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Has the Recession Started?

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ABSTRACT

This paper develops a new rule to detect US recessions by combining data on job vacancies and unemployment. We first construct a new recession indicator: the minimum of the Sahm-rule indicator (the increase in the 3-month average of the unemployment rate above its 12-month low) and a vacancy analogue. The minimum indicator captures simultaneous rises in unemployment and declines in vacancies. We then set the recession threshold to 0.29 percentage points (pp), so a recession is detected whenever the minimum indicator crosses 0.29pp. This new rule detects recessions faster than the Sahm rule: with an average delay of 1.2 months instead of 2.7 months, and a maximum delay of 3 months instead of 7 months. It is also more robust: it identifies all 15 recessions since 1929 without false positives, whereas the Sahm rule breaks down before 1960. By adding a second threshold, we can also compute recession probabilities: values between 0.29pp and 0.81pp signal a probable recession; values above 0.81pp signal a certain recession. In December 2024, the minimum indicator is at 0.43pp, implying a recession probability of 27%. This recession risk was first detected in March 2024.

JEL Classification: E24, E32, J63, J64

1 | Introduction

Has the US economy entered a recession? To answer the question, this paper develops a new Sahm [1]-type recession rule that combines data on job vacancies and unemployment. Unemployment and job vacancies are intricately related to the business cycle (see Figure 1), and they are measured independently at a monthly frequency. By combining data on vacancies and unemployment, we obtain a signal of the state of the business cycle that is less noisy than if we only used unemployment data—as the Sahm rule does. The combination, therefore, allows us to detect recessions in a more timely and robust manner.

The new rule is based on a new recession indicator that is itself the minimum of two indicators. The first is the Sahm-rule indicator, which measures the increase in the 3-month average of the unemployment rate above its 12-month low. The second is an analogous vacancy-based indicator, which measures the decrease in the 3-month average of the vacancy rate below its 12-month high. The minimum indicator only becomes positive once the unemployment rate rises and the vacancy rate declines.

We then set the recession threshold to 0.29 percentage points (pp), so a new recession is detected whenever the minimum indicator crosses 0.29pp. This is the lowest threshold that does not produce false positives (detect nonexistent recessions) between 1960 and 2021. Our approach mirrors that of the Sahm rule, which similarly selects a threshold of 0.50pp to avoid false positives [7]. For convenience and conciseness, we refer to our detection method as the Michez rule—using the name coined by the *Financial Times* [8].

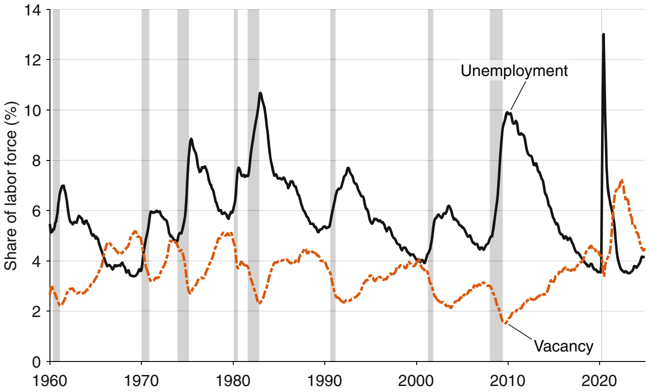

FIGURE 1 | US unemployment and vacancy rates, January 1960–December 2024. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The unemployment rate is computed from data produced by the BLS [2, 3]. The vacancy rate is computed from data produced by Barnichon [4] and the BLS [2, 5]. Both rates are 3-month trailing averages of monthly series. Shaded areas indicate recessions dated by the NBER [6].

We find that the Michez rule detects recessions earlier than the Sahm rule. It detects the nine recessions that occurred between 1960 and 2021 with an average delay of 1.2 months, while the Sahm rule detects them with an average delay of 2.7 months. Furthermore, the Michez rule detects the nine recessions within 3 months of their official starts. The Sahm rule sometimes takes as long as 7 months to detect them.

The Michez rule also has a better historical track record. It detects the 15 recessions that occurred between 1929 and 2021 without false positives. By contrast, the Sahm rule breaks down before 1960: it produces three false positives between 1929 and 1959.

The Sahm and Michez rules signal whether a recession has started or not, but they do not indicate how much uncertainty surrounds that binary signal. To assess the likelihood that a recession has started, we extend the Michez rule by adding a second, higher threshold to it. The second threshold is the highest threshold that does not generate false negatives (fail to detect existing recessions) between 1960 and 2021. The dual-threshold rule works as follows: When the minimum indicator is below 0.29pp, the rule signals that the economy is not in recession. When the minimum indicator is between 0.29pp and 0.81pp, the rule signals that the economy is in recession with positive probability. And when the minimum indicator rises above 0.81pp, the rule signals that the economy is in recession with certainty.

Finally, we apply the Michez rule to the current US situation. The Michez rule suggests that the US economy entered a recession in 2024. The Michez rule first detected a recession in March 2024, as the minimum indicator reached 0.29pp then. In December 2024, the value of the minimum indicator is 0.43pp, so the probability that the US economy is in recession is $(0.43 - 0.29)/(0.81 - 0.29) = 27\%$.

2 | Data

In this section, we present the data on US recessions, unemployment, and job vacancies that we use to implement the Michez rule. These data are widely used [9–14]. We collect data from January 1960—the typical starting point for applying the Sahm rule [7]—to December 2024.

2.1 | Recession Dates

Our goal is to develop an algorithm to detect recessions that is timely, fully automated and completely transparent. To assess the performance of the algorithm, we will compare the number of recessions that it detects and the detection dates to the number of official US recessions and their start dates.

US recessions are officially identified by the Business Cycle Dating Committee of the National Bureau of Economic Research [6]. The NBER [15] identifies the peaks and troughs of US business cycles by looking holistically at numerous macroeconomic variables. Following the NBER's convention, we set the first month of a recession as the month following the peak and the last month of a recession as the month of the trough.

However, the official dates are published months, if not years, after recessions have actually started [16]. For instance, the NBER did not announce before December 2008 that the previous business cycle peak had occurred in December 2007 and therefore that the Great Recession had started in January 2008.

The NBER-dated recessions are displayed in Figure 1. Between January 1960 and December 2021, the NBER identifies nine recessions. The stories behind these recessions are well known. The recession that started in March 2020 was caused by the coronavirus pandemic. The recession that started in January 2008 coincided with the global financial crisis. The recession that started in April 2001 followed the burst of the dot-com bubble. The recession that started in August 1990 followed the Iraqi invasion of Kuwait and associated oil price shock. The recessions that started in February 1980 and August 1982 are associated with the Volcker disinflation's tight monetary policy. The recession that started in December 1973 followed the first oil crisis. The recession that started in January 1970 coincided with fiscal and monetary tightening toward the end of the Vietnam War. Last, the recession that started in May 1960 followed tighter monetary policy in 1958–1960.

2.2 | Unemployment Data

We compute the US unemployment rate as the number of jobseekers measured by the Bureau of Labor Statistics [3] from the Current Population Survey (CPS), divided by the civilian labour force measured by the BLS [2] from the CPS. This is the standard, official measure of unemployment, labelled U3 by the BLS [17].[1]

The unemployment rate used in the analysis is plotted in Figure 1. It is countercyclical, rising sharply at the onset of all recessions.

2.3 | Vacancy Data

We measure the US vacancy rate from two different sources because there is no continuous vacancy series over the period.

Between January 1960 and December 2000, we use the vacancy rate constructed by Barnichon [4]. This series is based on the Conference Board's help-wanted advertising index, adjusted to account for the shift from print advertising to online advertising in the 1990s. The Conference Board index aggregates help-wanted advertising in major metropolitan newspapers in the United States. It serves as a reliable proxy for job vacancies [20, 21].

Between January 2001 and December 2024, we use the number of job openings measured by the BLS [5] from the Job Openings and Labor Turnover Survey (JOLTS), divided by the civilian labour force measured by the BLS [2] from the CPS. To best align labour force and vacancy data, we follow Michaillat and Saez [14] and shift forward by one month the number of job openings from JOLTS. For instance, we assign to December 2023 the number of job openings that the BLS assigns to November 2023. The motivation for this shift is that the number of job openings from the JOLTS refers to the last business day of the month (Thursday 30 November, 2023), while the civilian labour force from the CPS refers to the Sunday–Saturday week that includes the 12th of the month (Sunday 10 December 2023 to Saturday 16 December 2023) [22, 23]. So the number of job openings refers to a day that is closer to the next month's CPS reference week than to the current month's CPS reference week.

We then splice the two vacancy series to create a continuous vacancy rate covering January 1960–December 2024. The two series are perfectly aligned because Barnichon [4] used the JOLTS data to scale the Conference Board index and translate it into a vacancy rate (which was possible because the Conference Board and JOLTS series overlap in the early 2000s).

The vacancy rate is plotted in Figure 1. It is procyclical, dropping sharply at the onset of all recessions.

2.4 | Availability and Revisions of Labour Market Data

The unemployment and vacancy data required to apply the Michez rule in any given month are released in the first week of the following month, usually on a Tuesday for the JOLTS data and on a Friday for the CPS data [24]. This is another advantage of shifting forward by one month the number of job openings reported in the JOLTS: we have access to the vacancy and unemployment rates required to compute the minimum indicator in the same week, as soon as the month is over. Accordingly, the Michez rule can be applied in real time.

The value of the minimum indicator constructed in real time might not be its final value because the unemployment and vacancy data are revised after their initial release. The number of job openings released by the BLS [5] is preliminary and updated one month after its initial release to incorporate additional survey responses received from businesses and government agencies [25]. Additionally, the BLS revises the prior five years of CPS and JOLTS data each year at the beginning of January, to account for revisions to seasonal factors, population estimates, and employment estimates [25, 26]. Yet, revisions to labour market data are generally minimal, especially compared to GDP revisions, so the information provided in real time is almost indistinguishable from the information provided in the final version [27].

3 | Construction of the Michez Rule

This section constructs the Michez rule. We begin by combining unemployment and vacancy data into a single recession indicator. We then select a threshold that allows the rule to detect recessions accurately and in a timely manner.

3.1 | Unemployment Indicator

We start by constructing the recession indicator used by the Sahm rule. That indicator is computed in two steps from the unemployment rate.

First, we take the 3-month trailing average of the unemployment rate $u(t)$:

$$\overline{u}(t) = \frac{u(t) + u(t-1) + u(t-2)}{3}$$

This step allows us to smooth the unemployment series and reduce its noisiness.

Second, we take the difference between the average unemployment rate $\overline{u}(t)$ and its minimum value over the past 12 months:

$$\hat{u}(t) = \overline{u}(t) - \min_{0 \le s \le 12} \left\{ \overline{u}(t-s) \right\} \tag{1}$$

This step allows us to isolate increases in unemployment.

The unemployment indicator $\hat{u}(t)$ is displayed in Figure 2. The indicator is zero when the unemployment rate is trending downward. The indicator turns strictly positive once the unemployment rate starts rising. The indicator is larger when the unemployment rate increases more rapidly.[2]

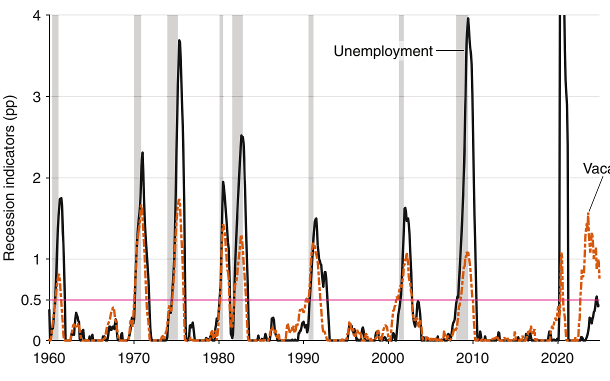

FIGURE 2 | Construction of the Michez rule: unemployment and vacancy indicators, January 1960–December 2024. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The unemployment indicator is computed using Equation (1). The vacancy indicator is computed using Equation (2). Both indicators are based on the unemployment and vacancy rates from Figure 1. The Sahm rule uses the unemployment indicator and a threshold of 0.50pp (highlighted). Extreme values are not shown (the unemployment indicator peaked at 9.47pp during the coronavirus pandemic). Shaded areas indicate recessions dated by the NBER [6].

3.2 | Vacancy Indicator

We analogously construct an indicator based on the vacancy rate. First, we take the 3-month trailing average of the vacancy rate $v(t)$:

$$\bar{v}(t) = \frac{v(t) + v(t-1) + v(t-2)}{3}$$

Second, we take the difference between the average vacancy rate $\bar{v}(t)$ and its maximum value over the past 12 months:

$$\hat{v}(t) = \max_{0 \leq s \leq 12} \left\{ \bar{v}(t-s) \right\} - \bar{v}(t) \tag{2}$$

The vacancy indicator $\hat{v}(t)$ is displayed in Figure 2. The indicator is zero when the vacancy rate is trending upward. The indicator turns strictly positive once the vacancy rate starts declining. The indicator is larger when the vacancy rate declines more rapidly.

3.3 | Reducing Noise: The Minimum Indicator

Our goal is to design an algorithm that detects recessions faster than the Sahm rule. A simple way to achieve this goal would be to lower the Sahm-rule threshold. But the threshold of 0.50pp was chosen to be the lowest threshold that does not generate false positives, so by construction, it cannot be lowered without generating errors. Instead, we need to find another recession indicator that signals recessions more accurately than the unemployment indicator.

The vacancy indicator is an appealing option. Looking at Figure 2, it appears somewhat faster than the unemployment indicator. It would call many recessions earlier (in 1990, 2001, and 2020) and some recessions slightly later (in 2008). But the main advantage of the vacancy indicator is that it does not present the same uninformative blips as the unemployment indicator. For instance, there is no problematic blip in June 2003: the vacancy indicator is not zero, but it is much lower than the unemployment indicator. Of course, the vacancy indicator presents its own uninformative blips, but they occur at the same time. For instance it has a peak in July 1967 while no recession was officially identified then—although Friedman and Schwartz did argue that a minirecession occurred in 1966–1967 [29, Chapter 13].

To reduce the noise affecting the unemployment and vacancy indicators, we therefore take the minimum of these two previous indicators:

$$m(t) = \min \left\{ \hat{u}(t), \hat{v}(t) \right\} \tag{3}$$

Given that the blips of the unemployment and vacancy indicators do not occur simultaneously, taking the minimum of the two indicators smooths out the blips and gives us a less noisy, more accurate recession indicator.

The minimum indicator $m(t)$ is plotted in Figure 3. The indicator is zero when either the unemployment rate is trending down or the vacancy rate is trending up. It is only positive when the unemployment rate rises and the vacancy rate declines.

By combining vacancy and unemployment data, we will be able to detect recessions more quickly and more robustly than the

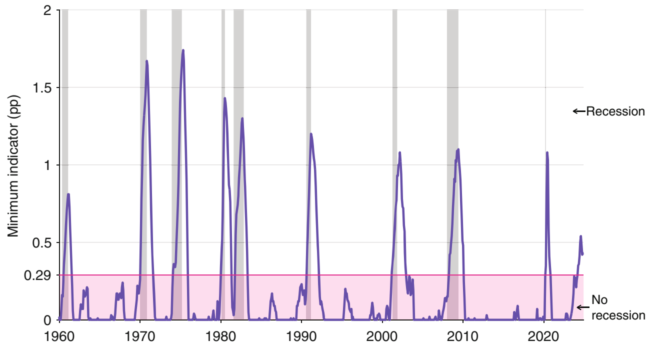

FIGURE 3 | Michez rule in the United States, January 1960–December 2024. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The Michez rule signals a recession when the minimum indicator crosses the threshold of 0.29pp. The minimum indicator is the minimum of the unemployment and vacancy indicators displayed in Figure 2. Shaded areas indicate recessions dated by the NBER [6].

Sahm rule. Indeed, job vacancies start falling quickly at the onset of recessions, when unemployment starts rising (Figure 1). Requiring that both unemployment rises and vacancies fall will yield a less noisy, more accurate and ultimately more timely recession signal.

3.4 | Recession Threshold

To obtain a less noisy recession signal, we take the minimum of the unemployment and vacancy indicators. The reduced noise then allows us to lower the recession threshold from 0.50pp to 0.29pp. We cannot lower the threshold below 0.29pp because in May 2003 the minimum indicator reached 0.28pp while there was no recession (Figure 3).

Of course, the minimum indicator is slower to increase than the unemployment indicator—since it can only increase when both the unemployment and vacancy indicators rise. But the reduction in threshold afforded by the reduced noise is so large that the minimum indicator will detect recessions faster than the unemployment indicator.

3.5 | Detection Methodology

The Michez rule detects that the US economy has entered a recession whenever the minimum indicator crosses the threshold of 0.29pp (Figure 3). Formally, a recession is detected in month t whenever

$$m(t-1) < 0.29 \qquad \text{and} \qquad m(t) \geq 0.29 \tag{4}$$

Below, we use the Sahm rule as a benchmark for assessing the performance of the Michez rule. It is therefore useful to formalize it. The Sahm rule detects a recession whenever the unemployment indicator crosses the threshold of 0.50pp. Formally, a recession is detected by the Sahm rule in month t whenever

$$\hat{u}(t-1) < 0.50 \qquad \text{and} \qquad \hat{u}(t) \geq 0.50 \tag{5}$$

3.6 | Theoretical Foundations

To improve upon the unemployment-based Sahm rule, we leverage two insights from the macroeconomics of slack. First, business cycles are mostly driven by shocks to aggregate demand, which trigger shocks to labour demand [30]. Second, such shocks produce negative comovements between the unemployment rate and vacancy rate as the economy moves along the Beveridge curve [30–32]. Therefore, a typical recession features both a drop in vacancy rate and a rise in unemployment rate. By combining data on unemployment and job vacancies—two noisy but independent measures of aggregate demand—we obtain a clearer signal of latent aggregate demand than the Sahm rule.

In particular, the Michez rule is not triggered by shifts in the Beveridge curve, which occur from time to time [13, Figure 5]. It is not triggered by an outward shift because such a shift produces a joint increase in the unemployment and vacancy rates—so the vacancy rate does not fall. It is not triggered by an inward shift either because such a shift produces a joint decrease in the unemployment and vacancy rates—so the unemployment rate does not rise. Only a diminution in economic activity pushing the economy down the Beveridge curve triggers the Michez rule.

4 | Evaluation of the Michez Rule (1960–2021)

We now evaluate the performance of the Michez rule between 1960 and 2021. We stop the evaluation at the end of 2021 because it is too early to say if and when a recession started after that. We focus on false positives and negatives as well as the timeliness of detection, comparing the performance of the Michez rule to that of the Sahm rule.

4.1 | No False Positives or Negatives

The Michez rule has a perfect track record between January 1960 and December 2021 (Figure 3). First, the Michez rule does not produce false negatives: it does not fail to detect existing recessions. Indeed, the rule detects the nine recessions that occurred between 1960 and 2021. This is because the minimum indicator peaks well above 0.29pp during each of the recessions. Second, the Michez rule does not produce false positives: it does not detect nonexistent recessions. This is because the minimum indicator always remains below 0.29pp outside of recessionary periods.

In sum, the Michez rule identifies all the recessions that occurred between 1960 and 2021, without any false alarms. Over that period, the Sahm rule does as well as the Michez rule: it produces neither false negatives nor false positives (Figure 2).

4.2 | Timeliness of Detection

The Michez and Sahm rules both perfectly detect the nine recessions that occurred between 1960 and 2021. However, the Michez rule generally detects these recessions faster than the Sahm rule (Table 1). On average, the Michez rule detects recessions 1.2 months after their official start dates. This is 1.5 months faster than the Sahm rule, which, on average, detects recessions 2.7 months after their official start dates. Furthermore, the Michez rule detects all nine recessions within 3 months of their official starts. The Sahm rule sometimes takes as long as 7 months to detect them.

In fact, the Michez rule detects all recessions faster than the Sahm rule except the Great Recession. In 2008, the Michez rule detected the recession 2 months later than the Sahm rule: in April 2008 instead of February 2008. The slight delay is because job vacancies took some time to drop at the onset of the Great Recession (Figures 1 and 2).

It is not surprising that the Sahm and Michez rules often only detect recessions after their official start dates because the official dates are backdated [16]. The NBER identifies recessions with

TABLE 1 | Detection of US recessions by the Michez rule, January 1960–December 2021.

Recession start date		Michez-rule detection date		Sahm-rule detection date	
Year	**Month**	**Year**	**Month**	**Year**	**Month**
1960	May	1960	August	1960	October
1970	January	1970	February	1970	March
1973	December	1974	February	1974	July
1980	February	1980	January	1980	February
1981	August	1981	October	1981	November
1990	August	1990	September	1990	October
2001	April	2001	March	2001	July
2008	January	2008	April	2008	February
2020	March	2020	April	2020	April
Average detection delay:		1.2 months		2.7 months	
Maximum detection delay:		3 months		7 months	

Note: Recession start dates are determined by the NBER [6]. The Michez rule detects a recession when the minimum indicator crosses the threshold of 0.29pp (Figure 3 and Equation 4). The Sahm rule detects a recession when the unemployment indicator crosses the threshold of 0.50pp (Figure 2 and Equation 5).

hindsight, not in real time, which is what the Sahm and Michez rules aim to do.

5 | Historical Robustness of the Michez Rule (1929–1959)

This section examines the historical robustness of the Michez rule by extending the analysis to the earlier period from 1929 to 1959. We assess whether the rule remains accurate and timely in detecting recessions during a period of greater macroeconomic volatility and less standardized data.

5.1 | Historical Data

Between April 1929 and December 1947, we use the unemployment rate constructed by Petrosky-Nadeau and Zhang [33]. They extrapolate Weir [34]'s annual unemployment series to a monthly series using monthly unemployment rates compiled by the NBER. Between January 1948 and December 1959, we compute the unemployment rate just as in the modern period: it is the number of jobseekers divided by the civilian labour force, both measured by the BLS [2, 3].

Between April 1929 and December 1950, we use the vacancy rate constructed by Petrosky-Nadeau and Zhang [33] from the help-wanted index created by the Metropolitan Life Insurance Company (MetLife). The MetLife index aggregates help-wanted advertisements from newspapers across major US cities. It is considered a reliable proxy for job vacancies [35]. The MetLife index is scaled to align with Barnichon [4]'s vacancy rate at the end of 1950, which effectively translates the index into a vacancy rate.[3] Between January 1951 and December 1959, we use again the vacancy rate produced by Barnichon [4].

Here again, the official recession dates are determined by the NBER [6].

The unemployment rate, vacancy rate, and recession dates for the historical period are plotted in Figure 4.

5.2 | Historical Recession Indicators

Using the historical data, we construct the unemployment, vacancy and minimum indicators just as in the modern period. The unemployment indicator is computed using Equation (1); the vacancy indicator is computed using Equation (2); and the minimum indicator is computed using Equation (3). The unemployment and vacancy indicators are plotted in Figure 5; the minimum indicator is plotted in Figure 6.

During the historical period, it appears maybe even more clearly how taking the minimum of the unemployment and vacancy indicators provides a more accurate recessionary signal. During that period, the unemployment and vacancy indicators both exhibited several large uninformative blips, which are ironed out once we take their minimum.

For example, the unemployment indicator peaked at 3.98pp in November 1934, although no recession occurred then (Figure 5).

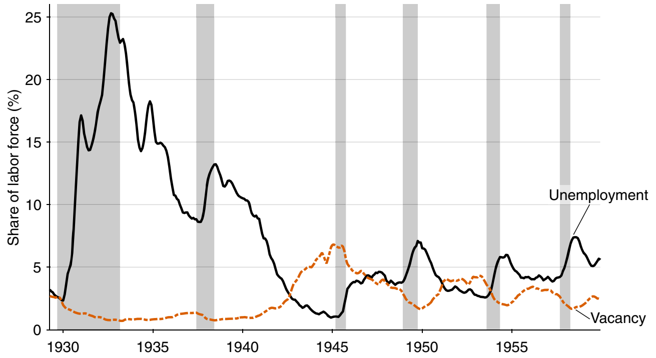

FIGURE 4 | US unemployment and vacancy rates, April 1929–December 1959. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The unemployment rate is computed from data produced by Petrosky-Nadeau and Zhang [33] and the BLS [2, 3]. The vacancy rate is computed from data produced by Petrosky-Nadeau and Zhang [33], Barnichon [4], and the BLS [2, 5]. Both rates are 3-month trailing averages of monthly series. Shaded areas indicate recessions dated by the NBER [6].

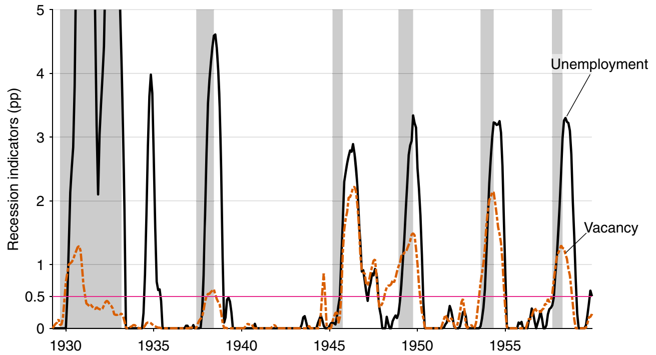

FIGURE 5 | Construction of the Michez rule: unemployment and vacancy indicators, April 1929–December 1959. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The unemployment indicator is computed using Equation (1). The vacancy indicator is computed using Equation (2). Both indicators are based on the unemployment and vacancy rates from Figure 1. The Sahm rule uses the unemployment indicator and a threshold of 0.50pp (highlighted). Extreme values are not shown (the unemployment indicator peaked at 14.79pp during the Great Depression). Shaded areas indicate recessions dated by the NBER [6].

The vacancy indicator is not subject to that blip: it remained close to zero during 1934–1935. Thus, the minimum indicator is not subject to the blip either. This situation occurred again at the end of the historical period. The unemployment indicator reached 0.59pp in November 1959, but there was no recession. Thankfully the vacancy indicator remained much lower during that episode, so the minimum indicator was only subject to a minor blip in 1959.

Sometimes, the situation is reversed: the vacancy indicator is subject to an uninformative blip that does not appear in the unemployment indicator. For instance, the vacancy indicator spiked at 0.86pp in September 1944 while no recession happened then. But because the unemployment indicator did not rise much at the time, the minimum indicator did not rise much either.

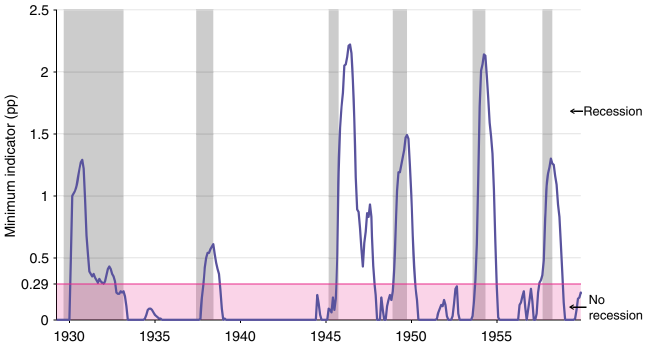

FIGURE 6 | Michez rule in the United States, April 1929–December 1959. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The Michez rule signals a recession when the minimum indicator crosses the threshold of 0.29pp. The minimum indicator is the minimum of the unemployment and vacancy indicators displayed in Figure 5. Shaded areas indicate recessions dated by the NBER [6].

Overall, taking the minimum of the unemployment and vacancy indicators eliminates numerous uninformative blips between 1929 and 2021 and provides a much less noisy recession indicator.

5.3 | No Historical Errors

The Michez rule continues to perform well in historical data: it detects the six recessions that occurred between April 1929 and December 1959 without producing any false positive (Figure 6). That historical period featured extreme macroeconomic volatility, with vast fluctuations in unemployment and job vacancies, driven by seismic events such as the Great Depression and World War 2 (Figure 4). Nevertheless, the Michez rule continues to work before 1960.

Unlike the Michez rule, the Sahm rule breaks down before 1960 (Figure 5). In November 1959, the unemployment indicator reached 0.59pp although there was no recession, so the Sahm rule produced a false positive. The Sahm rule produced another false positive in August 1947. Before World War 2, the Sahm rule faces an even bigger problem. In November 1934, the unemployment indicator peaked at 3.98pp, while there was no recession at the time. That peak was higher than many later recessionary peaks: the unemployment indicator remained below 3.5pp for the last four recessions of the 1929–1959 period. Because of the 1934 peak, all threshold rules based on the unemployment indicator would make classification mistakes between 1929 and 1959. Avoiding false positives would require the threshold to be above 3.98pp, while avoiding false negatives would require the threshold to be below 2.89pp, the peak associated with the 1945 recession. Obviously, no threshold can simultaneously be below 2.89pp and above 3.98pp.

5.4 | Historical Timeliness

In the historical period, the Michez rule is somewhat slower at detecting recessions. Between 1929 and 1959, the Michez rule detects recessions on average 3.0 months after their official start dates (Table 2). This is slower than over the modern period, when the rule's average detection delay is only 1.2 months (Table 1). The maximum detection delay is also longer: 6 months in the historical period instead of just 3 months in the modern period.

TABLE 2 | Detection of US recessions by the Michez rule, April 1929–December 1959.

Recession start date		Michez-rule detection date	
Year	**Month**	**Year**	**Month**
1929	September	1930	February
1937	June	1937	December
1945	March	1945	September
1948	December	1949	January
1953	August	1953	October
1957	September	1957	July
Average detection delay:		3.0 months	
Maximum detection delay:		6 months	

Note: Recession start dates are determined by the NBER [6]. The Michez rule detects a recession when the minimum indicator crosses the threshold of 0.29pp (Figure 6 and Equation 4).

A possible explanation for the relative slowness of the Michez rule is that the unemployment and vacancy data are noisier over the historical period. This noisiness might be explained by the facts that the unemployment data come from a patchwork of sources, and that the vacancy data were collected by private entities and not by the BLS.

As the Michez rule continues to work before 1960, it displays a perfect track record between 1929 and 2021—over almost a century of US business cycles. The Michez rule perfectly detects the 15 recessions that occurred between 1929 and 2021, without producing any false positives or negatives. The Michez rule detects these recessions on average 1.9 months after they have officially started.

5.5 | Stability of the Threshold Over Time

The historical data also show that if we had built and updated the Michez rule in the past following the same methodology, the Michez rule would have been remarkably stable.

Initially, in 1929–1932, any positive value of the minimum indicator marked a recession, so any positive threshold would have worked. In October 1934, the minimum indicator touched 0.09pp although there was no recession, so at that point the recession threshold would have needed to be raised to 0.10pp to avoid a false positive (Figure 6). That threshold would have worked for a decade. Then, in July 1944, the minimum indicator reached 0.20pp, but the recession had not yet started. To avoid a false positive, the recession threshold would have needed to be updated to 0.21pp. The 0.21pp threshold would have held for a few years.

In September 1952, the minimum indicator peaked at 0.27pp, but there was no recession, so the recession threshold would have needed to be increased to 0.28pp. That threshold is just 1 basis point away from the current threshold of 0.29pp, and it would have held for more than half a century. It would not have needed to be updated until May 2003. Then, the minimum indicator reached 0.28pp without a recession, so the threshold would have needed to be slightly raised to 0.29pp—its current value.

In sum, if it had existed, the Michez rule would have remained essentially the same between 1952 and today—barring a 1-basis-point increase in 2003. So it would have been exceedingly stable.

6 | Extension of the Michez Rule: Dual Thresholds and Recession Probability

This section introduces a second threshold in the Michez rule to move beyond binary classification and quantify the probability that a recession has started. This dual-threshold extension accounts for uncertainty in the true recession threshold and provides a simple way to nowcast recession risk.

So far, the Michez rule used only one threshold of 0.29pp. This is the lowest threshold that does not produce false positives between 1960 and 2021. But we can also select a second, conservative threshold, which is the highest threshold that does not produce false negatives between 1960 and 2021. This threshold is 0.81pp (Figure 7). The second threshold cannot be raised above 0.81pp because the minimum indicator peaked at 0.81pp in February 1961, at the end of the 1960–1961 recession. If we raised the threshold above 0.81pp, the Michez rule would miss the 1960–1961 recession.

With these two thresholds, we have a dual-threshold rule. When the minimum indicator is below 0.29pp, the rule signals that the economy is not in recession. When the minimum indicator is between 0.29pp and 0.81pp, the rule signals that the economy is in recession with positive probability. And when the minimum indicator rises above 0.81pp, the rule signals that the economy is in recession with certainty.

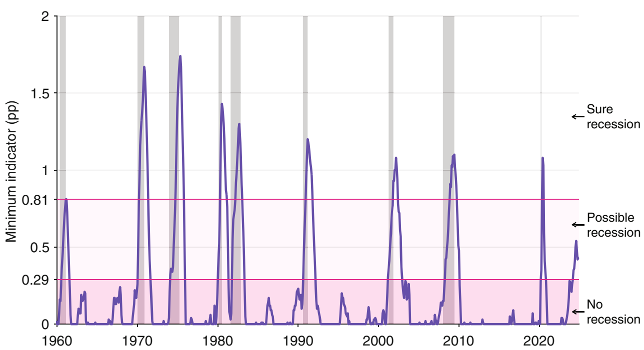

FIGURE 7 | Dual-threshold Michez rule in the United States, January 1960–December 2024. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* When the minimum indicator is below 0.29pp, the Michez rule signals no recession. When the minimum indicator is between 0.29pp and 0.81pp, the rule signals a probable recession. And when the minimum indicator is above 0.81pp, the rule signals a sure recession. The minimum indicator is the minimum of the unemployment and vacancy indicators displayed in Figure 5. Shaded areas indicate recessions dated by the NBER [6].

Furthermore, when the indicator is between 0.29pp and 0.81pp, we can compute the probability that the economy is in recession. The probability simply reflects the share of the 0.29pp–0.81pp band that has been covered by the indicator. When the minimum indicator has a value of $m(t) \in [0.29, 0.81]$, the probability that the economy is in recession is

$$p(t) = \frac{m(t) - 0.29}{0.81 - 0.29} \tag{6}$$

The recession probability is a byproduct of our ignorance, itself caused by a dearth of macroeconomic data. We start from the presumption that there is a unique threshold separating recessions from non-recessions. When the minimum indicator crosses the true threshold from below, the economy experiences a recession. The challenge is that there is not enough data to identify this threshold with exactitude. We know that the threshold is above 0.29pp because the indicator has crossed all values below 0.29pp without triggering a recession. We also know that the indicator is below 0.81pp because there are recessions between 1960 and 2021 that have not strictly crossed 0.81pp. So the latent threshold must be between 0.29pp and 0.81pp. We cannot narrow the range further without observing more recessions. Assuming that this unobservable threshold is uniformly distributed over 0.29pp–0.81pp—a convenient and neutral assumption—we compute the probability to be in a recession as the probability that the indicator has crossed the latent threshold, which is given by (6).

The recession probability given by formula (6) follows a simple pattern (Figure 8). When the minimum indicator reaches the bottom threshold of 0.29pp, the probability becomes positive. Then, when the indicator reaches the top threshold of 0.81pp, the probability becomes 1. In most cases, the probability quickly rises from 0 to 1 after the Michez rule first detects a recession, such that the probability reaches 1 before the recession officially ends.

FIGURE 8 | Probability of US recession from the dual-threshold Michez rule, January 1960–December 2024. [Colour figure can be viewed at wileyonlinelibrary.com] *Notes:* The recession probability is computed from formula (6). The formula uses the minimum indicator and thresholds displayed in Figure 7. Shaded areas indicate recessions dated by the NBER [6].

7 | Application to the Current Economic Situation (2022–2024)

Finally, we apply the Michez rule to contemporary data to assess the current risk of recession in the United States. Has the US economy entered a recession between January 2022 and December 2024?

In June 2022, the vacancy rate started falling, so the vacancy indicator started rising (Figure 2). However, the unemployment rate was still falling, so the unemployment and minimum indicators remained zero. In May 2023, the unemployment rate began climbing, so it was the turn of the unemployment and minimum indicators to start rising. In March 2024, the minimum indicator reached 0.29pp, so the Michez rule detected a recession at that time (Figure 7). After March 2024, the minimum indicator continued climbing, which raised the recession probability given by the dual-threshold rule. In August 2024, the minimum indicator attained 0.54pp, so the probability that the US economy was in recession was $(0.54 - 0.29)/(0.81 - 0.29) = 48\%$. The indicator tapered off after that. In December 2024, the minimum indicator stands at 0.43pp, implying a recession probability of $(0.43 - 0.29)/(0.81 - 0.29) = 27\%$.

Overall, the Michez rule signalled that the US economy entered a recession at the beginning of 2024. What did the Sahm rule find during the same period? In July 2024, the unemployment indicator reached 0.50pp, so the Sahm rule signalled a recession (Figure 2). The unemployment indicator rose to 0.54pp in August 2024 and fell below 0.50pp after that. The Sahm rule therefore detected a US recession in the summer of 2024, but the recessionary signal faded in the fall of 2024. It is not surprising that the Michez rule detected a recession earlier than the Sahm rule, since it is generally faster than the Sahm rule (Table 1).

8 | Other Algorithms to Detect Recessions in Real Time

There already exist several algorithms to detect US recessions in real time, using a variety of data and methods [36–44].[4] However, among available data, Crump, Giannone, and Lucca [27] find that labour market data are the most reliable to detect recessions because they are less noisy, so they produce fewer false positives. Another advantage is that labour market variables are less sensitive to revisions than other variables, especially GDP, so their real-time performance is almost as good as their final performance.

In fact, Crump, Giannone, and Lucca [63] observe that the unemployment rate, combined with a threshold rule, has a great record of identifying US recessions. This explains the long history, current popularity, and overall good performance of rules of that sort, such as the Sahm rule. Another such rule was designed by Schannep [64, Chapter 12]: it compares the unemployment rate to its cyclical low (determined by hand) and uses a threshold of 0.40pp. A similar rule was developed by Hatzius and Stehn [65]: that rule compares the unemployment rate to its cyclical low (determined by hand) and uses a threshold of 0.35pp. More recently, Sun, Feng, and Hu [66] proposed to use the Sahm rule with an unemployment measure purged of the labour force misclassifications identified by Abowd and Zellner [67]; this modified rule requires a threshold of 0.60pp.

Policymakers and private-sector practitioners have also been using such rules. In 2000, Goldman Sachs compared the unemployment rate to its cyclical low (determined by hand) and used a threshold of 0.33pp [7]. Bernanke [68] compared the unemployment rate to its value 4 quarters earlier and used a threshold of 0.30pp. BCA Research developed the Joshi rule, which does not consider all job seekers but instead focuses on job losers not on temporary layoff, and which uses a recession threshold of 0.20pp [69]. Finally, in 2024, UBS computed the decline in the employment-to-population ratio from its 12-month high and used a recession threshold of 0.48pp [8].

Philips [69] confirms Crump, Giannone, and Lucca's insight. Philips attempts to improve the performance of the Sahm rule by using the unemployment rate jointly with the slope of the yield curve—a popular recession predictor developed by Harvey [70, 71] and Estrella and Hardouvelis [72]. However, using the yield curve does not add much at all: Philips [69, p. 1] reports that 'for reasons I do not understand, it appears that the overall unemployment rate acts a pulse of the economy that behaves as a near-complete information set for its state'. Similarly, Mertens [73] finds that the unemployment rate is better at detecting recessions than the slope of the yield curve.

Given the good performance of threshold rules based on unemployment data, it is unsurprising that the Michez rule does well. Furthermore, we improve upon unemployment-only rules by combining data on unemployment and job vacancies, which allows us to construct a recession indicator that is less noisy than unemployment-based indicators.

There remains some arbitrariness in how the Michez rule is constructed. We follow the Sahm rule as much as possible: we pick the same smoothing method (3-month trailing average), and we detect turning points in the same way (12-month trailing extremum). Michaillat [74] constructs many other recession-detection rules by filtering the data differently and adjusting the threshold accordingly. He then shows that by filtering the data optimally and selecting the optimal threshold, recessions can be detected even more rapidly and accurately. However, this paper's key insight remains valid: taking the minimum of unemployment and vacancy indicators provides earlier and more accurate recession signals than relying on unemployment and vacancy indicators alone.

9 | Conclusion

This paper constructs a new recession rule for the US economy by combining data on job vacancies and unemployment. From the combination of unemployment and vacancy data, the Michez rule obtains a less noisy and more reliable signal of recessions than unemployment-only rules such as the Sahm rule. As a result, the Michez rule detects recessions faster than the Sahm rule, and it has a better historical track record. The Michez rule detected a US recession as early as March 2024. In December 2024, the probability that the US economy is in recession is 27%.

Knowing in real time whether the economy has entered a recession is essential to policymakers. Being in a recession means that economic conditions are deteriorating rapidly, which calls for timely and decisive monetary and fiscal interventions. In that way, the Michez rule conveys valuable information to policymakers, although the rule does not have direct implications for optimal monetary or fiscal policy.

This paper provides an example of the predictive power of the vacancy-unemployment combination; that combination has normative power as well. From the unemployment rate u and the vacancy rate v, Michaillat and Saez [14] compute the full-employment rate of unemployment (FERU) in the United States: $u^* = \sqrt{uv}$. The FERU is a central target for the federal government and Federal Reserve because both are legally mandated to maintain the economy at full employment. The FERU also corresponds to the socially efficient unemployment rate, so it is a key input into the design of optimal monetary and fiscal policies [31, 32, 75].

As of December 2024, the unemployment rate is 4.1% and the vacancy rate is 4.8%, so the FERU is $u^* = \sqrt{0.041 \times 0.048} = 4.4\%$. Since the unemployment rate is below the FERU, the US labour market is still inefficiently tight. However, the unemployment gap is almost back to zero, at $u - u^* = 4.1\% - 4.4\% = -0.3$pp. Thus, the US economy is almost back at full employment after overheating for several years, since the middle of 2021 [14].

If the US economy has indeed entered a recession in 2024, and it keeps cooling as it typically does in a recession, the labour market will rapidly become inefficiently slack. In such situations, the Fed should cut rates to stimulate aggregate demand and labour demand, as it started doing in September 2024 [76]. Rate cuts take some time to become fully effective, but they are the most natural way to keep the economy as close as possible to full employment.

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Endnotes

[1] By contrast, the Sahm [18] rule uses the unemployment rate produced by the BLS [19], which takes the same values as our unemployment rate but is rounded to the first digit. The rounding unnecessarily adds volatility to the recession indicator, which is especially problematic in the vicinity of the recession threshold. To reduce noise, we use the exact, unrounded unemployment rate.

[2] While our unemployment indicator is always positive, the standard Sahm-rule indicator is sometimes negative [18]. This is because Sahm [28] computes the trailing minimum over the previous 12 months without including the current month: $\hat{u}(t) = \bar{u}(t) - \min_{1 \le s \le 12}\left\{\bar{u}(t-s)\right\}$. We adjust the definition of the trailing minimum to produce an indicator that is always nonnegative, which is neater without affecting the results (since the positive values of the indicator are unaffected).

[3] Petrosky-Nadeau and Zhang [33] produce a vacancy series that starts in 1919 and an unemployment series that starts in 1890. We only begin our analysis in April 1929, however, because there are some limitations with the prior data [14].

[4] There also exist numerous related algorithms that identify past US recessions retrospectively [45–52], and that predict future US recessions at various time horizons [53–62].

References

1. C. Sahm, "Direct Stimulus Payments to Individuals," in *Recession Ready: Fiscal Policies to Stabilize the American Economy*, ed. H. Boushey, R. Nunn, and J. Shambaugh (Brookings Institution, 2019).

2. BLS, "Civilian Labor Force Level," FRED, Federal Reserve Bank of St. Louis, 2025a, https://fred.stlouisfed.org/series/CLF16OV.

3. BLS, "Unemployment Level," FRED, Federal Reserve Bank of St. Louis, 2025d, https://fred.stlouisfed.org/series/UNEMPLOY.

4. R. Barnichon, "Building a Composite Help-Wanted Index," *Economics Letters* 109 (2010): 175–178.

5. BLS, "Job Openings: Total Nonfarm," FRED, Federal Reserve Bank of St. Louis, 2025b, https://fred.stlouisfed.org/series/JTSJOL.

6. NBER, "US Business Cycle Expansions and Contractions," 2023, https://perma.cc/U8TW-D8JN.

7. C. Sahm, "No, You Didn't Invent the Sahm Rule and That's Ok, We Need More Tools!" Stay-At-Home Macro (SAHM), 2024, https://perma.cc/ZL88-BZNT.

8. S. Keynes, "Simple Indicators of Whether the US Is in Recession Are Flawed," *Financial Times* (2024), https://www.ft.com/content/8e8f22b7-9234-4fdf-a5c4-0a5e18fb65fb.

9. G. Barlevy, R. Faberman, B. Hobijn, and A. Sahin, "The Shifting Reasons for Beveridge Curve Shifts," *Journal of Economic Perspectives* 38 (2024): 83–106.

10. R. Barnichon and A. Figura, "Labor Market Heterogeneity and the Aggregate Matching Function," *American Economic Journal: Macroeconomics* 7 (2015): 222–249.

11. M. C. Daly, B. Hobijn, A. Sahin, and R. G. Valletta, "A Search and Matching Approach to Labor Markets: Did the Natural Rate of Unemployment Rise?," *Journal of Economic Perspectives* 26 (2012): 3–26.

12. M. W. L. Elsby, R. Michaels, and D. Ratner, "The Beveridge Curve: A Survey," *Journal of Economic Literature* 53 (2015): 571–630.

13. P. Michaillat and E. Saez, "Beveridgean Unemployment Gap," *Journal of Public Economics Plus* 2 (2021): 100009.

14. P. Michaillat and E. Saez, "$u^* = \sqrt{uv}$: The Full-Employment Rate of Unemployment in the United States," *Brookings Papers on Economic Activity* 55 (2024).

15. NBER, "Business Cycle Dating Procedure: Frequently Asked Questions," 2024, https://perma.cc/32QQ-D5NW.

16. NBER, "Business Cycle Dating Committee Announcements," 2021, https://perma.cc/JL65-XDWH.

17. BLS, "Labor Force Statistics From the Current Population Survey: Concepts and Definitions," 2023, https://perma.cc/6LGU-AEU6.

18. C. Sahm, "Sahm Rule Recession Indicator," FRED, Federal Reserve Bank of St. Louis, 2025, https://fred.stlouisfed.org/series/SAHMCURRENT.

19. BLS, "Unemployment Rate," FRED, Federal Reserve Bank of St. Louis, 2025e, https://fred.stlouisfed.org/series/UNRATE.

20. K. G. Abraham, "Help-Wanted Advertising, Job Vacancies, and Unemployment," *Brookings Papers on Economic Activity* 18 (1987): 207–248.

21. R. Shimer, "The Cyclical Behavior of Equilibrium Unemployment and Vacancies," *American Economic Review* 95 (2005): 25–49.

22. BLS, "Labor Force Statistics From the Current Population Survey: Overview," 2020, https://perma.cc/RN3P-S4SL.

23. BLS, "Job Openings and Labor Turnover Survey Overview Page," 2024a, https://perma.cc/Y6EQ-WBXF.

24. BLS, "Release Calendar," 2024c, https://perma.cc/ZC78-SDPN.

25. BLS, "JOLTS Frequently Asked Questions," 2024b, https://perma.cc/22QW-ASAL.

26. BLS, "Technical Documentation (CPS)," 2025c, https://perma.cc/DZ9K-AJP8.

27. R. Crump, D. Giannone, and D. Lucca, "*Reading the Tea Leaves of the US Business Cycle: Part One*," Liberty Street Economics, Federal Reserve Bank of New York, 2020a, https://perma.cc/W79A-EFPF.

28. C. Sahm, "The Sahm Rule: Step by Step," Stay-At-Home Macro (SAHM), 2023, https://perma.cc/CS6Z-NZXE.

29. E. Nelson, *Milton Friedman and Economic Debate in the United States, 1932–1972*, vol. 2 (University of Chicago Press, 2020).

30. P. Michaillat and E. Saez, "Aggregate Demand, Idle Time, and Unemployment," *Quarterly Journal of Economics* 130 (2015): 507–569.

31. P. Michaillat and E. Saez, "An Economical Business-Cycle Model," *Oxford Economic Papers* 74 (2022): 382–411.

32. P. Michaillat and E. Saez, "Beveridgean Phillips Curve," arXiv Preprint No. 2401.12475 (2025).

33. N. Petrosky-Nadeau and L. Zhang, "Unemployment Crises," *Journal of Monetary Economics* 117 (2021): 335–353.

34. D. R. Weir, "A Century of US Unemployment: 1890–1990. Revised Estimates and Evidence for Stabilization," *Research in Economic History* 14 (1992): 301–346.

35. J. L. Zagorsky, "Job Vacancies in the United States: 1923 to 1994," *Review of Economics and Statistics* 80 (1998): 338–345.

36. J. H. Stock and M. W. Watson, "New Indexes of Coincident and Leading Economic Indicators," *NBER Macroeconomics Annual* 4 (1989): 351–394.

37. M. Chauvet, "An Econometric Characterization of Business Cycle Dynamics With Factor Structure and Regime Switching," *International Economic Review* 39 (1998): 969–996.

38. M. Chauvet and J. Piger, "A Comparison of the Real-Time Performance of Business Cycle Dating Methods," *Journal of Business & Economic Statistics* 26 (2008): 42–49.

39. E. E. Leamer, "What's a Recession, Anyway?," NBER Working Paper No. 14221 (2008).

40. J. D. Hamilton, "Calling Recessions in Real Time," *International Journal of Forecasting* 27 (2011): 1006–1026.

41. A. Giusto and J. Piger, "Identifying Business Cycle Turning Points in Real Time With Vector Quantization," *International Journal of Forecasting* 33 (2017): 174–184.

42. Y.-F. Huang and R. Startz, "Improved Recession Dating Using Stock Market Volatility," *International Journal of Forecasting* 36 (2020): 507–514.

43. M. Keil, E. Leamer, and Y. Li, "An Investigation Into the Probability That This Is the Last Year of the Economic Expansion," *Journal of Forecasting* 42 (2023): 1228–1244.

44. F. Furno and D. Giannone, "Nowcasting Recession Risk," in *Research Methods and Applications on Macroeconomic Forecasting*, ed. M. Clements and A. Galvao (Edward Elgar Publishing, 2024).

45. G. Bry and C. Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs* (NBER, 1971).

46. J. D. Hamilton, "A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle," *Econometrica* 57 (1989): 357–384.

47. D. Harding and A. Pagan, "Dissecting the Cycle: A Methodological Investigation," *Journal of Monetary Economics* 49 (2002): 365–381.

48. D. Harding and A. Pagan, "Synchronization of Cycles," *Journal of Econometrics* 132 (2006): 59–79.

49. M. Chauvet and J. D. Hamilton, "Dating Business Cycle Turning Points," in *Nonlinear Time Series Analysis of Business Cycles*, ed. C. Milas, P. Rothman, and D. van Dijk (Elsevier, 2006).

50. J. H. Stock and M. W. Watson, "Indicators for Dating Business Cycles: Cross-History Selection and Comparisons," *American Economic Review* 100 (2010): 16–19.

51. T. J. Berge and O. Jorda, "Evaluating the Classification of Economic Activity Into Recessions and Expansions," *American Economic Journal: Macroeconomics* 3 (2011): 246–277.

52. J. H. Stock and M. W. Watson, "Estimating Turning Points Using Large Data Sets," *Journal of Econometrics* 178 (2014): 368–381.

53. J. H. Stock and M. W. Watson, "A Procedure for Predicting Recessions With Leading Indicators: Econometric Issues and Recent Experience," in *Business Cycles, Indicators and Forecasting*, ed. J. H. Stock and M. W. Watson (University of Chicago Press, 1993).

54. A. Estrella and F. S. Mishkin, "Predicting US Recessions: Financial Variables as Leading Indicators," *Review of Economics and Statistics* 80 (1998): 45–61.

55. M. Qi, "Predicting US Recessions With Leading Indicators via Neural Network Models," *International Journal of Forecasting* 17 (2001): 383–401.

56. M. Chauvet and S. Potter, "Forecasting Recessions Using the Yield Curve," *Journal of Forecasting* 24 (2005): 77–103.

57. M. Dueker, "Dynamic Forecasts of Qualitative Variables: A Qual VAR Model of US Recessions," *Journal of Business & Economic Statistics* 23 (2005): 96–104.

58. H. Kauppi and P. Saikkonen, "Predicting US Recessions With Dynamic Binary Response Models," *Review of Economics and Statistics* 90 (2008): 777–791.

59. H. Nyberg, "Dynamic Probit Models and Financial Variables in Recession Forecasting," *Journal of Forecasting* 29 (2010): 215–230.

60. C. Christiansen, J. N. Eriksen, and S. V. Moller, "Forecasting US Recessions: The Role of Sentiment," *Journal of Banking & Finance* 49 (2014): 459–468.

61. S. D. Vrontos, J. Galakis, and I. D. Vrontos, "Modeling and Predicting US Recessions Using Machine Learning Techniques," *International Journal of Forecasting* 37 (2021): 647–671.

62. E. E. Leamer, "Data Patterns That Reliably Precede US Recessions," *Journal of Forecasting* 43 (2024): 2522–2539.

63. R. Crump, D. Giannone, and D. Lucca, "*Reading the Tea Leaves of the US Business Cycle: Part Two*," Liberty Street Economics, Federal Reserve Bank of New York, 2020b, https://perma.cc/8CEL-TK37.

64. J. Schannep, *Dow Theory for the 21st Century: Technical Indicators for Improving Your Investment Results* (Wiley, 2008).

65. J. Hatzius and S. J. Stehn, "Comment on 'the Ins and Outs of Forecasting Unemployment: Using Labor Force Flows to Forecast the Labor Market'," *Brookings Papers on Economic Activity* 43 (2012): 118–131.

66. J. Sun, S. Feng, and Y. Hu, "Misclassification Errors in Labor Force Statuses and the Early Identification of Economic Recessions," *Journal of Asian Economics* 75 (2021): 101319.

67. J. M. Abowd and A. Zellner, "Estimating Gross Labor-Force Flows," *Journal of Business & Economic Statistics* 3 (1985): 254–283.

68. B. S. Bernanke, "September 2006 Federal Open Market Committee Meeting," Presentation Materials, Federal Reserve Board, 2006, https://perma.cc/7Z73-FVKG.

69. T. K. Philips, "A Simple Real-Time Algorithm to Identify Turning Points in US Business Cycles," 2024, https://perma.cc/5JJB-FZZ9.

70. C. R. Harvey, "The Real Term Structure and Consumption Growth," *Journal of Financial Economics* 22 (1988): 305–333.

71. C. R. Harvey, "Forecasting Economic Growth With the Bond and Stock Markets," *Financial Analysts Journal* 45 (1989): 38–45.

72. A. Estrella and G. A. Hardouvelis, "The Term Structure as a Predictor of Real Economic Activity," *Journal of Finance* 46 (1991): 555–576.

73. T. M. Mertens, "Recession Prediction on the Clock," FRBSF Economic Letter No. 2022–36 (2022).

74. P. Michaillat, "Early and Accurate Recession Detection Using Classifiers on the Anticipation-Precision Frontier," 2025, https://pascalmichaillat.org/17/.

75. P. Michaillat and E. Saez, "Optimal Public Expenditure With Inefficient Unemployment," *Review of Economic Studies* 86 (2019): 1301–1331.

76. Federal Reserve Board, "Federal Funds Effective Rate," FRED, Federal Reserve Bank of St. Louis, 2025, https://fred.stlouisfed.org/series/FEDFUNDS.