# The Possible Unemployment Cost of Average Inflation Below a Credible Target

**A Replication Study of Svensson (*American Economic Journal: Macroeconomics*, 2015)**

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*Journal of Comments and Replications in Economics, Volume 1, 2022-2,* DOI: 10.18718/81781.24

*JEL:* D84, E24, E31, E52, E58
*Keywords:* Monetary Policy, Central Banks, Phillips Curve, Inflation, Expectations, Unemployment, Replication Study

*Data Availability:* A detailed description of the data (access) can be found in the Data Appendix of this paper. The data and Stata code to reproduce the results of this replication can be downloaded at JCRE's data archive (DOI: 10.15456/j1.2021152.143135).

*Please Cite As:* Oraby, Ramy (2022). The Possible Unemployment Cost of Average Inflation Below a Credible Target:A Replication Study of Svensson (2015). *Journal of Comments and Replications in Economics*, Vol 1(2022-2). DOI: 10.18718/81781.24

## *Abstract*

This paper replicates the main analysis of Svensson (2015) with some expansion to the original analysis, mainly for the United States. Overall, the replication exercise successfully confirms the conclusions of Svensson (2015). In both Sweden and the United States, empirical evidence supports the existence of a non-vertical long run Phillips curve. The slope of the long run Phillips curve recorded -0.75 in Sweden and -0.23 in the United States. While the average inflation rate in the United States was very close to its targeted level, the average inflation rate in Sweden was 0.6 percentage points below its targeted level over the sample period. The deviation of inflation rate from its targeted level in Sweden resulted in an unemployment cost equivalent to 0.8 percentage points over the sample period where the average unemployment rate recorded 7.4 percent compared with an estimated 6.6 percent had the average inflation rate been at its targeted level.

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Received June 01, 2021; Revised August 02, 2021; Accepted February 19, 2022; Published April 20, 2022.

## 1 Introduction

The first official inflation target in Sweden was announced in 1993 with an achievement horizon set to start from 1995 onward. In 1993, the inflation target was defined as 2.0 percent in terms of the annual percentage change in the consumer price index (CPI). Starting September 2017, the inflation target has been defined in terms of the annual percentage change in the consumer price index with fixed mortgage interest rates (CPIF)[1], which was published for the first time in July 2008[2]. The Swedish case is unique since most of central banks that adopted inflation targeting within a period close to that of Sweden managed to keep their average inflation rate very close to its targeted level. In this context, Svensson (2015) tackled two main policy concerns:

- Whether persistently undershooting the inflation target would lead to a higher unemployment rate, relative to the case if the average inflation rate met its targeted level.
- Whether such an unemployment cost is large.

Svensson (2015) presented empirical evidence of the unemployment cost associated with having the average inflation rate below its targeted level in Sweden, which would be useful for other small open economies. Moreover, the analysis of the Swedish case was also complemented by examining other country cases.

In this paper, we replicate the main analysis of Svensson (2015) for Sweden and the United States where the discussion on the Phillips curve has recently resurfaced[3]. We also extend the analysis in Svensson (2015) by expanding the sample period as well as investigating different specifications of unemployment and inflation indicators to reach the best possible fit for estimating the Phillips curve.

## 2 Data

The dependent variable is the inflation rate, while the explanatory variables include inflation expectations and unemployment indicators. Following Svensson (2015), the dependent variable in this paper (i.e., the inflation rate) is measured by the quarterly annualized percentage changes in the price indices, mainly to avoid the impact of overlapping data due to base effects, in line with existing literature[4].

We work with two separate datasets, one for each country. Each dataset consists of quarterly data on different measures of inflation (CPIF, Core CPI, GDP deflator, and core Personal Consumption Expenditure [PCE]), inflation expectations, and unemployment indicators. Each observation represents the national economy at a point in time. The original data was mainly sourced from national statistics agencies, business surveys, and national central banks.

[1] www.riksbank.se/en-gb/monetary-policy/the-inflation-target/how-is-inflation-measured

[2] www.riksbank.se/globalassets/media/rapporter/ppr/fordjupningar/engelska/2017/cpif-as-target-variable-for-monetary-policy-article-in-monetary-policy-report-september-2017

[3] www.stlouisfed.org/open-vault/2020/january/what-is-phillips-curve-why-flattened

[4] Using the annual percentage changes in the consumer price index (CPI) as the dependent variable to estimate the short run Phillips curve would be associated with some econometric complications, see Harri and Brorsen (1998).

While we use the same original data for Sweden, we update the dataset of the United States up to 2021 Q1 (see Data Appendix for further details). Moreover, the replication exercise is done using Stata, while most of the original data and all the codes provided by the author were stored in EViews workfiles.

## 3 Empirical analysis

Estimating the unemployment cost of having the average inflation rate below the targeted level requires estimating the long run Philips curve. Following Svensson (2015), the long run Phillips curve is estimated by taking the unconditional mean of the short run Phillips curve.

### 3.1 Sweden – Estimating the short run Phillips curve

Table 1 shows the results of Table 2 in Svensson (2015) in which different lags of unemployment rate and inflation expectations[5] were used as independent variables. We get similar results in terms of the significance and the size of the estimated coefficients. Using the change in the unemployment rate ($u_t - u_{t-1}$) and lagged unemployment rate ($u_{t-1}$) as explanatory variables (column 1) result in the best possible fit relative to the other models in Table 1.

Adding inflation expectations as explanatory variables in columns (2) and (3) shows that the variation in inflation expectations, which is relatively low since inflation expectations are well anchored around the targeted level (Table 2), plays a statistically insignificant role in explaining the variation in the actual inflation rate.

As an alternative to the unemployment rate in Table 1, we use the unemployment gap as an explanatory variable over the same sample period in Table 3. The unemployment gap is defined as the deviation of the unemployment rate ($u_t$) from its long-term average ($u^*$). The coefficients are statistically significant, while the sign is also consistent with economic theory (i.e., a higher unemployment rate than its natural level implies lower inflation rate). Column (2) shows that including 1-year-ahead inflation expectations lagged one quarter (New Keynesian Phillips curve) results in statistically insignificant coefficient, which is also consistent with the findings in Table 1. However, column (3) shows that including 1-year-ahead inflation expectations lagged four quarters (New Classical Phillips curve) results in statistically significant coefficient at 5 percent level. Nevertheless, the coefficient of the unemployment gap in Table 3, column (3) (-0.81) is almost identical to the coefficient of the unemployment rate in Table 1, column (1) (-0.80), which implies that a one percentage point increase (decrease) in the unemployment rate tends to reduce (increase) the inflation rate by an average of 0.8 percentage points, holding other variables constant. Moreover, the explanatory power of the variation in the unemployment gap in explaining the variation in the inflation rate is lower than that in Table 1, column (1).

[5] Following Svensson (2015), column (2) represents a New Classical Phillips curve by including 1-year-ahead inflation expectations lagged four quarters ($\pi^{e1}_{t-4}$). Meanwhile, column (3) represents a New Keynesian Phillips curve by including 1-year-ahead inflation expectations lagged one quarter ($\pi^{e1}_{t-1}$).

Table 1: Replication of Table 2 from Svensson (2015) - Estimates of the short run Phillips curve in Sweden using different lags of unemployment rate and inflation expectations between 1997 and 2011

| | (1) | | (2) | | (3) | | (4) | | (5) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication |
| Constant | 7.192 | 7.192 | 8.230 | 8.230 | 8.758 | 8.758 | 6.638 | 6.638 | 5.227 | 5.227 |
| | (1.360) | (1.360) | (1.771) | (1.771) | (2.267) | (2.267) | (1.220) | (1.219) | (1.393) | (1.393) |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0003] | [0.0003] | [0.0000] | [0.0000] | [0.0004] | [0.0004] |
| $u_t - u_{t-1}$ | −2.700 | −2.700 | −2.156 | −2.156 | −2.678 | −2.678 | | | | |
| | (0.723) | (0.723) | (0.936) | (0.936) | (0.725) | (0.725) | | | | |
| | [0.0005] | [0.0005] | [0.0253] | [0.0253] | [0.0005] | [0.0005] | | | | |
| $u_{t-1}$ | −0.807 | −0.807 | −0.826 | −0.826 | −0.917 | −0.917 | | | −0.516 | −0.516 |
| | (0.186) | (0.186) | (0.188) | (0.188) | (0.226) | (0.226) | | | (0.177) | (0.177) |
| | [0.0001] | [0.0001] | [0.0001] | [0.0001] | [0.0002] | [0.0002] | | | [0.0050] | [0.0050] |
| $\pi^{e1}_{t-4}$ | | | −0.456 | −0.456 | | | | | | |
| | | | (0.498) | (0.498) | | | | | | |
| | | | [0.3638] | [0.3638] | | | | | | |
| $\pi^{e1}_{t-1}$ | | | | | −0.386 | −0.386 | | | | |
| | | | | | (0.447) | (0.447) | | | | |
| | | | | | [0.3913] | [0.3913] | | | | |
| $u_t$ | | | | | | | −0.715 | −0.715 | | |
| | | | | | | | (0.167) | (0.167) | | |
| | | | | | | | [0.0001] | [0.000] | | |
| $R^2$ | 0.30 | 0.301 | 0.31 | 0.312 | 0.31 | 0.311 | 0.20 | 0.197 | 0.12 | 0.120 |
| Adj. $R^2$ | 0.27 | 0.275 | 0.27 | 0.273 | 0.27 | 0.272 | 0.18 | 0.182 | 0.10 | 0.104 |
| RMSE | 1.53 | 1.534 | 1.54 | 1.537 | 1.54 | 1.538 | 1.63 | 1.630 | 1.71 | 1.705 |
| DW | 1.77 | 1.766 | 1.74 | 1.739 | 1.71 | 1.706 | 1.47 | 1.465 | 1.34 | 1.343 |
| AIC | | 213.47 | | 214.58 | | 214.68 | | 219.40 | | 224.57 |
| $N$ | | 57 | | 57 | | 57 | | 57 | | 57 |

Notes: Newey-West standard errors are used in column 4 and column 5. Standard errors within parentheses; p-values within brackets.

Table 4 shows the results of Table 3 in Svensson (2015). We get similar results in terms of the significance and the size of the estimated coefficients. In columns (1) and (2), using two least squares estimation provides close results to the ordinary least square estimation in Table 1. In columns (3) and (4), the short run Philips curve is estimated using the GDP deflator, as a measure of inflation over the same sample period, instead of the CPI inflation. The results confirm the superiority of the main short run Phillips curve in Table 1, column (1), which is estimated using the CPI inflation, relative to the estimated short run Philips curve using GDP deflator. Intuitively, sticking with the estimated CPI inflation Phillips curve is supported by the fact that the central bank in Sweden defined its target in terms of CPI inflation during the sample period.

Table 2: Summary statistics of inflation expectations in Sweden between 1997 and 2011

| Variable | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| 1-year inflation expectations | 1.94 | 0.57 | 0.74 | 3.25 |
| 2-year inflation expectations | 2.13 | 0.37 | 1.31 | 2.93 |
| 5-year inflation expectations | 2.23 | 0.17 | 1.77 | 2.61 |

### *3.2 Sweden – Estimating the long run Phillips curve*

Using the replicated model in Table 1, column (1), the long run Phillips curve is estimated by taking the unconditional mean of the short run Phillips curve.

$$\pi_t = \beta_0 - \beta_1(u_t - u_{t-1}) - \beta_2 u_{t-1} + \epsilon_t \tag{1}$$

$$\pi = \beta_0 - \beta_2 u \tag{2}$$

where $\pi = E[\pi_t], u = E[u_t]$, and $E[\epsilon_t] = 0$.

Accordingly, $\beta_2$ represents the slope of the long run Phillips curve, which is estimated at around -0.8 in Table 1, column (1). Nevertheless, Svensson (2015) noted that the slope of the long run Phillips curve is sensitive to the sample period. In Table 5, we present different slopes of the long run Phillips curve that are associated with different sample start points. The benchmark slope in Svensson (2015) was approximated by taking the average of the estimated slope for the sample that starts 1997 Q3 and 1997 Q4, which recorded -0.75.

This confirms that the associated unemployment cost of a 1.0 percentage points inflation rate below its targeted level is estimated at 1.3 percentage points, which is consistent with Svensson (2015). Between 1997 and 2011, the average inflation rate fell below its targeted level by 0.6 percentage points. Hence, the associated unemployment cost is estimated at around 0.8 percentage points, which is also consistent with the main findings of Svensson (2015). Had the average inflation rate been at its targeted level, the average unemployment rate would have been 6.6 percent (instead of 7.4 percent), which is close to the long-term average of the unemployment rate ($u^*$) (6.4 percent).

### *3.3 Sweden – Robustness check*

While the inflation target was initially defined in terms of the CPI, monetary policy formulation has given more attention to the annual percentage changes in the CPIF before it became the official inflation target starting September 2017. This led Andersson and Jonung (2014) to estimate the short run Phillips curve using the CPIF for the whole sample period. However, a strong argument against using the CPIF for the whole sample period is the fact that it was published for the first time in July 2008. Accordingly, the CPIF was not available for monetary policymakers prior to July 2008. Alternatively, we generated an indicator that combines both the CPI and the CPIF (CPI over

Table 3: Estimates of the short run Phillips curve in Sweden using the unemployment gap.

| | (1) | (2) | (3) |
|---|---|---|---|
| Constant | 2.068 | 3.492 | 3.958 |
| | (0.280) | (1.326) | (0.781) |
| | [0.0000] | [0.011] | [0.0000] |
| Unemployment gap | −0.715 | −0.910 | −0.811 |
| | (0.167) | (0.281) | (0.189) |
| | [0.0000] | [0.002] | [0.0001] |
| Inflation expectation, 1st lag ($\pi^{e1}_{t-1}$) | | −0.643 | |
| | | (0.639) | |
| | | [0.319] | |
| Inflation expectation, 4th lag ($\pi^{e1}_{t-4}$) | | | −0.951 |
| | | | (0.371) |
| | | | [0.0131] |
| $R^2$ | 0.197 | 0.225 | 0.284 |
| Adj. $R^2$ | 0.182 | 0.196 | 0.257 |
| RMSE | 1.630 | 1.615 | 1.553 |
| DW | 1.465 | 1.415 | 1.633 |
| AIC | 219.40 | 219.35 | 214.84 |
| $N$ | 57 | 57 | 57 |

Notes: Newey-West standard errors are used in column 1 and column 2. Standard errors within parentheses; p-values within brackets.

the period 1997 Q4-2008 Q2, and CPIF over the period 2008 Q3 - 2011 Q4). The CPI/CPIF indicator recorded an average of 1.5 percent between 1997 Q4 and 2011 Q4, relative to an average of 1.4 percent using the CPI. Table 6 shows the estimated short run Phillips curve using the CPI/CPIF indicator along with the baseline model in Table 1, column (1).

The coefficient of the lagged unemployment rate using CPI/CPIF is also statistically significant at all conventional levels, while the sign is also consistent with economic theory. Accordingly, the slope of the long run Phillips curve using CPI/CPIF is estimated at -0.6, which is slightly smaller than that of the baseline model (-0.8) and the benchmark slope in Svensson (2015) (-0.75). Between 1997 and 2011, the average CPI/CPIF fell below the 2.0 percent level by 0.5 percentage points (instead of 0.6 percentage points using CPI only). Hence, the associated unemployment cost using CPI/CPIF is estimated at around 0.8 percentage points, which is also consistent with the main findings of Svensson (2015) replicated in this paper.

Table 4: Replication of Table 3 from Svensson (2015) - Estimates of the short run Phillips curve in Sweden using other measures of inflation between 1997 and 2011.

| | (1) CPI Q/Q AR | | (2) CPI Q/Q AR | | (3) GDP-deflator Q/Q AR | | (4) GDP-deflator Q/Q AR | | (5) CPI Q/Q AR Revised | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication | Svensson (2015) | Replication |
| Constant | 7.344 | 7.344 | 8.255 | 8.255 | 5.665 | 5.665 | 6.812 | 6.812 | 7.278 | 7.278 |
| | (1.462) | (1.462) | (−3.070) | (3.070) | (1.691) | (1.691) | (1.732) | (1.732) | (1.415) | (1.415) |
| | [0.0000] | [0.0000] | [0.0096] | [0.0096] | [0.0015] | [0.0015] | [0.0002] | [0.0002] | [0.0000] | [0.0000] |
| $u_t - u_{t-1}$ | −2.909 | −2.909 | −3.533 | −3.533 | −1.137 | −1.137 | −1.621 | −1.621 | −2.538 | −2.538 |
| | (1.030) | (1.030) | (1.071) | (1.071) | (0.899) | (0.899) | (0.854) | (0.854) | (0.753) | (0.753) |
| | [0.0066] | [0.0066] | [0.0017] | [0.0017] | [0.2116] | [0.2116] | [0.0634] | [0.0634] | [0.0014] | [0.0014] |
| $u_{t-1}$ | −0.829 | −0.829 | −0.929 | −0.929 | −0.579 | −0.579 | −0.722 | −0.722 | −0.830 | −0.830 |
| | (0.202) | (0.202) | (−0.296) | (0.296) | (0.232) | (0.232) | (0.225) | (0.225) | (0.194) | (0.194) |
| | [0.0001] | [0.0001] | [0.0028] | [0.0028] | [0.0155] | [0.0155] | [0.0023] | [0.0023] | [0.0001] | [0.0001] |
| $\pi_t^e$ | | | −0.112 | −0.112 | | | | | | |
| | | | (0.583) | (0.583) | | | | | | |
| | | | [0.8483] | [0.8483] | | | | | | |
| $\pi_{t-1}^{GDP}$ | | | | | | | −0.349 | −0.349 | | |
| | | | | | | | (0.129) | (0.129) | | |
| | | | | | | | [0.0090] | [0.0090] | | |
| $\pi_{t-3}^{GDP}$ | | | | | | | 0.259 | 0.259 | | |
| | | | | | | | (0.125) | (0.125) | | |
| | | | | | | | [0.0434] | [0.0434] | | |
| $R^2$ | 0.30 | 0.300 | 0.27 | 0.274 | 0.10 | 0.104 | 0.26 | 0.256 | 0.28 | 0.284 |
| Adj. $R^2$ | 0.27 | | 0.23 | | 0.07 | 0.071 | 0.20 | 0.199 | 0.26 | 0.257 |
| RMSE | 1.54 | 1.535 | 1.58 | 1.578 | 1.91 | 1.908 | 1.77 | 1.772 | 1.60 | 1.597 |
| DW | 1.78 | 1.782 | 1.79 | 1.786 | 2.59 | 2.591 | 1.94 | 1.945 | 1.79 | 1.789 |
| AIC | | | | | | 238.34 | | 231.77 | | 218.04 |
| $N$ | | 57 | | 57 | | 57 | | 57 | | 57 |

Notes: Standard errors within parentheses; p-values within brackets.

Table 5: Long run Phillips curve slope in Sweden:

| Sample Starting Point | Slope $\lvert\beta_2\rvert$ | Standard Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|
| 97Q1 | 0.46 | 0.15 | 0.16 | 0.76 |
| 97Q2 | 0.55 | 0.16 | 0.22 | 0.88 |
| **97Q3** | **0.70** | 0.18 | 0.34 | 1.05 |
| **97Q4** | **0.81** | 0.19 | 0.43 | 1.18 |
| 98Q1 | 0.88 | 0.20 | 0.49 | 1.27 |
| 98Q2 | 0.82 | 0.21 | 0.41 | 1.24 |
| 98Q3 | 0.85 | 0.22 | 0.40 | 1.29 |
| 98Q4 | 0.80 | 0.23 | 0.33 | 1.26 |
| 99Q1 | 0.74 | 0.24 | 0.26 | 1.22 |
| 99Q2 | 0.69 | 0.25 | 0.20 | 1.19 |

Table 6: Estimates of the short run Phillips curve in Sweden using CPIF.

| | (1) CPI Q/Q AR | (2) CPI/CPIF Q/Q AR |
|---|---|---|
| Constant | 7.192 | 6.027 |
| | (1.360) | (1.223) |
| | [0.0000] | [0.0000] |
| Unemployment rate, 1st difference | −2.700 | −0.758 |
| | (0.723) | (0.651) |
| | [0.0005] | [0.2490] |
| Unemployment rate, 1st lag | −0.807 | −0.621 |
| | (0.186) | (0.168) |
| | [0.0001] | [0.0005] |
| $R^2$ | 0.301 | 0.205 |
| Adj. $R^2$ | 0.275 | 0.175 |
| RMSE | 1.534 | 1.380 |
| DW | 1.766 | 1.896 |
| AIC | 213.47 | 201.43 |
| N | 57 | 57 |

Notes: Standard errors within parentheses; p-values within brackets.

### *3.4 The United States*

In this section, we start by looking into the updated dataset of the United States (up to 2021 Q1). Then, we estimate the short run Phillips curve before estimating the long run Phillips curves as in Svensson (2015).

### *3.5 The United States – Descriptive analysis of the updated dataset*

While the Federal Reserve did not announce an official inflation target until January 2012, a core annual PCE inflation rate that is close to 2.0 percent had been widely considered as the unofficial inflation target prior to 2012 (Taylor 1993). Over the period 1970-2021, the core PCE annual inflation rate recorded an average of 3.4 percent with 66.4 percent coefficient of variation, which indicates a large volatility. To help identify our period of interest where the average inflation rate is below the 2.0 percent level and inflation expectations are anchored around the 2.0 percent level, we decompose the overall period into four main sub-periods. Following Ball and Mazumder (2019):

a. High and volatile inflation (1970 Q1 and 1997 Q4)

b. Pre- the Great Recession (1998 Q1 – 2007 Q4)

c. Post the Great Recession and pre- Covid-19 (2008 Q1 – 2019 Q4)

d. Post Covid-19 (2020 Q1 – 2021 Q1)

a. High and volatile inflation:
Between 1970 Q1 and 1997 Q4, the core PCE annual inflation recorded an average of 4.8 percent with a minimum reading of 1.5 percent and a maximum reading of 10.1 percent (Table 7). Over the same period, the unemployment rate recorded an average of 6.6 percent with a minimum reading of 4.2 percent, which is 1.7 percentage points below its natural level, and a maximum reading of 10.7 percent, which is 4.8 percentage points above its estimated natural level.

Table 7: Summary statistics of inflation and unemployment indicators in the US between 1970Q1 and 1997Q4

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Core PCE inflation Y/Y | 4.77 | 2.17 | 1.47 | 10.10 |
| Unemployment rate | 6.56 | 1.32 | 4.17 | 10.67 |
| U* | 5.91 | 0.29 | 5.31 | 6.24 |

b. Pre- the Great Recession: Between 1998 Q1 and 2007 Q4, the inflation rate stabilized at a low level. The average core PCE annual inflation nearly halved to 1.8 percent as inflation expectations were estimated to be very close to the 2.0 percent level and the average unemployment rate was also very close to its estimated natural level (Table 8).

Table 8: Summary statistics of inflation expectations in the US between 1998Q1 and 2007Q4

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Core PCE inflation Y/Y | 1.79 | 0.37 | 1.15 | 2.49 |
| Inflation expectations$^{+}$ | 2.09 | 0.03 | 2.02 | 2.15 |
| Unemployment rate | 4.90 | 0.67 | 3.90 | 6.13 |
| U* | 5.11 | 0.12 | 4.91 | 5.30 |

$^{+}$Data start point: 1999 Q1

c. Post the Great Recession and pre- Covid-19: In the aftermath of the economic shock of the Great Recession, the average core PCE annual inflation declined slightly to record 1.6 percent in spite of the well anchored inflation expectations at around 2.0 percent between 2008 Q1 – 2019 Q4 (Table 9). Meanwhile, the average unemployment rate increased to record 6.4 percent, which was 1.7 percentage points above its estimated natural level.

Table 9: Summary statistics of inflation and unemployment indicators in the US between 2008Q1 and 2019Q4

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Core PCE inflation Y/Y | 1.61 | 0.32 | 0.92 | 2.19 |
| Inflation expectations | 2.04 | 0.06 | 1.94 | 2.13 |
| Unemployment rate | 6.44 | 2.10 | 3.60 | 9.93 |
| U* | 4.72 | 0.11 | 4.52 | 4.90 |

d. Post Covid-19 between 2020 Q1 and 2021 Q1: The average core PCE annual inflation continued to decline to record 1.4 percent between 2020 Q1 and 2021 Q1 (Table 10). Inflation expectations remained anchored around the 2.0 percent level, despite marginally declining. Meanwhile, the average unemployment rate continued to increase to record 7.7 percent, which is 3.2 percentage points above its natural level as the negative impact associated with the COVID-19 shock was not fully reversed by 2021Q1.

Table 10: Summary statistics of inflation and unemployment indicators in the US between 2020Q1 and 2021Q1

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Core PCE inflation Y/Y | 1.42 | 0.27 | 1.02 | 1.76 |
| Inflation expectations | 1.95 | 0.034 | 1.93 | 2.01 |
| Unemployment rate | 7.72 | 3.48 | 3.80 | 13.07 |
| U* | 4.49 | 0.02 | 4.47 | 4.51 |

The above decomposition shows that the average inflation rate in the United States has been below the 2.0 percent level starting 1998 onward, while inflation expectations have been anchored around the 2.0 percent level starting 1999 onward. Consistent with Fuhrer (2011) and Svensson (2015), the start point of our sample period is set at 2000 in order to properly incorporate the needed lags. Meanwhile, the end point of our sample period is initially set at 2011 similar to Fuhrer (2011) and Svensson (2015). Additionally, we expand the analysis in Svensson (2015) by: a) using 2007 as an end point to exclude the potential bias from the Great Recession, and b) using 2019 as an end point. Regardless of the end point, the data shows that the deviation of the average inflation rate from its targeted level in the United States is minor (0.2-0.3 percentage points), which is half of its value in Sweden during the sample period. Similar to Sweden, inflation expectations in the United States have been broadly well anchored around the targeted inflation rate over the sample periods, which also suggests a nonvertical long run Phillips curve.

### *3.6 The United States – Estimating the short run Phillips curve*

We start by estimating the short run Phillips curve using the same specifications used to estimate the short run Phillips curve for Sweden in Table 1. In addition to the original sample period in Svensson (2015) that is 2000-2011, we investigate two additional end points: the pre-Great Recession period (2000-2007) as well as the overall period (2000-2019). In each sample period, the short run Phillips curve is estimated using both the core CPI inflation as well as the core PCE inflation to identify the best possible fit. Similar to Sweden, we use the quarterly annualized percentage changes in core CPI or PCE as the dependent variable to estimate the short run Phillips curve.

Table 11 shows the estimated short run Phillips curve between 2000 and 2011. Meanwhile, Table 12 shows the estimated short run Phillips curve between 2000 and 2007. Table 13 shows the estimated short run Phillips curve between 2000 and 2019. From these tables, we can conclude that using core CPI inflation as the dependent variable results in a better fit, relative to using the core PCE inflation. Meanwhile, similar to Sweden, using lagged unemployment rate as an explanatory variable within the CPI models results in statistically significant coefficients where the sign is also consistent with economic theory. Also, the coefficients of the well anchored inflation expectations are statistically insignificant at 1 percent and 5 percent significance levels. However, unlike Sweden, the coefficients of the first difference in the unemployment rate are statistically insignificant. This confirms Svensson (2015) finding that the specifications of estimating the short run Phillips curve for the United States cannot be the same as that of Sweden.

Following Fuhrer (2011), we estimate the short run Phillips curve for the United States using the following specifications:

$$\pi_t = \beta_0 + \beta_1 \pi_{t-4} - \beta_2 u_{t-1} + \epsilon_t \tag{3}$$

Where $\pi_t$ reflects the quarterly annualized percentage changes in the inflation rate in quarter $t$; $\pi_{t-4}$ reflects four-quarter lag of the inflation rate; $u_{t-1}$ reflects one-quarter lag of the unemployment rate; $\epsilon_t$ reflects exogenous shock.

Table 11: Estimates of short run Phillips curve in the United States between 2000 and 2011 using CPI and PCE as the dependent variable.

| | Core CPI Q/Q AR | | | | | Core PCE Q/Q AR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Constant | 3.515 | 5.875 | 4.169 | 3.478 | 3.525 | 2.513 | −1.666 | −7.887 | 2.559 | 2.455 |
| | (0.270) | (6.337) | (7.530) | (0.273) | (0.266) | (0.299) | (6.999) | (8.184) | (0.304) | (0.310) |
| | [0.0000] | [0.3592] | [0.5827] | [0.0000] | [0.0000] | [0.0000] | [0.8130] | [0.3407] | [0.0000] | [0.0000] |
| Unemp. rate, | 0.098 | 0.093 | 0.092 | | | −0.547 | −0.538 | −0.444 | | |
| 1st difference | (0.227) | (0.229) | (0.241) | | | (0.251) | (0.253) | (0.262) | | |
| | [0.6663] | [0.6859] | [0.7047] | | | [0.0350] | [0.0398] | [0.0975] | | |
| Unemp. rate, | −0.255 | −0.251 | −0.254 | | −0.255 | −0.112 | −0.119 | −0.131 | | −0.112 |
| 1st lag | (0.043) | (0.045) | (0.046) | | (0.043) | (0.048) | (0.050) | (0.050) | | (0.050) |
| | [0.0000] | [0.0000] | [0.0000] | | [0.0000] | [0.0242] | [0.0212] | [0.0120] | | [0.0298] |
| Inflation exp., | | −1.136 | | | | | 2.012 | | | |
| 4th lag | | (3.048) | | | | | (3.367) | | | |
| | | [0.7112] | | | | | [0.5532] | | | |
| Inflation exp., | | | −0.315 | | | | | 5.002 | | |
| 1st lag | | | (3.619) | | | | | (3.933) | | |
| | | | [0.9311] | | | | | [0.2105] | | |
| Unemp. rate | | | | −0.243 | | | | | −0.127 | |
| | | | | (0.043) | | | | | (0.048) | |
| | | | | [0.0000] | | | | | [0.0112] | |
| $R^2$ | 0.449 | 0.451 | 0.449 | 0.419 | 0.447 | 0.192 | 0.199 | 0.222 | 0.138 | 0.103 |
| Adj. $R^2$ | 0.424 | 0.412 | 0.410 | 0.406 | 0.434 | 0.154 | 0.141 | 0.166 | 0.118 | 0.082 |
| RMSE | 0.539 | 0.545 | 0.546 | 0.548 | 0.534 | 0.597 | 0.602 | 0.593 | 0.610 | 0.622 |
| DW | 1.639 | 1.641 | 1.641 | 1.662 | 1.659 | 1.859 | 1.896 | 1.909 | 1.609 | 1.520 |
| AIC | 76.66 | 78.51 | 78.65 | 77.11 | 74.86 | 86.05 | 87.66 | 86.31 | 87.04 | 88.86 |
| $N$ | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 |

Notes: Standard errors within parentheses; p-values within brackets.

Table 14, column (1) replicates the results of Table 4 in Svensson (2015) using Equation 3. We get similar results in terms of statistical significance as well as the size of the estimated coefficients. Moreover, in Table 14, we also estimate the short run Phillips curve in Equation 3 for the two additional sample periods: the pre-Great Recession period (2000-2007) as well as the overall period (2000-2019). Using core CPI inflation as a dependent variable still provides a better fit, relative to using core PCE inflation, which is consistent with the findings of Svensson (2015). Within the core CPI models, the coefficients of lagged unemployment rate are statistically significant at nearly all conventional significance levels where the sign is also consistent with economic theory. However, the magnitude is sensitive to the end point of the sample period. Consistent with the findings of Svensson (2015), prior to the Great recession (2000-2007), the coefficient of lagged unemployment rate is larger (0.572), relative to the baseline model Replication (1) (0.308), which implies a steeper curve. Meanwhile, using the overall sample period (2000-2019), the coefficient of lagged unemployment rate is smaller (0.192), which implies a flattening curve over time. Finally, we can also conclude that the specifications of the short run Phillips curve for the United States in Table 14

Table 12: Estimates of short run Phillips curve in the United States between 2000 and 2007 using CPI and PCE as the dependent variable.

| | Core CPI Q/Q AR | | | | | Core PCE Q/Q AR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Constant | 4.832 | 7.083 | −10.954 | 4.795 | 4.903 | 2.679 | −9.709 | −14.000 | 2.700 | 2.477 |
| | (0.610) | (6.800) | (8.255) | (0.631) | (0.582) | (0.730) | (7.810) | (10.024) | (0.725) | (0.708) |
| | [0.0000] | [0.3065] | [0.1952] | [0.0000] | [0.0000] | [0.0010] | [0.2241] | [0.1735] | [0.0008] | [0.0015] |
| Unemp. rate, | 0.187 | 0.113 | 0.602 | | | −0.536 | −0.128 | −0.098 | | |
| 1st difference | (0.412) | (0.474) | (0.449) | | | (0.493) | (0.544) | (0.546) | | |
| | [0.6523] | [0.8127] | [0.1911] | | | [0.2858] | [0.8159] | [0.8590] | | |
| Unemp. rate, | −0.521 | −0.516 | −0.643 | | −0.534 | −0.145 | −0.173 | −0.274 | | −0.107 |
| 1st lag | (0.120) | (0.123) | (0.131) | | (0.115) | (0.144) | (0.141) | (0.159) | | (0.140) |
| | [0.0002] | [0.0002] | [0.0000] | | [0.0001] | [0.3196] | [0.2306] | [0.0965] | | [0.4477] |
| Inflation exp., | | −1.086 | | | | | 5.979 | | | |
| 4th lag | | (3.268) | | | | | (3.754) | | | |
| | | [0.7421] | | | | | [0.1224] | | | |
| Inflation exp., | | | 7.817 | | | | | 8.259 | | |
| 1st lag | | | (4.077) | | | | | (4.951) | | |
| | | | [0.0655] | | | | | [0.1064] | | |
| Unemp. rate | | | | −0.511 | | | | | −0.151 | |
| | | | | (0.124) | | | | | (0.143) | |
| | | | | [0.0003] | | | | | [0.2973] | |
| $R^2$ | 0.424 | 0.426 | 0.490 | 0.361 | 0.419 | 0.058 | 0.136 | 0.143 | 0.036 | 0.019 |
| Adj. $R^2$ | 0.384 | 0.364 | 0.436 | 0.340 | 0.400 | −0.007 | 0.043 | 0.051 | 0.004 | −0.013 |
| RMSE | 0.457 | 0.465 | 0.438 | 0.473 | 0.451 | 0.548 | 0.534 | 0.531 | 0.544 | 0.549 |
| DW | 1.516 | 1.518 | 1.657 | 1.598 | 1.551 | 2.089 | 2.130 | 2.143 | 1.849 | 1.761 |
| AIC | 43.60 | 45.48 | 41.66 | 44.89 | 41.83 | 55.12 | 54.34 | 54.08 | 53.84 | 54.39 |
| $N$ | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |

Notes: Standard errors within parentheses; p-values within brackets.

are superior to that in Table 11, Table 12, and Table 13.

In Table 15, we use the unemployment gap as an alternative explanatory variable following Fuhrer (2011), instead of the unemployment rate, which would lead us to similar conclusions as in Table 14.

Table 13: Estimates of short run Phillips curve in the United States between 2000 and 2019 using CPI and PCE as the dependent variable.

| | Core CPI Q/Q AR | | | | | Core PCE Q/Q AR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Constant | 2.984 | −1.258 | −0.350 | 2.957 | 2.988 | 2.167 | −3.066 | −4.181 | 2.197 | 2.148 |
| | (0.281) | (2.546) | (2.364) | (0.271) | (0.283) | (0.211) | (2.655) | (2.406) | (0.211) | (0.213) |
| | [0.0000] | [0.6226] | [0.8828] | [0.0000] | [0.0000] | [0.0000] | [0.2516] | [0.0863] | [0.0000] | [0.0000] |
| Unemp. rate, | 0.071 | 0.013 | 0.024 | | | −0.336 | −0.407 | −0.425 | | |
| 1st difference | (0.184) | (0.191) | (0.191) | | | (0.199) | (0.199) | (0.195) | | |
| | [0.7010] | [0.9450] | [0.8986] | | | [0.0959] | [0.0441] | [0.0325] | | |
| Unemp. rate, | −0.166 | −0.198 | −0.192 | | −0.167 | −0.075 | −0.114 | −0.124 | | −0.071 |
| 1st lag | (0.051) | (0.038) | (0.037) | | (0.051) | (0.034) | (0.039) | (0.038) | | (0.035) |
| | [0.0020] | [0.0000] | [0.0000] | | [0.0020] | [0.0326] | [0.0046] | [0.0016] | | [0.0440] |
| Inflation exp., | | 2.140 | | | | | 2.640 | | | |
| 4th lag | | (1.280) | | | | | (1.335) | | | |
| | | [0.0988] | | | | | [0.0516] | | | |
| Inflation exp., | | | 1.687 | | | | | 3.212 | | |
| 1st lag | | | (1.192) | | | | | (1.213) | | |
| | | | [0.1611] | | | | | [0.0098] | | |
| Unemp. rate | | | | −0.162 | | | | | −0.079 | |
| | | | | (0.048) | | | | | (0.034) | |
| | | | | [0.0010] | | | | | [0.0230] | |
| $R^2$ | 0.255 | 0.281 | 0.274 | 0.240 | 0.253 | 0.085 | 0.130 | 0.162 | 0.064 | 0.051 |
| Adj. $R^2$ | 0.235 | 0.253 | 0.245 | 0.230 | 0.244 | 0.061 | 0.095 | 0.129 | 0.052 | 0.039 |
| RMSE | 0.523 | 0.517 | 0.520 | 0.525 | 0.520 | 0.549 | 0.539 | 0.529 | 0.552 | 0.556 |
| DW | 1.426 | 1.492 | 1.476 | 1.446 | 1.436 | 1.632 | 1.747 | 1.819 | 1.553 | 1.523 |
| AIC | 126.28 | 125.39 | 126.20 | 125.87 | 124.42 | 134.07 | 132.05 | 129.01 | 133.82 | 134.97 |
| $N$ | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |

Notes: Newey-West standard errors are used in column 1, column 4 and column 5. Standard errors within parentheses; p-values within brackets.

## *3.7 The United States – Estimating the long run Phillips curve*

We estimate the long run Phillips curve by taking the unconditional mean of equation (3).

$$\pi = \beta_0 + \beta_1 \pi - \beta_2 u \tag{4}$$

$$(1 - \beta_1)\pi = \beta_0 - \beta_2 u \tag{5}$$

$$\pi = \frac{\beta_0}{(1 - \beta_1)} - \frac{\beta_2}{(1 - \beta_1)} u \tag{6}$$

Where $\frac{\beta_2}{(1-\beta_1)}$ represents the slope of the long run Phillips curve.

Table 14: Replication of Table 4 from Svensson (2015) - Estimates of the short run Phillips curve in the US using equation (3).

| Sample period | 2000-2011 | | | 2000-2007 | | 2000-2019 | |
|---|---|---|---|---|---|---|---|
| | Sevensson (2015) | Replication | | | | | |
| | (1) Core CPI Q/Q AR | (1) Core CPI Q/Q AR | (2) Core PCE Q/Q AR | (3) Core CPI Q/Q AR | (4) Core PCE Q/Q AR | (5) Core CPI Q/Q AR | (6) Core PCE Q/Q AR |
| Constant | 4.504 | 4.485 | 3.059 | 5.503 | 2.360 | 3.558 | 2.400 |
| | (0.471) | (0.455) | (0.491) | (0.735) | (0.848) | (0.366) | (0.331) |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0094] | [0.0000] | [0.0000] |
| Core CPI Q/Q AR, 4th lag | −0.332 | −0.315 | | −0.188 | | −0.210 | |
| | (0.129) | (0.124) | | (0.143) | | (0.097) | |
| | [0.0140] | [0.0151] | | [0.1999] | | [0.0340] | |
| Unemployment rate, 1st lag | −0.304 | −0.308 | −0.140 | −0.572 | −0.103 | −0.192 | −0.080 |
| | (0.047) | (0.045) | (0.053) | (0.117) | (0.143) | (0.049) | (0.036) |
| | [0.0000] | [0.0000] | [0.0110] | [0.0000] | [0.4787] | [0.0000] | [0.0281] |
| Core PCE Q/Q AR, 4th lag | | | −0.244 | | 0.050 | | −0.115 |
| | | | (0.175) | | (0.194) | | (0.115) |
| | | | [0.1690] | | [0.7978] | | [0.3208] |
| $R^2$ | 0.50 | 0.519 | 0.150 | 0.452 | 0.022 | 0.291 | 0.063 |
| Adj. $R^2$ | 0.33 | 0.496 | 0.111 | 0.414 | −0.046 | 0.272 | 0.039 |
| RMSE | 0.52 | 0.504 | 0.613 | 0.446 | 0.558 | 0.510 | 0.556 |
| DW | 1.56 | 1.573 | 1.482 | 1.571 | 1.796 | 1.383 | 1.507 |
| AIC | | 70.47 | 88.36 | 41.99 | 56.32 | 122.32 | 135.94 |
| $N$ | | 46 | 46 | 32 | 32 | 80 | 80 |

Notes: Newey-West standard errors are used in column 2 and column 5. Standard errors within parentheses; p-values within brackets.

Using the replicated baseline model in Sevensson (2015), which can be found in Table 14, column (1), the slope of the long run Phillips curve is estimated at around -0.234. This is very close to the estimated slope in Svensson (2015) (-0.228). Additionally, in Table 16, we present different slopes of the long run Phillips curve that are associated with different sample end points: (2000-2007) and (2000-2019). The flattening the curve, the higher the associated unemployment cost.

Nevertheless, the associated unemployment cost is negligible since the average inflation rate measured by both the core CPI and the core PCE was very close to the 2.0 percent level across the different sample periods as shown in Table 17.

Table 15: Estimates of the short run Phillips curve in the US using the unemployment gap.

| Sample period | 2000-2011 | | 2000-2007 | | 2000-2019 | |
|---|---|---|---|---|---|---|
| | (1) Core CPI Q/Q AR | (2) Core PCE Q/Q AR | (3) Core CPI Q/Q AR | (4) Core PCE Q/Q AR | (5) Core CPI Q/Q AR | (6) Core PCE Q/Q AR |
| Constant | 2.918 | 2.321 | 2.588 | 1.819 | 2.662 | 2.021 |
| | (0.288) | (0.321) | (0.326) | (0.370) | (0.204) | (0.218) |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] |
| Core CPI Q/Q AR, 4th lag | −0.310 | | −0.183 | | −0.228 | |
| | (0.125) | | (0.145) | | (0.094) | |
| | [0.0171] | | [0.2185] | | [0.017] | |
| Unemployment gap, 1st lag | −0.291 | −0.129 | −0.544 | −0.061 | −0.197 | −0.083 |
| | (0.044) | (0.051) | (0.115) | (0.139) | (0.048) | (0.035) |
| | [0.0000] | [0.0150] | [0.0001] | [0.6606] | [0.0000] | [0.0206] |
| Core PCE Q/Q AR, 4th lag | | −0.230 | | 0.062 | | −0.119 |
| | | (0.175) | | (0.194) | | (0.114) |
| | | [0.1940] | | [0.7510] | | [0.2999] |
| $R^2$ | 0.512 | 0.141 | 0.436 | 0.011 | 0.308 | 0.070 |
| Adj. $R^2$ | 0.489 | 0.101 | 0.397 | −0.057 | 0.290 | 0.046 |
| RMSE | 0.508 | 0.616 | 0.452 | 0.561 | 0.504 | 0.554 |
| DW | 1.554 | 1.468 | 1.528 | 1.790 | 1.412 | 1.517 |
| AIC | 71.12 | 88.86 | 42.89 | 56.67 | 120.36 | 135.37 |
| $N$ | 46 | 46 | 32 | 32 | 80 | 80 |

Notes: Newey-West standard errors are used in column 2 and column 5. Standard errors within parentheses; p-values within brackets.

Table 16: Long run Phillips curve slope in the US

| Sample period | Slope $\lvert\frac{\beta_2}{(1-\beta_1)}\rvert$ | Standard Error | 95% Confidence Interval Lower bound | Upper bound |
|---|---|---|---|---|
| 2000-2007 | 0.48 | 0.12 | 0.25 | 0.72 |
| 2000-2011 (Svensson 2015) | 0.23 | 0.05 | 0.14 | 0.32 |
| 2000-2019 | 0.16 | 0.03 | 0.09 | 0.23 |

Table 17: Average inflation and inflation expectations in the US over different sample periods

| | 2000-2007 | 2000-2011 | 2000-2019 |
|---|---|---|---|
| Core PCE inflation Y/Y | 1.91 | 1.77 | 1.73 |
| Core PCE inflation Q/Q AR | 1.94 | 1.79 | 1.73 |
| Core CPI inflation Y/Y | 2.21 | 2.02 | 2.00 |
| Core CPI inflation Q/Q AR | 2.22 | 2.01 | 2.01 |
| Index of Common Inflation Expectation | 2.09 | 2.10 | 2.06 |

## 4 Concluding remarks

This paper successfully replicates the findings presented in Svensson (2015). The deviation of the average inflation rate from its targeted level, when the inflation expectations are well anchored around the targeted level, leads the long run Phillips curve to be non-vertical. The non-vertical long run Phillips curve implies that the lower the average inflation rate relative to its targeted level, the higher the average unemployment rate.

In Sweden, the slope of the long run Phillips curve is estimated at around -0.75 over the sample period, which implies an estimated average unemployment cost of 1.3 percentage points that is associated with a one percentage point decrease in the average inflation. Such associated unemployment cost led to an average unemployment rate of 7.4 percent, compared to an estimated 6.6 percent in the case of no inflation deviation from its targeted level over the sample period. Lower average inflation rate over the sample period in Sweden, relative to its targeted level, partly reflected aggressive monetary policy tightening that followed the introduction of the inflation targeting framework as noted by Batini and Ishi (2012).

In the United States, the slope of the long run Phillips curve is estimated at around -0.23 over the sample period 2000-2011. However, using an extended sample period 2000-2019, the long run Phillips curve flattens at an estimated slope of -0.16, compared with -0.48 for the pre-Great Recession sample period 2000-2007. Nevertheless, unlike Sweden, the associated unemployment cost in the United States is neglectable since the average inflation rate only deviated marginally from the 2.0 percent level over the sample periods.

Further research could help explain how the deviation of inflation rate from its target feeds into inflation expectations and vice-versa. In Sweden, inflation expectations remained anchored around the targeted level even though the actual inflation rate over the sample period undershoots its targeted level. Finally, a valid question remains whether implementing a different monetary policy framework could help reduce the unemployment cost of having the average inflation rate below a credible target.

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## *Data Appendix*

Most of the original data and all the codes provided by the author were stored in EViews workfiles. Accordingly, we extracted the needed data from EViews and added them the excel sheets that were originally provided by the author.

### *A1. Sweden Data*

No changes to the dataset from our side.
Excel sheet name: SW.xlsx

Variables:

- Date: 1981 Q1 – 2012Q4
- Unemployment indicators:
  - Unemployment rate
  - Riksbank long-term unemployment
- Inflation indicators:
  - CPI inflation Y/Y
  - CPI Q/Q, annualized
  - CPIF Q/Q, annualized
  - GDP-deflator inflation Q/Q, annualized
- Inflation expectations indicators:
  - 1-year inflation expectation
  - 2-year inflation expectation
  - 5-year inflation expectation

Main data operations:

- Defining time series.
- Adding labels.
- Generating inflation target variable.
- Generating lag variables.
- Generating gap variables:
  - Unemployment gap.
  - Inflation gap.

## *A2. US Data*

We updated the full dataset up to 2021 Q1.
Excel sheet name: LSUSData.xlsx
Source: fred.stlouisfed.org (unless otherwise mentioned).

Variables:

- Date: 1970 Q1 – 2021 Q1
- Unemployment indicators:
  - Unemployment rate
  - CBO Long-run non-accelerating inflationary rate of unemployment
  - CBO Short run non-accelerating inflationary rate of unemployment
- Inflation indicators:
  - Core CPI Y/Y
  - Core CPI Q/Q, annualized
  - Core PCE Y/Y
  - Core PCE Q/Q, annualized
- Inflation expectations indicators:
  - Index of Common Inflation expectations
  - Common Inflation Expectations, alternative index
    Source: www.federalreserve.gov/econres/notes/feds-notes/research-data-series-index-of-common-inflation-expectations-20210305.htm

Main data operations:

- Defining time series.
- Adding labels.
- Generating inflation target variable.
- Generating lag variables.
- Generating gap variables:
  - Unemployment gap.
  - Inflation gap.