



Three Microsoft Azure SQL Managed Instances offered better SQL Server performance and value than their Amazon RDS counterparts* in our tests

Using managed Microsoft SQL Server databases in the cloud has the potential to simplify scaling and performance optimization while saving administrators time and effort in tasks such as provisioning infrastructure and updating software. Not all managed services offer the same operational and financial benefits, so it's important to examine performance as well as price for the types of SQL Server workloads you run.

Principled Technologies compared the cost and performance of three instances each of two managed cloud instance services: Azure SQL Managed Instance and Amazon Relational Database Service (RDS) for SQL Server. Across those three sets of instances using three common SQL Server database workloads—two for online transaction processing and one for data analysis—Azure SQL Managed Instance significantly outperformed Amazon RDS. Offering between double and five times the performance depending on the workload, the three SQL Managed Instances we tested also offered better overall value, reducing price/performance by as much as 90.3 percent.

These three Azure SQL Managed Instances could offer better overall value in two ways. First, their significantly better price/performance ratio shrinks cloud operating costs compared to their competitors in one-to-one comparisons. Second, these SQL Managed Instances could potentially reduce the number of instances an organization has to purchase to handle expected customer loads.

**Using SQL Managed Instance on the business-critical service tier with premium-series hardware compared to R5b and M6i instances from Amazon RDS*



2.4x the transactions per minute (TPM) for a TPROC-C, online transaction processing (OLTP) workload

80vCore Business Critical on Premium-series hardware vs. db.m6i.32xlarge



5.5x the transactions per second (tps) for a complex online order processing workload

16vCore Business Critical on Premium Memory-Optimized-series hardware vs. db.r5b.4xlarge



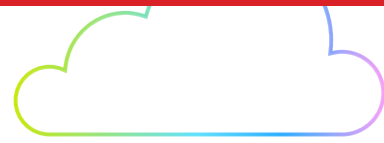
Up to 5.5x as fast to analyze a single stream using a TPROC-H workload

64vCore Business Critical on Premium Memory-Optimized-series hardware vs. db.r5b.16xlarge



Get up to 90.3% better price/performance using pay-as-you-go pricing

64vCore Business Critical on Premium Memory-Optimized-series hardware vs. db.r5b.16xlarge



About our testing approach

To compare performance of Azure SQL Managed Instance and Amazon RDS for SQL Server (on Amazon Web Services, or AWS), we tested three instance types using three common SQL Server database workloads: online transaction processing (TPROC-C), complex online transaction processing (MSOLTPE), and data analytics (TPROC-H). In each test case, we tried to match Azure and AWS as close to equally as possible on either vCore count or memory capacity, due to the 64K IOPS limit for AWS RDS SQL Server, which is lower than the capabilities of Azure SQL Managed Instance. For the TPROC-H workload, we compared the 64vCore memory-optimized offerings for each cloud service provider (CSP); for the MSOLTPE workload, we compared the 16vCore memory-optimized offerings for each CSP; and for the TPROC-C workload, we compared the most powerful non-memory-optimized offerings from each CSP (80vCore on Azure, 128vCore on AWS).

As you will note in each testing and results section, specifications differed across the competitors—but we used the fairest comparison available at the start of each test, depending on what each instance offered. For example, for TPROC-C testing, the Azure VM was capable of up to 320K IOPS, whereas Amazon RDS had a cap of only 64K IOPS. To compensate, we configured the Amazon RDS instance with more vCPU, but the limitation in available IOPS led the Azure VM with 80 vCore to outperform the 128vCPU Amazon RDS instance. While not an exact match, we chose Multi-AZ from Amazon RDS (which is a considerable price increase) to match the high availability level that Azure SQL Managed Instance provides.

In every testing case, the Azure SQL Managed Instance IOPS cap was higher than that of the Amazon instance it was competing with, either due to the AWS IO1 limit of 64K IOPS, or in the case of the 16vCore AWS MSOLTPE instance, due to the instance's lower IOPS cap of 43.3K. To make these instances match on IOPS would have required a mismatch in vCores, memory, or both, particularly in the case of the large VMs we used in TPROC-C and TPROC-H testing. (Note: After we created our test plan and testing was well under way, Amazon RDS unveiled support for a new memory-optimized instance type. To read more details about our testing, the configurations of each instance, and what instances are available now, read the [science behind the report](#).)

Note: Azure SQL Managed Instance service allows customers to select from three backing hardware series and does not give a VM series name. In this study, we describe the Azure SQL Managed instances in terms of vCore count, service tier (General Purpose or Business Critical), and hardware series (Standard, Premium, or Premium Memory-Optimized).

In contrast, the Amazon RDS instance types have direct analogs in their AWS EC2 offerings; for example, Amazon RDS hosted the TPROC-H instance on the db.r5b.16xlarge platform.

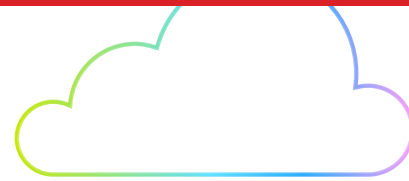
About Azure SQL Managed Instance

Azure SQL Managed Instance is a platform-as-a-service offering that provides fully managed SQL Server applications in the Azure cloud. Because SQL Managed Instance is built on the SQL Server engine, Microsoft asserts that software will always stay up to date without administrator intervention.

According to Microsoft, Azure SQL Managed Instance offers these attractive features:¹

- Broad SQL Server compatibility on a fully managed service requires minimal code changes
- Use the tools and experience you already have with SQL Server
- Secure data with layers of protection and intelligent threat detection
- Native virtual network support functionality

With Azure SQL Managed Instance, organizations can also use Azure Hybrid Benefit pricing that allows them to use existing SQL Server licensing to reduce costs in the Azure cloud. To learn more about Azure SQL Managed Instance, visit <https://azure.microsoft.com/en-us/products/azure-sql/managed-instance/#overview>.



TPROC-C on Microsoft SQL Server

Azure SQL Managed Instance

- 80vCore Business Critical on Premium-series hardware (non-memory optimized)
- 560GB memory
- 1.2TB database (13,000 warehouses)
- 320K max IOPS

Amazon RDS for SQL Server

- m6i.32xlarge
- 128 vCore
- 512GB memory
- 1.2TB database (13,000 warehouses)
- 64K max IOPS

Handle more customer transactions (TPROC-C)

With an 80vCore Business Critical Azure SQL Managed Instance on Premium-series hardware

If your organization plans to use your managed cloud instances to host OLTP databases, maximizing the number of customer transactions that each instance can handle ensures you can support customers at peak times and could reduce the number of instances you must purchase. Running a TPROC-C workload that simulates customer order fulfillment, an 80vCore Business Critical Azure SQL Managed Instance on Premium-series hardware handled 2.4 times the transactions per minute that the db.m6i.32xlarge Amazon RDS instance did (see Figure 1). In these tests, we compared the most powerful non memory-optimized instances available for each cloud service provider at the time of testing.

Database performance

Transactions per minute (TPM) | TPROC-C workload | Higher is better

Azure SQL Managed Instance

Instance name: 80vCore Business Critical Premium-series hardware



Amazon RDS for SQL Server

Instance name: db.m6i.32xlarge



Figure 1: OLTP database performance, in transactions per minute, that the instances achieved on the HammerDB TPROC-C benchmark. Higher numbers are better. Source: Principled Technologies.

That large increase in performance means that for this workload, you could reduce the chances that customers bottleneck the system and slow down ordering at peak times, making a smoother consumer experience. Or, when sizing your managed cloud instances to expected site visitors, you could keep your cloud operating budget in check by purchasing fewer instances to handle your load with a SQL Managed Instance.

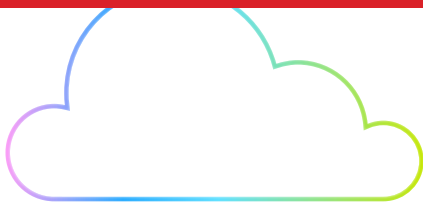


Figure 2 compares the price/performance of an 80vCore Business Critical Azure SQL Managed Instance on Premium-series hardware and an db.m6i.32xlarge Amazon RDS instance using results from our TPROC-C workload.² Though the 80vCore Business Critical SQL Managed Instance on Premium-series hardware outperformed the Amazon RDS db.m6i.32xlarge instances dramatically, it didn't come at a correlated price increase. In fact, using pay-as-you-go pricing, Azure SQL Managed Instance would reduce cost by 79.1 percent. If you have existing SQL Server licenses, you can use Azure Hybrid Benefit pricing, which drops cost even further—reducing overall cost by 88.7 percent compared to Amazon RDS.

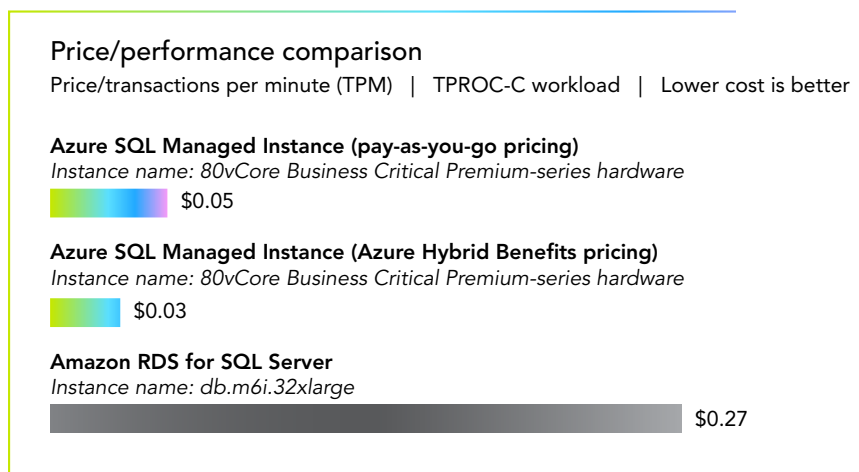


Figure 2: Price/performance comparison for running TPROC-C workloads using both cloud services. Lower costs are better. Source: Principled Technologies.

Who typically uses SQL Server for OLTP?

Online business services such as grocery stores, parcel delivery services, and retail organizations all rely on OLTP databases. If you've ever made an online purchase, you've accessed an OLTP database. Customers can search, make purchases, and complete transactions. Boosting OLTP database performance means that an instance can handle more customers completing these actions at a time, which can ensure a speedy consumer experience even at peak times.

The benchmark

To test OLTP performance, we used the TPROC-C workload from HammerDB—an open-source tool that tests the performance of many leading databases. While HammerDB developers derived their TPROC-C workload from the TPC-C standard, it is not a full implementation of TPC-C specifications. As such, the results we cite in this paper are not directly comparable to those officially published by TPC. HammerDB reports results in both transactions per minute (TPM) and new orders per minute (NOPM) that a system can handle. For more information about HammerDB, visit www.hammerdb.com.



Complete more financial transactions (MSOLTPE)

On a 16vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware

Some workloads, such as financial applications, use OLTP databases that have more diverse and complex actions. To show what the performance difference looks like between Azure SQL Managed Instance and Amazon RDS for these types of workloads, we used a benchmark developed by Microsoft to compare them. The benchmark, known as MSOLTPE, was specifically requested by Microsoft for purposes of comparing our results to those produced by their own internal testing. As Figure 3 shows, the 16vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware handled 5.5 times the transactions per second (tps) of the db.r5b.4xlarge Amazon RDS for SQL Server instance.

Again, for this type of workload, this performance increase could mean that your organization spends less money on fewer cloud instances to handle the load your customers place on your databases. Or, it could mean that your business is ready to comfortably support customers during peak financial transaction times, such as tax season.

MSOLTPE on Microsoft SQL Server

Azure SQL Managed Instance

- 16vCore Business Critical on Premium Memory-Optimized-series hardware
- 217GB memory
- 80,000 customer database
- 64K max IOPS

Amazon RDS for SQL Server

- db.r5b.4xlarge
- 16 vCore
- 128GB memory
- 80,000 customer database
- 43.3K max IOPS

Database performance

Transactions per second (tps) | MSOLTPE workload | Higher is better

Azure SQL Managed Instance

Instance name: 16vCore Business Critical Premium Memory-Optimized-series hardware

 571.52 tps

Amazon RDS for SQL Server

Instance name: db.r5b.4xlarge


 102.36 tps

Figure 3: Complex OLTP database performance, in tps, that the instances achieved on the MSOLTPE benchmark. Higher numbers are better. Source: Principled Technologies.



Figure 4 presents the price/performance comparison using results from our MSOLTPE testing. For financial transaction workloads, the cost reduction was even greater than for our ecommerce workload: With pay-as-you-go pricing, the 16vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware would reduce costs by 89.5 percent over the db.r5b.4xlarge instance on Amazon RDS for SQL Server. Taking advantage of Azure Hybrid Benefit pricing would reduce costs even further, by as much as 93.3 percent.

For organizations using their cloud managed database instances for financial transactions, choosing this Azure SQL Managed Instance over a db.r5b.4xlarge instance on Amazon RDS can boost performance while simultaneously helping their bottom line.

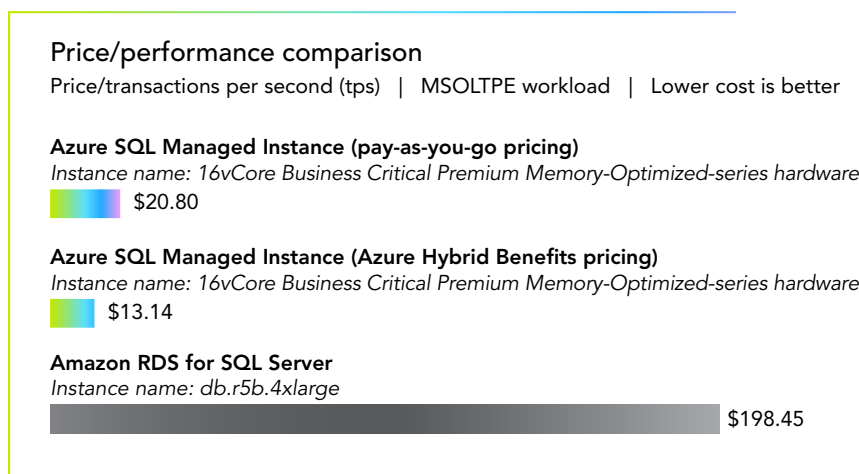


Figure 4: Price/performance comparison for running complex OLTP workloads using both cloud services. Lower costs are better. Source: Principled Technologies.

Who typically uses SQL Server for OLTP with more complex workloads?

Some OLTP databases are more complex than the standard type businesses use for ecommerce workloads. Financial organizations use databases that are more structurally complex to handle a range of diverse transactions that occur between customers and partners reporting and executing financial transactions. Some actions in these types of OLTP databases are customer-driven, while other transactions occur at set price or time criteria.

The benchmark

For testing, Microsoft provided us with a benchmark kit they developed called MSOLTPE, or the Microsoft TPC-E benchmark derived from TPC-E 1.14.0. Using the model of a brokerage firm while remaining applicable to any organization executing financial transactions, the benchmark simulates both customer and partner transactions with different run times. The benchmark reports in transactions per second (tps) that a system can handle. This workload is derived from the TPC-E® Benchmark and is not comparable to published TPC-E Benchmark results, as this implementation does not comply with all requirements of the TPC-E Benchmark.



Analyze your data faster (TPROC-H)

TPROC-H on Microsoft SQL Server

Azure SQL Managed Instance

- 64vCore Business Critical on Premium Memory-Optimized-series hardware
- 870.4GB memory
- 256K max IOPS

Amazon RDS for SQL Server

- db.r5b.16xlarge
- 64 vCore
- 512GB memory
- 64K max IOPS

Using a 64vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware

Making sense of your piles of data faster can reduce the time to insight, facilitating quicker business decisions that lead to real gains. Successfully running online analytical processing (OLAP) workloads on managed SQL Server databases requires knowing which type of managed service can help you cut through the data quicker. To find out, we ran a TPROC-H workload on comparable 64vCore memory-optimized instance types on both cloud service providers using both a single stream of data and eight simultaneous data streams.

As Figure 5 shows, the 64vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware analyzed a single data stream 5.5 times as fast as the db.r5b.16xlarge Amazon RDS instance, and analyzed eight streams 4.2 times as fast. Completing analytics in less time improves business agility by delivering answers based on customer data sooner.

Time to complete data analysis

Seconds | TPROC-H workload | Lower is better

1 stream

Azure SQL Managed Instance

Instance name: 64vCore Business Critical Premium Memory-Optimized-series hardware

669

Amazon RDS for SQL Server

Instance name: db.r5b.16xlarge

3,687

8 streams

Azure SQL Managed Instance

Instance name: 64vCore Business Critical Premium Memory-Optimized-series hardware

5,482

Amazon RDS for SQL Server

Instance name: db.r5b.16xlarge

23,083

Figure 5: Data analytics completion times, in seconds, that the instances achieved on the HammerDB TPROC-H benchmark. Lower numbers are better. Source: Principled Technologies.

Figure 6 shows the price/performance comparison using results from our TPROC-H tests. Again, Azure SQL Managed Instances achieved better results at far less cost. With pay-as-you-go pricing, the 64vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware would reduce costs by 90.3 percent over the db.r5b.16xlarge instance on Amazon RDS for SQL Server. Taking advantage of Azure Hybrid Benefit pricing would reduce costs even further, by as much as 93.9 percent.

These results show that a 64vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware could speed up data analytics workloads on SQL Server databases—and do so at an attractive price point that can reduce ongoing cloud operating costs over db.r5b.16xlarge instances on Amazon RDS.

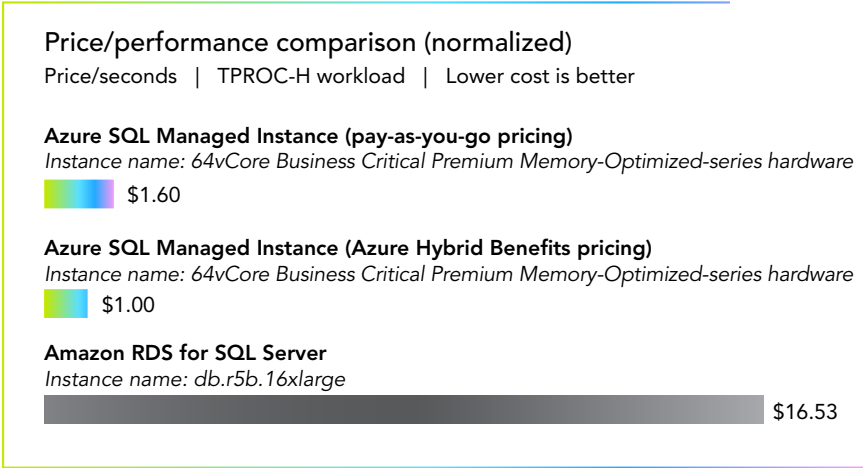


Figure 6: Price/performance comparison (normalized to the lowest price/performance value for ease of reading) for running TPROC-H workloads using both cloud services. Lower costs are better. Source: Principled Technologies.

Who typically runs data analysis workloads on SQL Server data?

After collecting customer data, businesses are left with rows and rows of data with nothing to link them. By analyzing that SQL Server data using TPC-H-like workloads, organizations can make meaningful relations between data and find the answer to critical business questions. The insights gleaned from data analysis workloads can include identifying peak buying times, suggesting other purchases to customers based on what they search for, and more.

The benchmark

To test data analysis speeds for both a single stream of data and eight simultaneous data streams, we used the TPROC-H benchmark from the HammerDB suite. The TPROC-H workload runs analytical queries about business-related retail operations and reports the complete time, in seconds, that a system takes to complete these data analytics tasks. As with the TPROC-C results, our test results do not represent official TPC results and are not comparable in any manner to the official TPC-audited results. For more information about HammerDB, visit www.hammerdb.com.



Bolster your bottom line while serving more database users

Selecting managed cloud instances for SQL Server platform-as-a-service doesn't have to be a perplexing process. In our tests of three popular database workloads that simulate ecommerce databases, financial transaction databases, and data analytics, we found that the three Azure SQL Managed Instances we tested offered significant performance increases over the strongest comparable offerings available from Amazon RDS at time of testing. Though you might expect performance increases of two to five times more to come with a related price increase, our research shows this isn't the case. In fact, the 16vCore Business Critical Azure SQL Managed Instance on Premium Memory-Optimized-series hardware we tested would shrink total cloud cost to run our TPC-E workload using pay-as-you-go pricing by 89.5 percent—or 93.3 percent by taking advantage of Azure Hybrid Benefit pricing—compared to the db.r5b.4xlarge instance on Amazon RDS.

If your organization seeks the agility and flexibility of managed cloud instances for SQL Server, these test results show that choosing these Business Critical Azure SQL Managed Instances on Premium or Premium Memory-Optimized-series hardware can help you serve more database users per instance while shrinking cloud operating costs compared to M6i and R5b instances from Amazon RDS for SQL Server.



1. Microsoft, "Azure SQL Managed Instance," accessed April 21, 2022, <https://azure.microsoft.com/en-us/products/azure-sql/managed-instance/#overview>.
2. To see pricing details and calculations, visit the [science behind the report](#).

Read the science behind this report at <https://facts.pt/VE2gSX5> ►



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