E = (\lambda + a)\frac{dE}{d\lambda}$$

$$\frac{dE}{d\lambda} = \frac{da}{d\lambda}\frac{(1-E)}{(\lambda + a)} - \frac{E}{(\lambda + a)} < 0$$

As the derivation is negative, this indicates that when there is a positive shock to job separations, employment decreases.

Appendix E: Diamond-Mortensen-Pissarides Steady State Results

DMP Results – Shock to Productivity: Sweden

Quarter	GDP	y	a	alpha	Equilibrium	E	U	Change pp
1	1	1.077333	0.359485	0.490702	0	92.8%	7.2%	0.000000
2	0.921	1.012582	0.279573	0.630962	0	91.0%	9.0%	1.866213
3	0.966	1.048391	0.325943	0.541199	0	92.1%	7.9%	0.680639
4	0.971	1.052561	0.330964	0.532988	0	92.3%	7.7%	0.570652

DMP Results – Shock to Productivity: Denmark

Quarter	GDP	y	a	alpha	Equilibrium	E	U	Change pp
1	1	1.051743	0.637769	0.953950	0	95.1%	4.9%	0.000000
2	0.929	0.991892	0.487456	1.248112	0	93.7%	6.3%	1.420864
3	0.978	1.032414	0.593125	1.025754	0	94.7%	5.3%	0.350788
4	0.984	1.037631	0.605474	1.004832	0	94.8%	5.2%	0.248847

DMP Results – Shock to Job Separations: Sweden

Quarter	GDP	lambda	a	alpha	Equilibrium	E	U	Change pp
1	1	0.028078	0.359975	0.490035	0	92.8%	7.2%	0.000000
2	0.921	0.057071	0.334792	0.526894	0	85.4%	14.6%	7.328386
3	0.966	0.040460	0.348967	0.505491	0	89.6%	10.4%	3.153989
4	0.971	0.038631	0.350569	0.503182	0	90.1%	9.9%	2.690167

DMP Results – Shock to Job Separations: Denmark

Quarter	GDP	lambda	a	alpha	Equilibrium	E	U	Change pp
1	1	0.032467	0.636610	0.955687	0	95.1%	4.9%	0.000000
2	0.929	0.078175	0.595284	1.022033	0	88.4%	11.6%	6.755471
3	0.978	0.046544	0.623559	0.975690	0	93.1%	6.9%	2.093245
4	0.984	0.042699	0.627095	0.970188	0	93.6%	6.4%	1.522360

DMP Results – Shock to Productivity & Job Separations: Sweden

Quarter	y	lambda	a	alpha	Equilibrium	E	U	Change pp
1	1.077333	0.027800	0.359485	0.490702	0	92.8%	7.2%	0.000000
2	1.049789	0.030254	0.325443	0.542030	0	91.5%	8.5%	1.327262
3	1.080101	0.035161	0.355948	0.495578	0	91.0%	9.0%	1.811846
4	1.075670	0.032349	0.353549	0.498941	0	91.6%	8.4%	1.204530

DMP Results – Shock to Productivity & Job Separations: Denmark

Quarter	y	lambda	a	alpha	Equilibrium	E	U	Change pp
1	1.051743	0.033000	0.637771	0.953947	0	95.1%	4.9%	0.000000
2	1.020849	0.033000	0.564842	1.077115	0	94.5%	5.5%	0.600141
3	1.052167	0.040795	0.638721	0.952529	0	94.0%	6.0%	1.083840
4	1.028765	0.035401	0.584337	1.041180	0	94.3%	5.7%	0.792514

Appendix F: Discrete Version of the DMP Model

To create a dynamic model using Dynare, the Diamond-Mortensen-Pissarides framework is altered to a discrete version. The discrete model is used as the Dynare program is designed for solving only models in discrete time.

The discrete version of the model is based on Miao (2014), but the variables are altered to correspond with the continuous model presented previously. The idea of the discrete model is precisely as in the continuous version of the model, except that the model now assumes that workers and firms match today, such that they can start producing at $t+1$.

Corresponding to Equation (3) in the continuous model, the change in unemployment is denoted as:

$$U_{t+1} - U_t = \lambda * (1 - U_t) - a_t * U_t \qquad (A.1)$$

That is, the change in unemployment is the inflow to unemployment through the probability of job separations, λ, multiplied by the number of employed E, minus the outflow from unemployment, i.e., the probability of finding a job multiplied by the number of unemployed.

The probability that a worker will find a job or that a vacancy will be filled is represented by the job finding rate, a, and the vacancy filling rate, α. These are identical to the continuous version of the model (Equations (5)-(6)).

$$a_t = k * \theta_t^{\gamma} \qquad (A.2)$$

$$\alpha_t = k * \theta_t^{\gamma-1} \qquad (A.3)$$

The value of being employed is denoted V_E, whereas V_U, V_F and V_V are the value of being unemployed, the value of having a filled job, and the value of posting a vacancy, respectively. Equations (A.2) - (A.5) correspond to equations (7)-(10) in the continuous model.

The values of being employed and unemployed, respectively are:

$$V_{E\,t} = w_t + \beta * \left(\lambda * V_{U_{t+1}} + (1-\lambda) * V_{E\,t+1}\right) \qquad (A.4)$$

$$V_{U_t} = b + \beta * \left(a_t * V_{E\,t+1} + (1-a_t) * V_{U\,t+1}\right) \qquad (A.5)$$

The value of being employed is found as the wage income, w_t, plus the discounted value of the next period $(t+1)$. The value next period is found by probability of a job separation, λ, multiplied by the value of being unemployed, V_{U_t+1}, plus the probability of no job separation, $(1-\lambda)$, multiplied by the value of being employed in the next period, $V_{E_{t+1}}$. Similarly, the value of being unemployed is found by the unemployment benefits plus the discounted value of next period. The next period value is the probability of finding a job, a, multiplied by the value of being employed $V_{E_{t+1}}$ plus the probability of not finding a job, $(1-a)$, multiplied by the value of being unemployed.
The values of having a filled job and a vacancy, respectively, are:

$$V_{F_t} = y_t - w_t + \beta * \left(\lambda * V_{V\,t+1} + (1-\lambda) * V_{F_t+1}\right) \qquad (A.6)$$

$$V_{V_t} = -c + \beta * \left(\alpha_t * V_{F_{t+1}} + (1-\alpha_t) * V_{V_{t+1}}\right) \qquad (A.7)$$

The value of having a filled position is the productivity, y, minus the wage paid to workers, w, plus the discounted value of next period. The value of next period is the probability of job separation, λ multiplied by the value of having a vacant position next period, $V_{V_{t+1}}$ plus the probability of no job separation, $(1-\lambda)$, multiplied by the value of having a filled position next period, $V_{F_{t+1}}$. Similarly, the value of having a vacant position is the cost of posting a vacancy plus the discounted value of next period. The next period value is found as the probability that a vacancy is filled, α multiplied by the value of having a filled vacancy next period, $V_{F_{t+1}}$, plus the probability that a vacancy is not filled, $1-\alpha$, multiplied by the value of having a vacancy next period, $V_{V_{t+1}}$. Like in the continuous model, the value of posting a vacancy, V_{Vt}, is zero in steady state.

As in the continuous model, where all $\dot{V}$'s were equal to zero in steady state, the steady state in the discrete model assumes that period t values are equal to those of period $t+1$ for all V's. That is, all variables are constant over time.

Like in the continuous model, the worker's surplus is the difference between the value of being employed an unemployed, $V_E - V_U$. Corresponding to Equation (11), the following equation denotes the worker surplus.

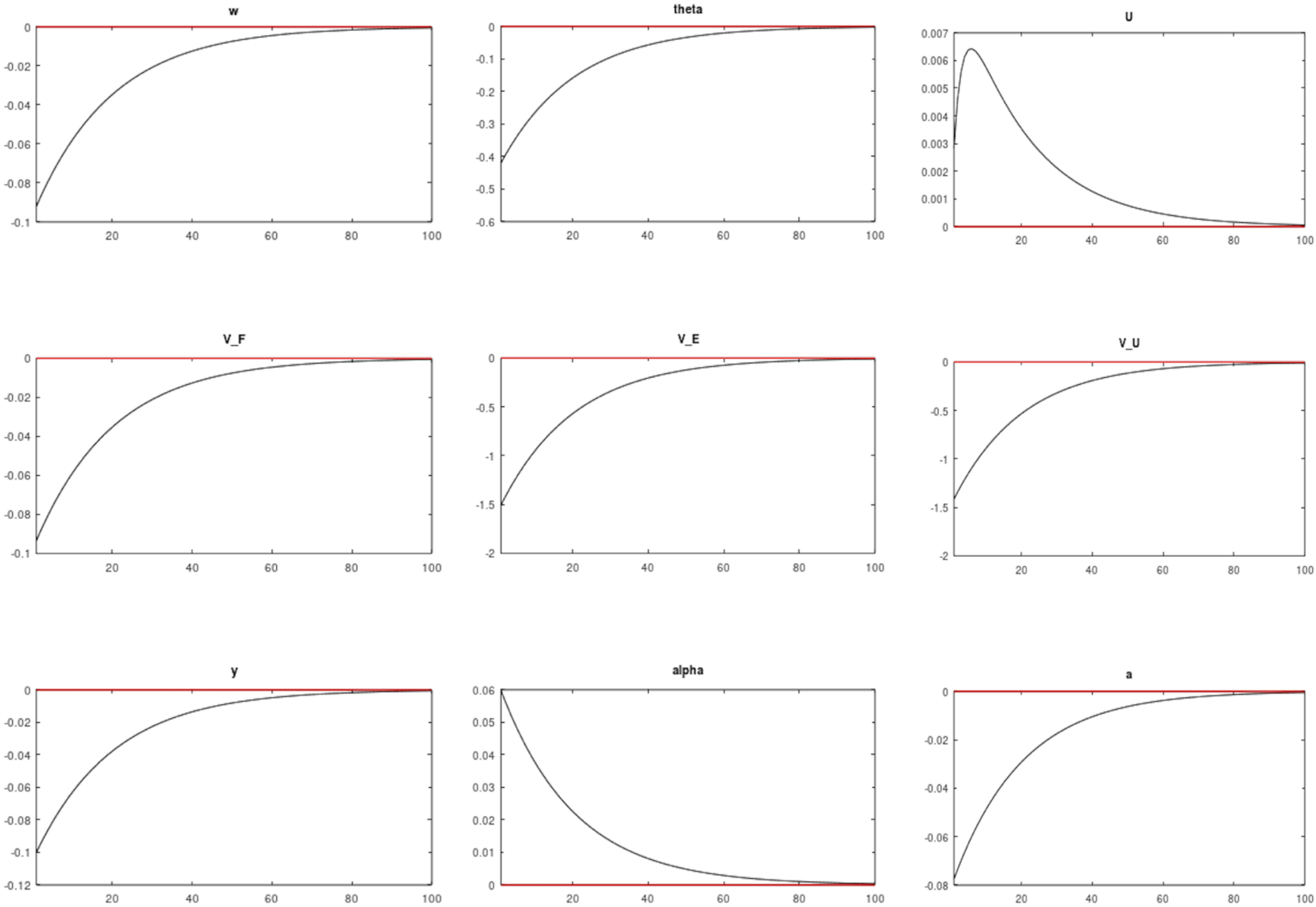
$$V_{E\,t} - V_{U_t} = \phi * (V_{E\,t} - V_{U_t} + V_{F_t} - V_{V_t}) \qquad (A.8)$$

Equations (A.1)-(A.8) are used as input for coding in Dynare.

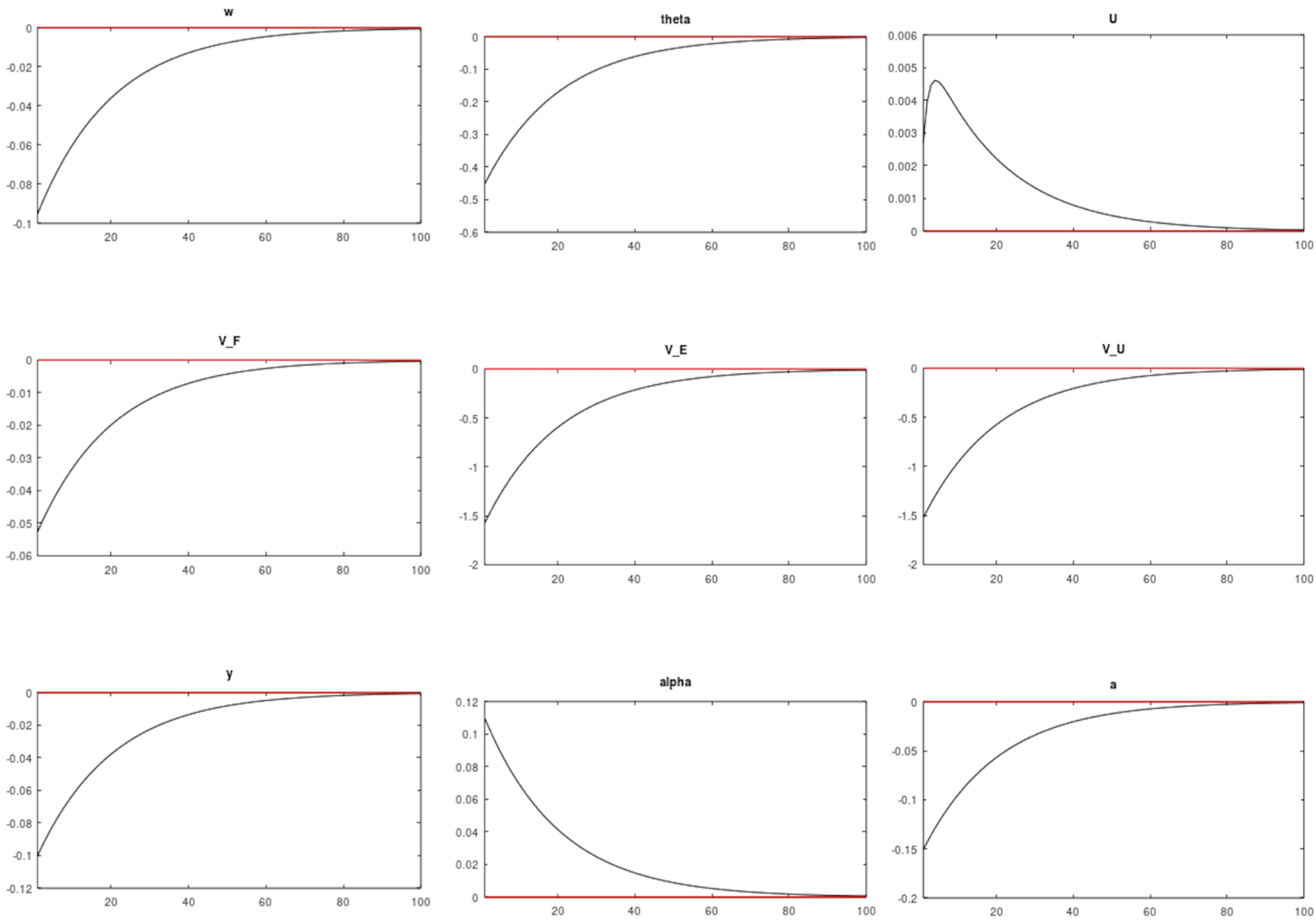
Source: *Miao (2014)*

Appendix G: Dynare Output – Dynamic DMP Model on Shock to Productivity

Dynare Output - Sweden



Dynare Output – Denmark



Appendix H: Coding in Dynare – Dynamic Shock to Productivity in the DMP Model

Code for Dynamic DMP Model in Sweden

```
// DMP discrete version (Sweden)

var w, theta, U, V_F, V_E, V_U, y, alpha, a;
varexo yshock;

parameters gamma, beta, lambda, c, phi, k, b, V_V;

gamma    = 0.5;     // matching efficiency
beta     = 1/1.01;  // time discount factor
phi      = 0.5;     // worker bargaining power

k        = 0.42;    // matching productivity
b        = 0.7;     // unemployment benefits

lambda   = 0.0278;   // job separation rate
c        = 0.2;     // vacancy cost

V_V      = 0;       // free entry condition

model;

V_F = y - w + beta*(lambda*V_V(+1) + (1-lambda)*V_F(+1));

V_E = w + beta*(lambda*V_U(+1)+(1-lambda)*V_E(+1));

V_U = b + beta*(a*V_E(+1)+(1-a)*V_U(+1));

V_V = -c + beta*(alpha*V_F(+1)+(1-alpha)*V_V(+1));

U(-1) = U - lambda*(1-U)+a*U;

V_E - V_U = phi*(V_E-V_U+V_F-V_V);

alpha = k*(theta^(gamma-1));

a = k*(theta^(gamma));

y = (1-0.95)*1.0+0.95*y(-1) - yshock;

end;

initval;

w     = 0.961925831;
theta = 0.7325942760;
U     = 0.0717817202;
V_F   = 0.411655422;
V_E   = 88.58203006;
V_U   = 85.49840438;
y     = 1.07733282;
alpha = 0.490701631;
a     = 0.3594852296;

end;

steady;

shocks;
var yshock; stderr 0.1;
end;

stoch_simul(order=1,irf=100);
```

Code for Dynamic DMP Model in Denmark

```
// DMP discrete version (Denmark)

var w, theta, U, V_F, V_E, V_U, y, alpha, a;
varexo yshock;

parameters gamma, beta, lambda, c, phi, k, b, V_V;

gamma    = 0.5;    // matching efficiency
beta     = 1/1.01; // time discount factor
phi      = 0.5;    // worker bargaining power

k        = 0.78;   // matching productivity
b        = 0.7;    // unemployment benefits

lambda   = 0.033;  // job separation rate
c        = 0.2;    // vacancy cost

V_V      = 0;      // free entry condition

model;

V_F = y - w + beta*(lambda*V_V(+1) + (1-lambda)*V_F(+1));

V_E = w + beta*(lambda*V_U(+1)+(1-lambda)*V_E(+1));

V_U = b + beta*(a*V_E(+1)+(1-a)*V_U(+1));

V_V = -c + beta*(alpha*V_F(+1)+(1-alpha)*V_V(+1));

U(-1) = U - lambda*(1-U)+a*U;

V_E - V_U = phi*(V_E-V_U+V_F-V_V);

alpha = k*(theta^(gamma-1));

a = k*(theta^(gamma));

y = (1-0.95)*1.0+0.95*y(-1)-yshock;

end;

initval;

w     = 0.9427268204;
theta = 0.6685538452;
U     = 0.0491973301;
V_F   = 0.211750752;
V_E   = 86.76539725;
V_U   = 84.20478767;
y     = 1.05174287;
alpha = 0.9539517460;
a     = 0.6377681079;

end;

steady;

shocks;
var yshock; stderr 0.1;
end;

stoch_simul(order=1,irf=100);
```

The parameter values correspond to the calibration in Table 2 in the paper.

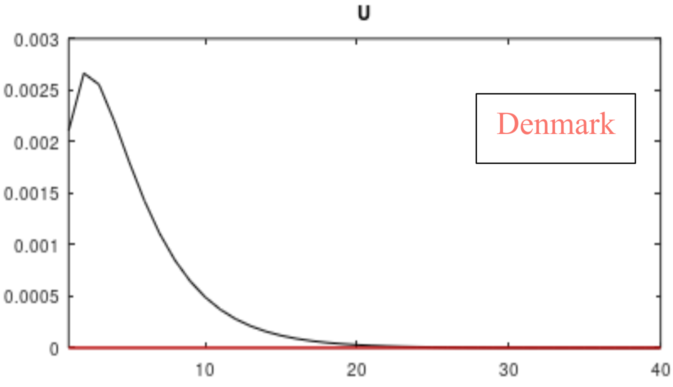
The model equations are based on equations (A.1)-(A.9). Furthermore, an equation is added to explain how y evolves over time. In the model, this is the weighted average of the steady state and the value of last period.

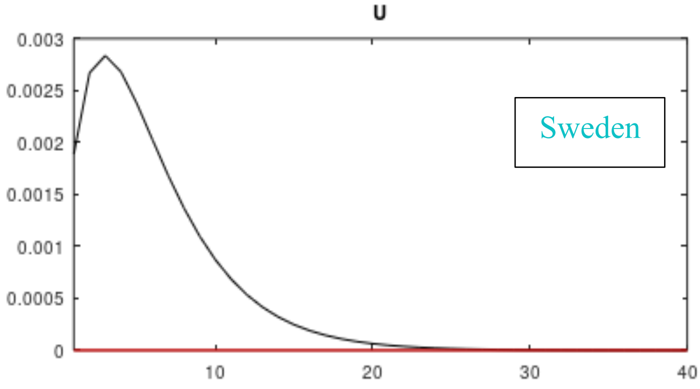
The initial values in the coding were found in the following way:

- θ was calculated using Problem Solver in Excel by setting alpha equal to the value found in the static model and solving for θ
- w was calculated from the formula $w = \phi * (y + c\theta) + (1 - \phi)b$ as presented in Miao (2014).
- U, a and α were calculated based on the formulas shown in Equations (A.1)-(A.3).
- V_F, V_U and V_E were calculated based on Equations (A.4-A.7) in steady state.

Appendix I: Dynare Output – Alternative DMP Models

Shock to Productivity





Appendix J: Evaluating the Parallel Trends Assumption

Parallel Trends for Weekly Unemployment Inflow
The parallel trends assumption is evaluated through a two-sided t-test. To calculate the t-statistic, the following formula is used:

$$t - stat = \frac{b_D - b_S}{\sqrt{SE_D^2 + SE_S^2}}$$

By regressing the weekly unemployment over time in Denmark (1) and Sweden (2), respectively, the slope and standard error of each trendline is found:

	Dependent variable:	
	Weekly Unemployment Inflow	
	(1)	(2)
Time	0.431*	0.323***
	(0.254)	(0.117)
Intercept	123.787***	63.604***
	(11.306)	(5.091)
Note:	*p<0.1; **p<0.05; ***p<0.01	

This is then inserted into the formula, concluding a t-stat of 0.3841:

$$t - stat = \frac{0.43067 - 0.32325}{\sqrt{0.25402^2 + 0.11697^2}} = 0.3841$$

The degrees of freedom are:

$$52 + 52 - 4 = 100$$

Based on a distribution table (Stock & Watson, 2015), the paper finds that the t-stat should be larger than 1.984 to reject the null hypothesis on a 95% confidence level. As $1.984 > 0.3841$, the null hypothesis cannot be rejected. Alternatively, the p-value can be calculated using the T.DIST.2T function in Excel (Currell, 2015) by inserting the t-stat of 0.3841 and the degrees of freedom (100). This gives a p-value of 0.7049.

Parallel Trends for Monthly Unemployment Rate
The parallel trends assumption is evaluated through a two-sided t-test. To calculate the t-statistic, the following formula is used:

$$t - stat = \frac{b_D - b_S}{\sqrt{SE_D^2 + SE_S^2}}$$

By regressing the monthly unemployment rate over time in Denmark (1) and Sweden (2), respectively, the slope and standard error of each trendline is found:

	Dependent variable:	
	Monthly Unemployment Rate	
	(1)	(2)
Time	-0.0002	0.0005
	(0.0002)	(0.0003)
Intercept	0.051^{***}	0.066^{***}
	(0.002)	(0.003)
Note:	*p<0.1; **p<0.05; ***p<0.01	

This is then inserted into the formula, concluding a t-stat of 1.9414.

$$t - stat = \frac{0.00047 - (-0.00015)}{\sqrt{0.00033^2 + 0.000164^2}} = 1.6859$$

The degrees of freedom are:

$$12 + 12 - 4 = 20$$

Based on a distribution table (Stock & Watson, 2015), the paper concludes that the t-stat should be larger than 2.09 to reject the null hypothesis on a 95% confidence level. As $2.09 > 1.6859$, the null hypothesis cannot be rejected. Alternatively, the p-value can be calculated using the T.DIST.2T function in Excel (Currell, 2015) and inserting the t-stat of 1.6859 and the degrees of freedom (20). This gives a p-value of 0.1074. Thus, this indicates that there is a significant difference between the two trends on a 10% level.

Appendix K: Coding in R – DiD Models

Difference-in-Differences on Monthly Unemployment Rate

```
#Load Data
data <- read.csv("monthly data.csv")
view(data)
count(data, Country, Year)

#Set the date
data$Date <- as.Date(data$Date, "%d/%m/%Y")

#Make treatment variable
data$treat = data$Year.Month.Dummy * data$Country.Dummy

#Plot the data + time of treatment
library(ggplot2)

ggplot(data, aes(x=Date, y=Monthly.Unemployment.Rate, group=Country, color=Country)) +
  geom_line() +
  geom_point() +
  scale_fill_viridis_d()+
  geom_vline(xintercept = as.numeric(data$Date[35]), linetype="dashed")

#Make regression model
didreg = lm(Monthly.Unemployment.Rate ~ treat + Year.Month.Dummy + Country.Dummy, data = data)
summary(didreg)

#Model with Robust Standard Error
model1 <- coeftest(didreg, vcov = vcovHC(didreg, type = "HC0"))
model1

stargazer(model1, type="html",
          dep.var.labels=c("Monthly Unemployment"), covariate.labels=c("Treatment Effect","Time Dummy","Country Dummy",
                                                                            "Intercept"), out="models.htm")

#Make diff-in-diffs plot
b1 <- coef(didreg)[[1]]
b2 <- coef(didreg)[[4]]
b3 <- coef(didreg)[[3]]
delta <- coef(didreg)[[2]]
C <- b1+b2+b3+delta
E <- b1+b3
B <- b1+b2
A <- b1
D <- E+(B-A)
plot(1, type="n", xlab="Time", ylab="Monthly.Unemployment.Rate", xaxt="n",
     xlim=c(-0.01, 1.01), ylim=c(0.04, 0.1))
segments(x0=0, y0=A, x1=1, y1=E, lty=1, lwd=3, col="#0dc1c6")#control
segments(x0=0, y0=B, x1=1, y1=C, lty=1, lwd=3, col="#f8786f")#treated
segments(x0=0, y0=B, x1=1, y1=D,      #counterfactual
         lty=4, lwd= 2, col="black")
legend("topleft", legend=c("control", "treated",
                           "counterfactual"), lty=c(1,1,4), col=c("#0dc1c6","#f8786f","black"))
axis(side=1, at=c(0,1), labels=NULL)
```

Difference-in-Differences on Weekly Unemployment Inflow

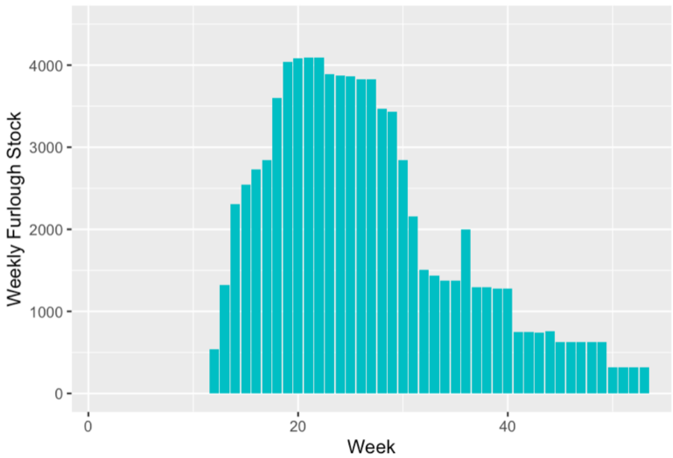
```
#Load data
data <- read.csv("weekly data.csv")
view(data)
count(data, Country, Year)

#Set the date
data$Date <- as.Date(data$Date, "%d/%m/%Y") # I Tell R the date format with the "%m/%d/%Y"

#Make treatment variable
data$treat = data$Year.Week.Dummy * data$Country.Dummy

#Plot the data + time of treatment
ggplot(data, aes(x=Date, y=Weekly.Unemployment.Inflow, group=Country, color=Country)) +
  geom_line() +
  geom_point() +
  scale_fill_viridis_d() +
  geom_vline(xintercept = as.numeric(data$Date[167]), linetype="dashed")

#Make regression model
didreg = lm(Weekly.Unemployment ~ treat + Year.Week.Dummy + Country.Dummy, data = data)
summary(didreg)

#Make model with robust standard errors
model2 <- coeftest(didreg, vcov = vcovHC(didreg, type = "HC0"))
model2

stargazer(model2, type="html",
          dep.var.labels=c("Weekly Unemployment Inflow"), covariate.labels=c("Treatment Effect","Time Dummy","Country Dummy",
                                                                                    "Intercept"), out="models.htm")

#Diff-in-difffs plot
b1 <- coef(didreg)[[1]]
b2 <- coef(didreg)[[4]]
b3 <- coef(didreg)[[3]]
delta <- coef(didreg)[[2]]
C <- b1+b2+b3+delta
E <- b1+b3
B <- b1+b2
A <- b1
D <- E+(B-A)
plot(1, type="n", xlab="Time", ylab="Weekly.Unemployment", xaxt="n",
     xlim=c(-0.01, 1.01), ylim=c(50, 250))
segments(x0=0, y0=A, x1=1, y1=E, lty=1, lwd=3, col="#0dc1c6")#control
segments(x0=0, y0=B, x1=1, y1=C, lty=1, lwd=3, col="#f8786f")#treated
segments(x0=0, y0=B, x1=1, y1=D,      #counterfactual
         lty=4, lwd= 2, col="black")
legend("topleft", legend=c("control", "treated",
                           "counterfactual"), lty=c(1,1,4), col=c("#0dc1c6","#f8786f","black"))
axis(side=1, at=c(0,1), labels=NULL)
```

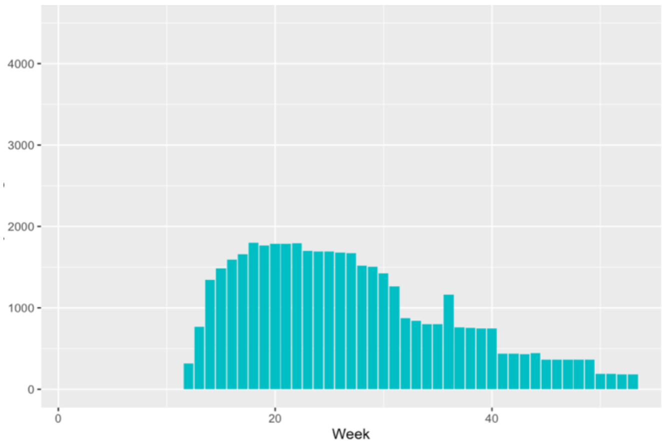
Difference-in-Differences on Weekly Furlough Stock

```
#Load data for graphs
data.furlough.den <- read.csv("furlough.den.csv")
data.furlough.swe <- read.csv("furlough.swe.csv")

#Load data for regressions
data.furlough <- read.csv("furlough 2.csv")

#Plot the data
den <-ggplot(data=data.furlough.den, aes(x=Week, y=Weekly.Furlough.Stock)) +
  geom_bar(stat="identity", fill='#f8766d') +
  ylab("Weekly Furlough Stock") +
  coord_cartesian(xlim =c(1, 53), ylim = c(0, 4500))
den

swe <-ggplot(data=data.furlough.swe, aes(x=Week, y=Weekly.Furlough.Stock)) +
  geom_bar(stat="identity", fill='#00bfc4') +
  ylab("Weekly Furlough Stock") +
  coord_cartesian(xlim =c(1, 53), ylim = c(0, 4500))
swe

#Make treatment variables
data.furlough$treat = data.furlough$Week.Dummy * data.furlough$Country.Dummy

#Make regression model
didreg.f = lm(Weekly.Furlough.Stock ~ treat + Week.Dummy + Country.Dummy, data = data.furlough)
summary(didreg.f)


#Models with Robust Standard Error
model1 <- coeftest(didreg.f, vcov = vcovHC(didreg.f, type = "HC0"))
model1

stargazer(model1, type="html",
          dep.var.labels=c("Weekly Furlough Stock"), covariate.labels=c("Treatment Effect","Time Dummy","Country Dummy",
                                                                     "Intercept"), out="models.htm")
```

Appendix L: Robustness Check for DiD Regression on Weekly Furlough Stock

As the furlough in Sweden only results in a reduction in working hours of 20%-80%, there is some uncertainty with calculating the data to full-time equivalents, as there is no data pertaining to the average reduction in working hours. For this reason, the paper assumes that the average was a 60% reduction, as this was the most common reduction according to Tillväxtverket. Still, there is a lot of uncertainty with this assumption, why bar charts and DiD regressions are further conducted with the assumption of (i) a maximum reduction in working hours (60-80% depending on the month), and (ii) a reduction in working hours of 35%.

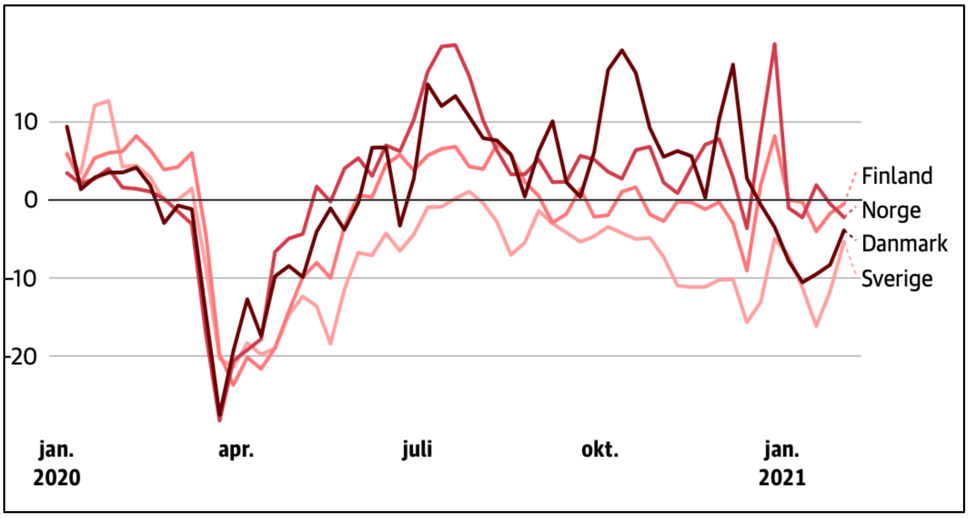




The results indicate that the regression is very sensitive to the assumption of the reduction in working hours. That is, with the assumption that all individuals on furlough had their working time reduced by the maximum amount, the treatment effect is negative and insignificant. Instead, if the assumption is that the average reduction in working time was 35%, the treatment effect is instead positive and significant. This indicates that the results based on this DiD regression should be drawn with a lot of caution, as the robustness of the results are weak.

	Dependent variable:	
	Weekly Furlough Stock	
	(1)	(2)
Treatment Effect	-407.331	559.361**
	(333.588)	(275.615)
Time Dummy	1,944.207***	977.515***
	(208.650)	(90.652)
Country Dummy	0.000	0.000
	(0.000)	(0.000)
Intercept	0.000	0.000***
	(0.000)	(0.000)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Appendix M: Spending in the Nordics during 2020

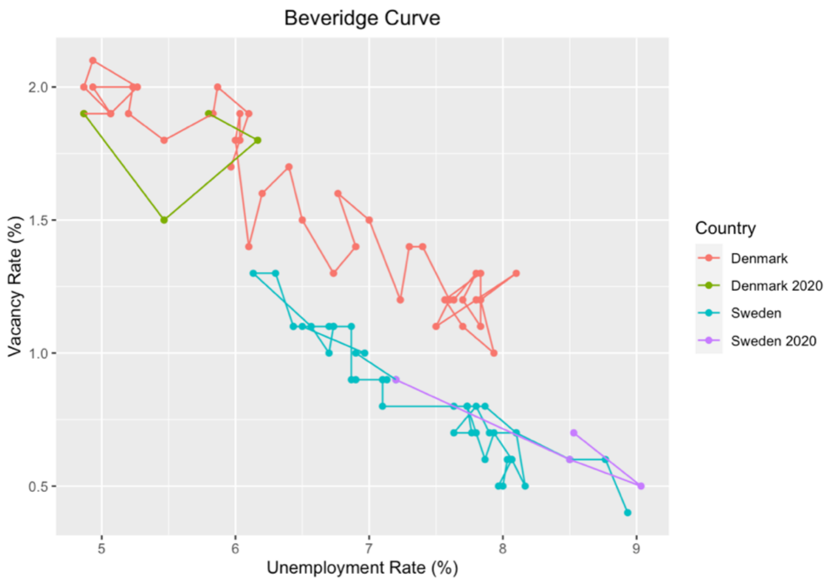


Source: *Nielsen (2021)*

Appendix N: Beveridge Curve

To get an idea of the labor market tightness in each country, a Beveridge Curve is drawn up based on data from 2010 to 2020. The green and purple points indicate the year of 2020. Generally, it seems that the Beveridge Curve for Denmark is less efficient than the Beveridge Curve for Sweden. However, this observation is counterintuitive, considering that Denmark has a higher unemployment inflow but a lower unemployment rate. Furthermore, according to Bjørsted (2015), the Danish labor market generally has lower structural unemployment than the Swedish. Hence, the finding in the Beveridge Curve could be explained by the fact that vacancy data is often misleading, as concluded by Hansen & Sievertsen (2016).

For the above-mentioned reason, the Beveridge curves will merely be used to conclude on the relative impact of the pandemic in each country.



Beveridge Curves for Denmark and Sweden in 2010-2020.

Source: OECD Data (2021a), dst.dk (LSK01) and scb.se

Q1-Q2

From Q1 to Q2, the vacancy rate decreased, while the unemployment rate increased in both countries. As shown in Figure 1, a decrease in vacancies with a simultaneous increase in unemployment, indicates a push towards a recession. It seems that the curve for Denmark is steeper, meaning that this moves to a more efficient location, as the vacancy rate has decreased a lot, while only increasing the unemployment rate to a smaller extent. This means that they are able to reallocate employees more efficiently, i.e., they have a lower unemployment for a given number of vacancies.

Q2-Q3

For Denmark, the decrease in vacancies only occurred from Q1 to Q2, whereas for Sweden, the vacancy rate further decreased towards Q3. In Sweden, the efficiency of the market seems relatively unchanged, whereas the point on the Danish curve shifts away from the origin. This indicates a less efficient position, as more vacancies are being posted while the unemployment rate is increasing. The fact that more vacancies are being posted in Denmark can be tied to the theoretical idea that firms in

Denmark has flexicurity, making it easier to hire and fire people, why posting a vacancy does not result in the same consequences as it might in Sweden. In the theoretical section, this corresponds to the fact that the country has a high matching productivity, k, indicating that firms are more willing to post vacancies than in Sweden, thereby alleviating the shock.

Q3-Q4

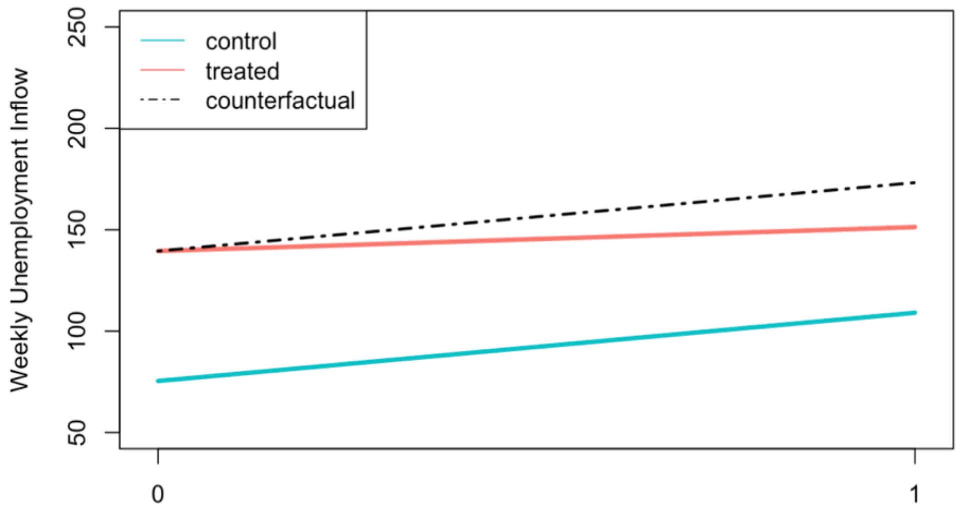
In Q4, the unemployment rate in Sweden decreased, while the number of vacancies increased. This indicates that the labor market tightness is increasing and that the country is on the path away from a recession. In Denmark, the unemployment rate also decreased, while the number of vacancies increased. For both countries, this indicates that more vacancies are being posted and that more people are being employed.

The figure shows that Denmark is back to the same vacancy rate as previously, while the unemployment rate is still higher than before the shock. Oppositely, Sweden is still having far fewer vacant position than before the pandemic and their unemployment rate is also higher than pre-COVID-19. In the theoretical model, this corresponds to a labor market tightness that is lower than before the pandemic, which parallels with the increase in the vacancy filling rate and the decrease in the job finding rate found in the theoretical analysis.

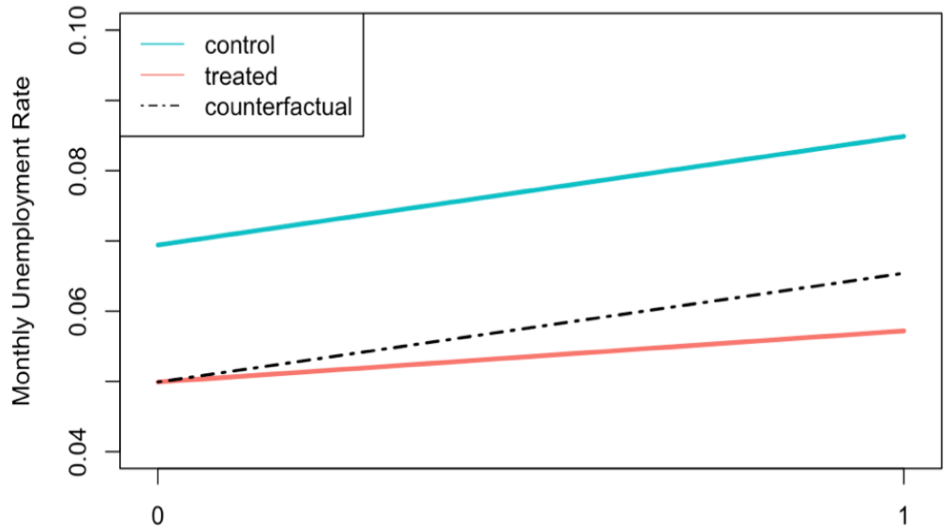
Appendix O: DiD Illustration (Control, treatment & counterfactual)

The figures are drawn based on the pre-treatment (0) and post-treatment (1) averages for each country.

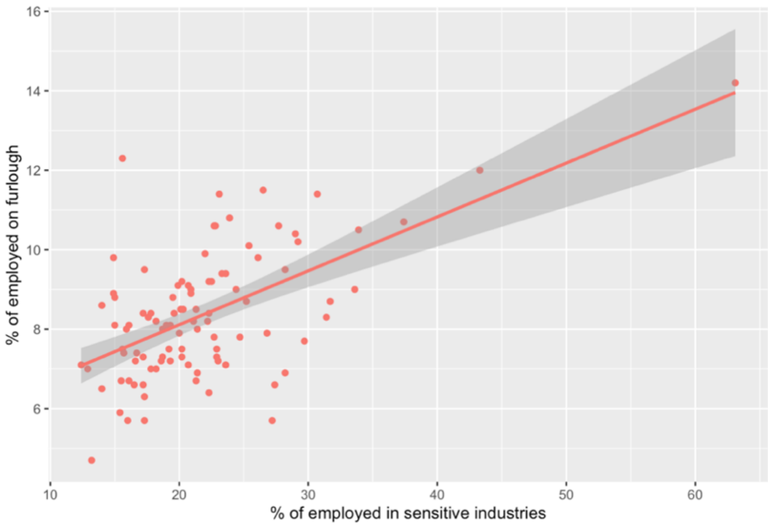
Weekly unemployment inflow



Monthly unemployment rate



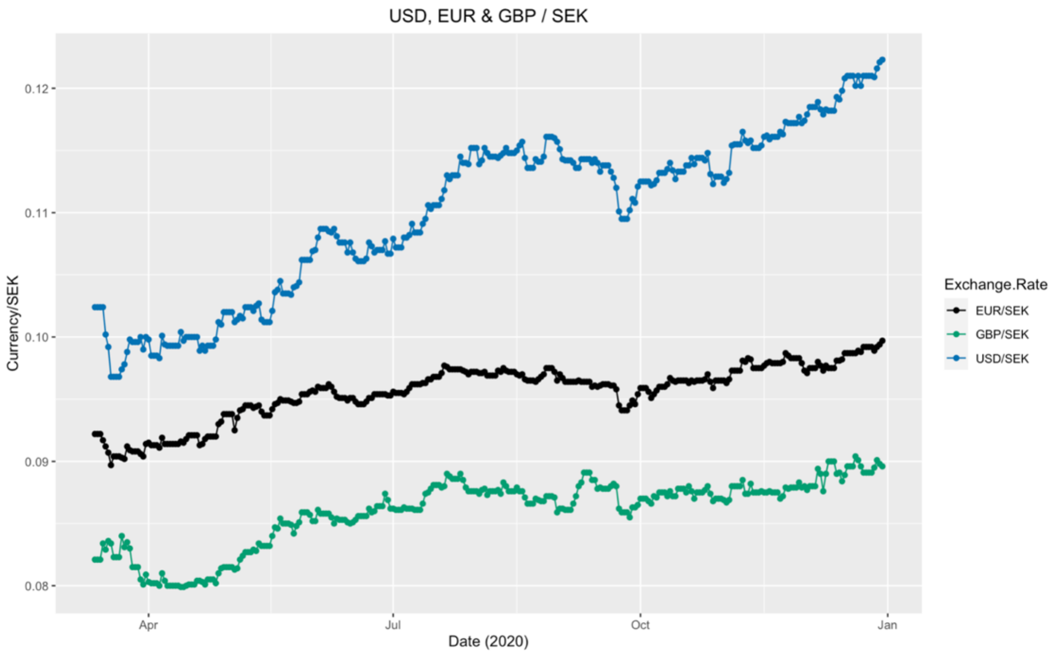
Appendix P: Relation between the percentage of employed in vulnerable sectors and the percentage of employed on furlough



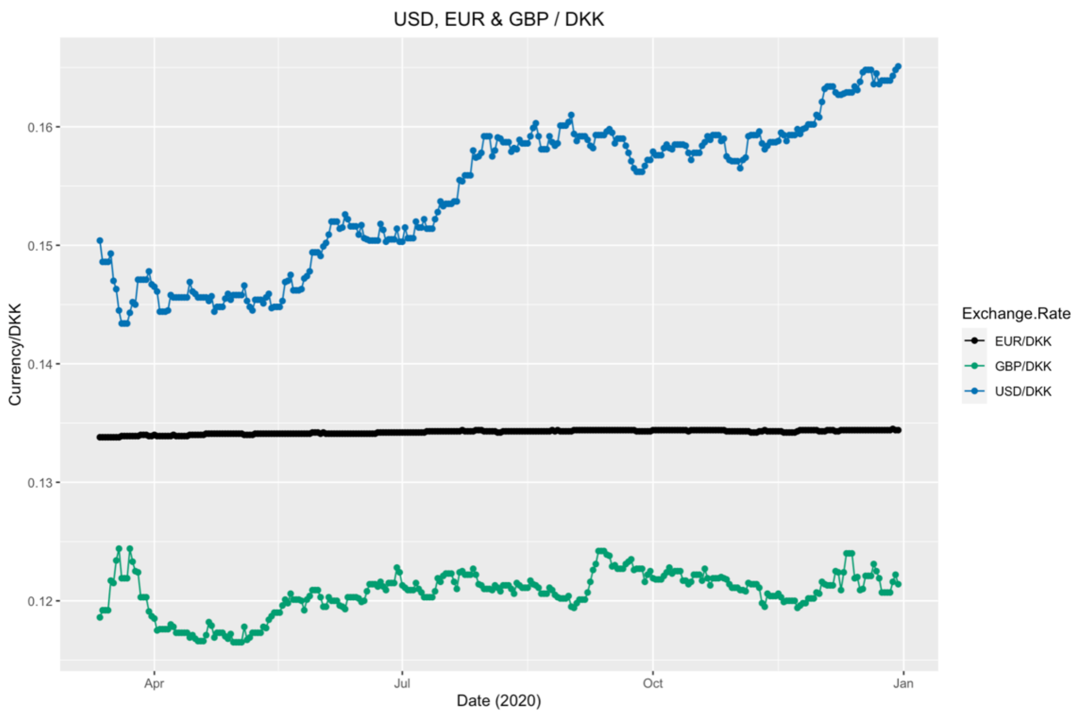
Source: *Damm (2020)*

Appendix Q: Currency Fluctuations

Swedish Krona against USD, EUR & GBP (2020)



Danish Kroner against USD, EUR & GBP (2020)



Danish Kroner and Swedish Krona against NOK (2020)