**1. Growth Patterns in the Ecosystem (RQ1: What are the patterns in the growth of the Maven Central graph across different time periods?)**

* **Overview:**
  + The total added and removed dependencies exhibit a steady upward trajectory across the years, reflecting the natural growth of the Maven Central ecosystem. This pattern indicates the increasing reliance of libraries on reusable components and modular designs to improve development efficiency and reduce redundancy.
* **Key Observations:**
  + **2020 (Significant Decline):**
    - The year 2020 saw a dip in both added and removed dependencies, largely due to the **COVID-19 pandemic**, which disrupted global workflows.
    - Developers and teams faced resource constraints and shifted focus from creating new features or dependencies to stabilizing existing software, prioritizing essential updates and maintenance.
    - This is evident in the reduction of dependency removals, as teams were less inclined to make disruptive changes.
  + **2022 (Decline After Recovery):**
    - Following the initial recovery post-pandemic, the decline in 2022 suggests a **stabilization phase** in the ecosystem.
    - Developers opted for a more cautious approach to dependency updates due to increasing concerns about **supply chain security** and vulnerabilities in dependencies.
    - This year reflects a slowing pace of dependency updates and removals, likely as a response to the growing focus on maintaining long-term stability and security.
* **Overall Pattern:**
  + The long-term trend suggests that as Maven Central matured, the frequency of dependency changes increased, reflecting the ecosystem's reliance on third-party modules and reusable artifacts. Temporary declines like those in **2020** and **2022** highlight the impact of external factors such as global disruptions and evolving industry priorities.

**2. Dependency Trends (RQ2: Do libraries tend to use more dependencies than in the past?)**

* **Overview:**
  + The average net change in dependencies per library provides insights into the evolution of dependency usage in the Maven Central ecosystem. This metric tracks whether libraries, on average, are adding more dependencies over time or reducing their reliance on external artifacts.
* **Key Observations:**
  + **2005 (Initial Decline):**
    - In 2005, the ecosystem was still in its early stages. Many libraries were standalone or had minimal dependencies, as modularization and dependency management practices were not yet widely adopted.
    - The significant negative net change in this year reflects a "clean slate" scenario where libraries were largely independent or removed unnecessary dependencies during early development stages.
  + **2006 (Steep Increase):**
    - The steep rise in net change during 2006 signals a pivotal shift in the ecosystem's evolution.
    - This period likely coincided with the **increased adoption of Maven as a dependency management tool**, encouraging libraries to incorporate reusable modules and external dependencies into their projects.
    - The spike demonstrates the rapid modularization of software development, where projects began leveraging third-party libraries to enhance functionality and efficiency. This marked the start of an interconnected ecosystem.
* **Overall Pattern:**
  + While the net change fluctuates across the years, it shows an overall stabilization in later years, suggesting that libraries now consistently manage dependencies rather than making drastic changes. The early years (2005–2006) were characterized by significant shifts as developers transitioned to modern dependency practices.

**Insights from Combined Results**

1. **Ecosystem Growth (RQ1):**
   * The **total added and removed dependencies** serve as proxies for the overall activity in the ecosystem. The data highlights an initial growth phase (2005–2019), followed by **disruptions in 2020 and 2022** caused by external factors such as the pandemic and increasing security concerns.
   * These observations demonstrate how external events and industry shifts impact the pace of development and dependency changes within the ecosystem.
2. **Dependency Evolution (RQ2):**
   * The **average net change** in dependencies underscores a transformation in the way libraries were built:
     + Early years (2005–2006): Libraries transitioned from standalone artifacts to modular components relying on third-party dependencies.
     + Recent years: A stabilization phase emerged, where libraries managed dependencies more consistently, reflecting maturity in the ecosystem.
   * This trend shows how the ecosystem evolved from a "build-everything-from-scratch" approach to a more modular and collaborative approach.

**Top 4 Sources Referenced**

1. **Sonatype State of the Software Supply Chain Report (2021):**
   * Key insights into how the pandemic affected software dependencies and development trends.
   * Source: Sonatype Report
2. **JetBrains Developer Ecosystem Survey (2021):**
   * Discusses changes in dependency update patterns during the pandemic and post-pandemic recovery.
   * Source: [JetBrains Developer Survey](https://www.jetbrains.com/lp/devecosystem-2021/)
3. **Snyk’s State of Open Source Security Report (2022):**
   * Focus on supply chain security and how it influences dependency management practices.
   * Source: Snyk Report
4. **Maven Central Usage Stats (Archived Data):**
   * Provides historical context and usage trends for Maven Central repositories.
   * Source: [Maven Central](https://repo.maven.apache.org/maven2/)