

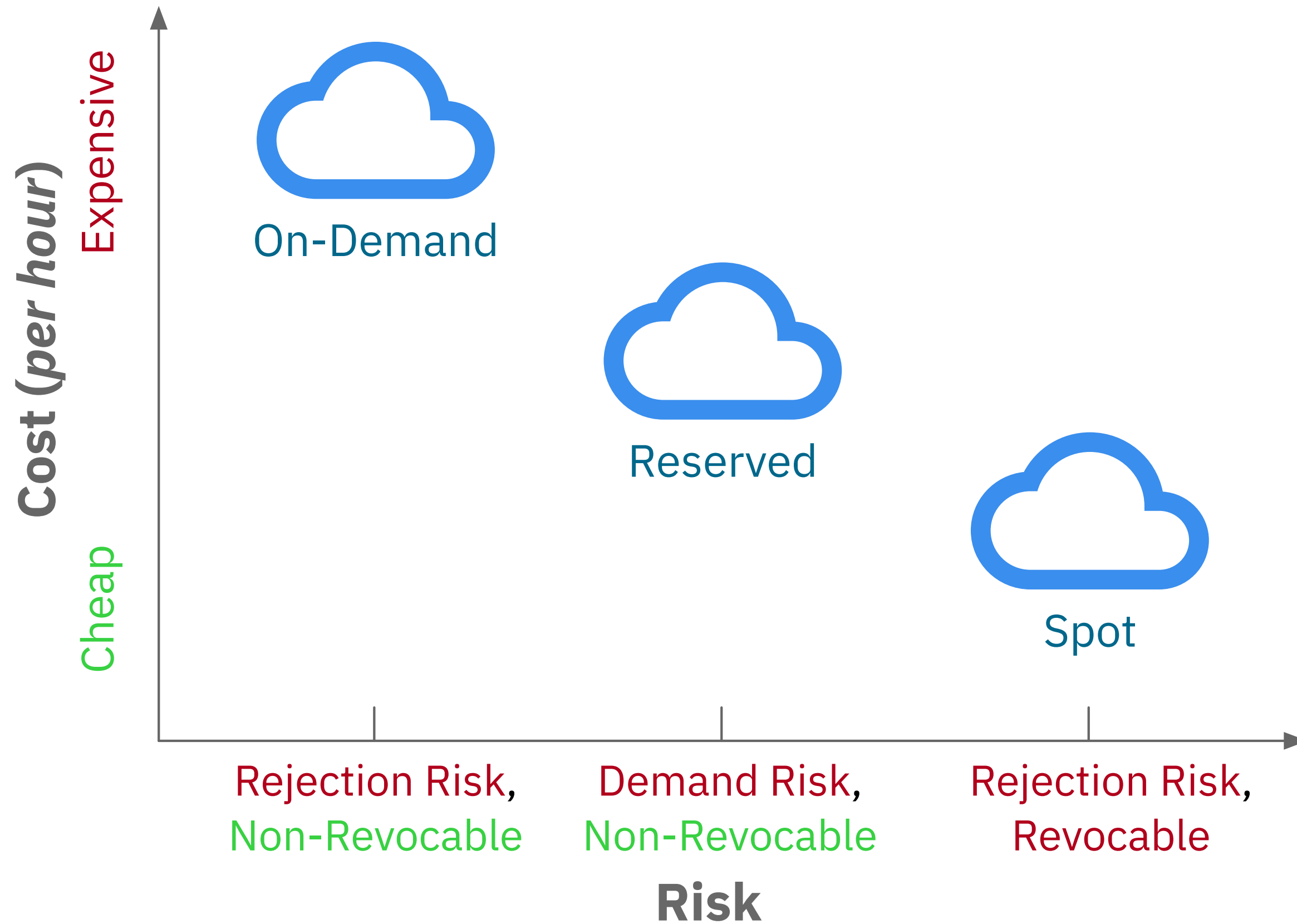
No Reservations: A First Look at Amazon's Reserved Instance Marketplace

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Cost vs. Risk Tradeoffs in IaaS Clouds



Reserved Instance (RI) Risks

- RI's only cheaper than on-demand if highly utilized
- Accurately forecasting demand over long periods is challenging
 - Unforeseen events like **COVID-19** can substantially change demand
- Reserved VMs expose users to **substantial demand risk**
 - Due to the gap between forecasted and actual demand
- To mitigate demand risk...
 - ...Amazon operates the **Reserved Instance Marketplace (RIM)**

Reserved Instance Marketplace (RIM)

- RIM allows users to sell VM reservations at a price they set
 - After listing reserved VMs, EC2 posts them on the RIM

Purchase Reserved Instances							
Platform:	Linux/UNIX ▼	Term:	Any ▼				
Instance Type:	m2.2xlarge ▼	Tenancy:	Default ▼				
Availability Zone:	Any ▼	Offering Type:	Heavy Utilization ▼				
Seller	Term	Effective Rate	Upfront Price	Hourly Rate	Availability Zone	Offering Type	Quantity Available
3rd Party	7 months	\$0.414	\$1199.00	\$0.176	us-east-1d	Heavy Utilization	2
AWS	12 months	\$0.411	\$2060.00	\$0.176	us-east-1c	Heavy Utilization	Unlimited
AWS	12 months	\$0.411	\$2060.00	\$0.176	us-east-1a	Heavy Utilization	Unlimited
AWS	12 months	\$0.411	\$2060.00	\$0.176	us-east-1d	Heavy Utilization	Unlimited

- Enables purchasing variable and shorter-term VM reservations
 - AWS only offers 1-year and 3-year reservations on the market

Comparing RIM with the Spot Market

- RIM is a **competitive market** with multiple buyers and sellers
 - In contrast, EC2's spot market has only a single seller (Amazon)
 - Spot price not set based on instantaneous supply/demand
- RIM is akin to the **housing market** with many unique listings
 - Listing value defined by a large set of attributes
 - E.g., VM type, number of instances listed, term duration, supply/demand, etc.
- Spot market is akin to the **stock market**
 - Uniform pricing of many identical assets (VMs) across regions and AZs

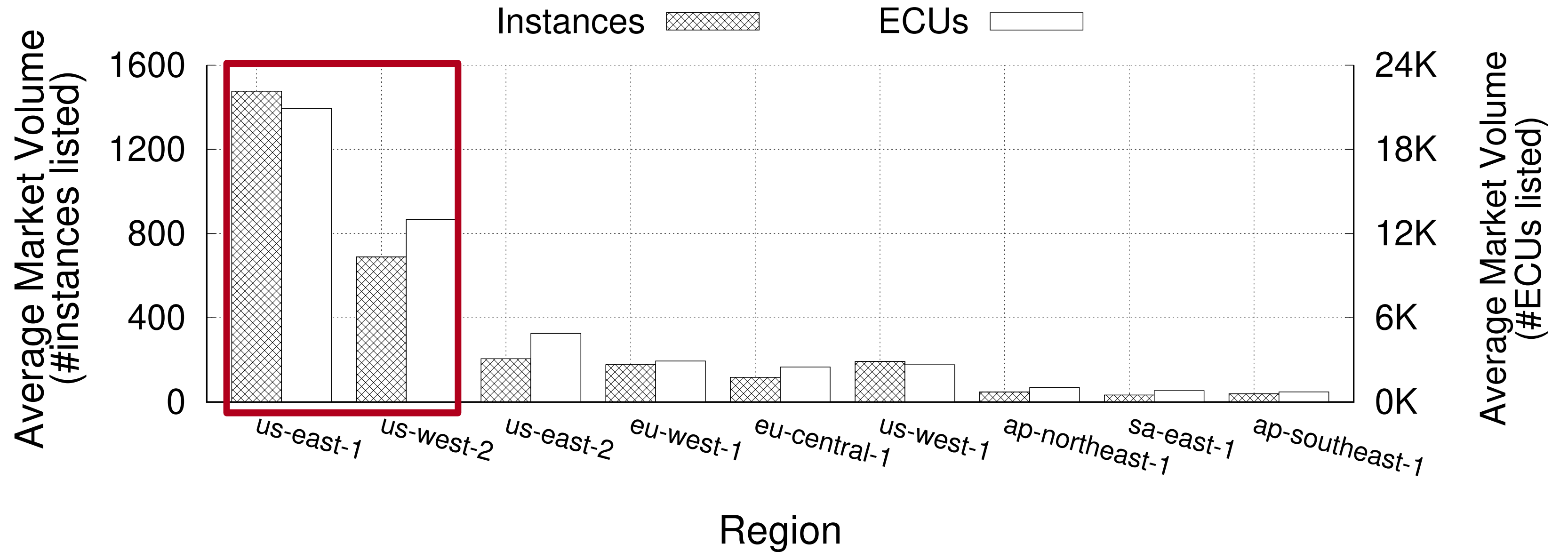
RIM Pricing

- Clearly, RIM's usefulness is a function of its prices
 - But, EC2 does not automatically archive RIM price data
- We started monitoring and archiving RIM prices in 2018/9
 - Query RIM using EC2's python Boto3 API every 30 minutes
 - Collect data for all VM types in 69 AZs across 22 regions
- Publicly released data at UMass Trace Repository
 - <http://traces.cs.umass.edu/index.php/Main/Cloud>

A First Look at RIM Data

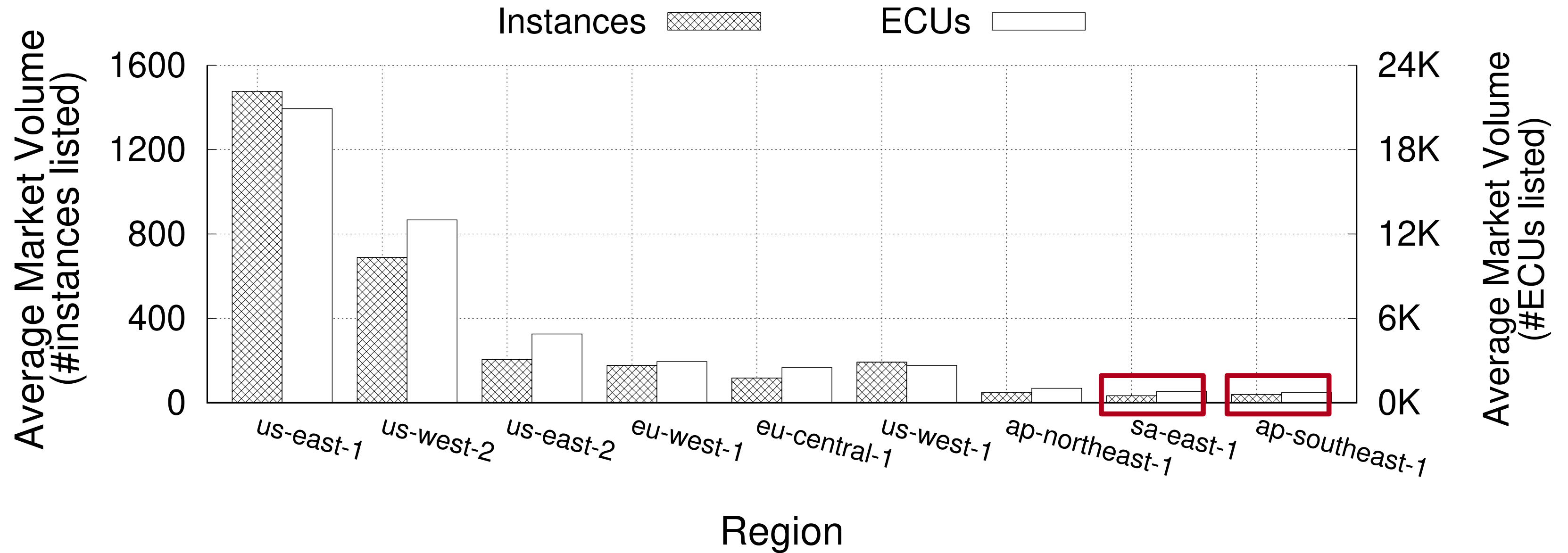
- Analyze RIM data from 2018/9 to 2020/5
 - Reveal important market characteristics
 - Identify potential reserved VM optimization opportunities
- Key Market Characteristics
 - Market volume
 - VM type
 - Term duration
 - Time-on-market
 - Comparison with on-demand and spot

Market Volume across Regions



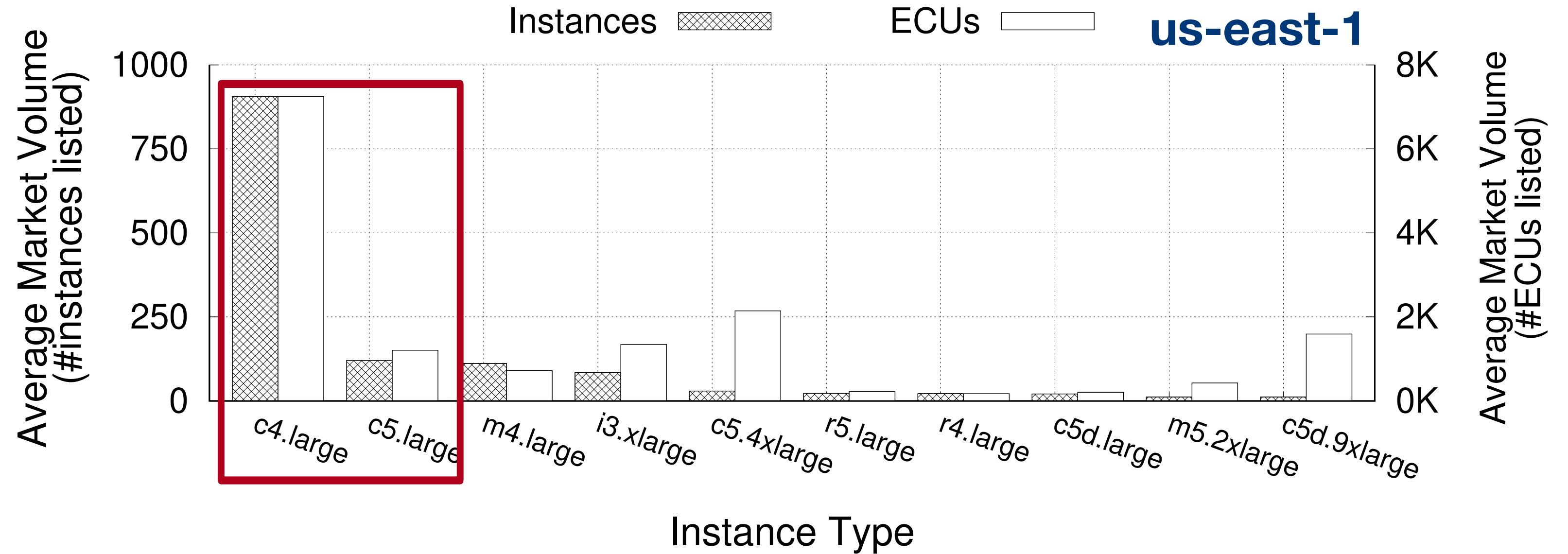
us-east-1 and us-west-2 are largest regions

Market Volume across Regions



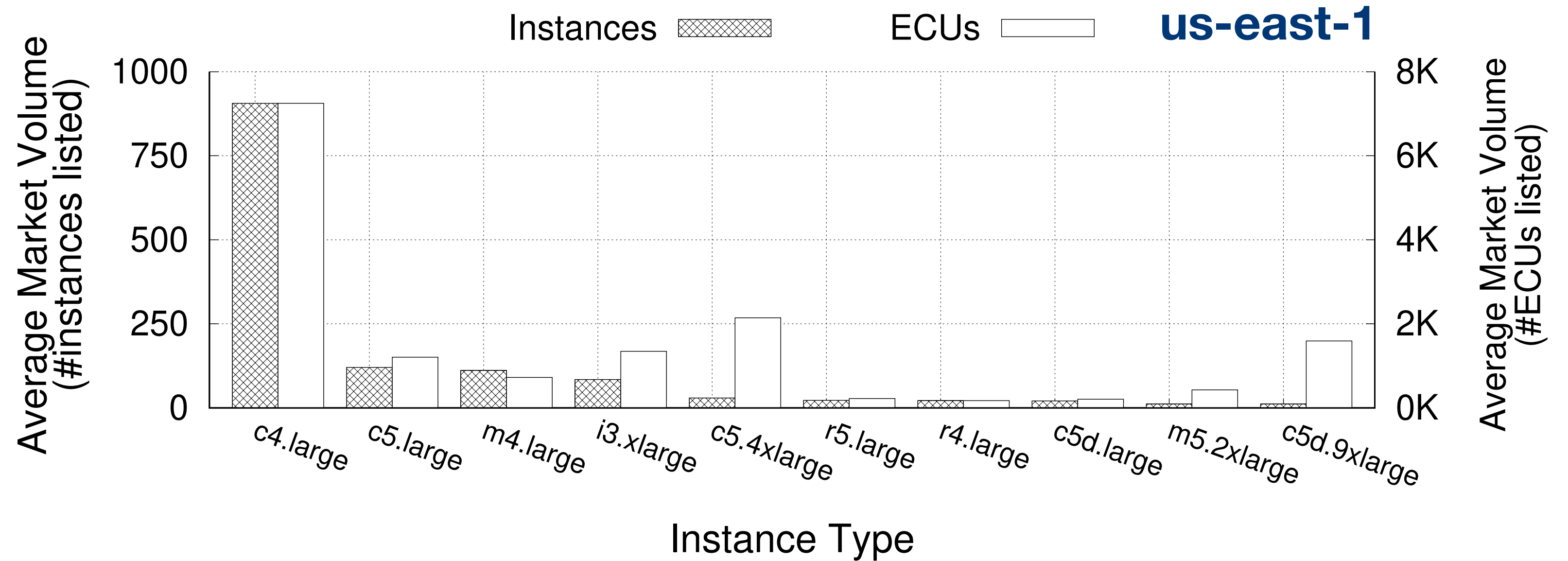
Lower market volume may increase risk of using RIM

Market Volume by VM Type



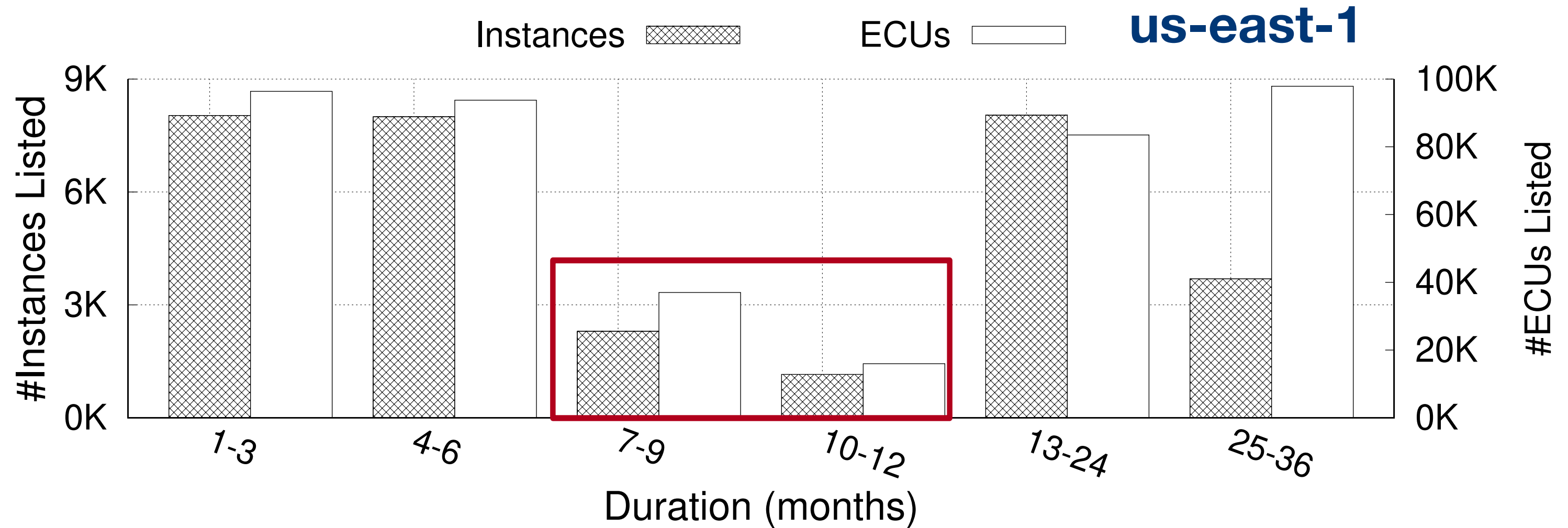
c4.large and c5.large are most popular VM types

Market Volume by VM Type



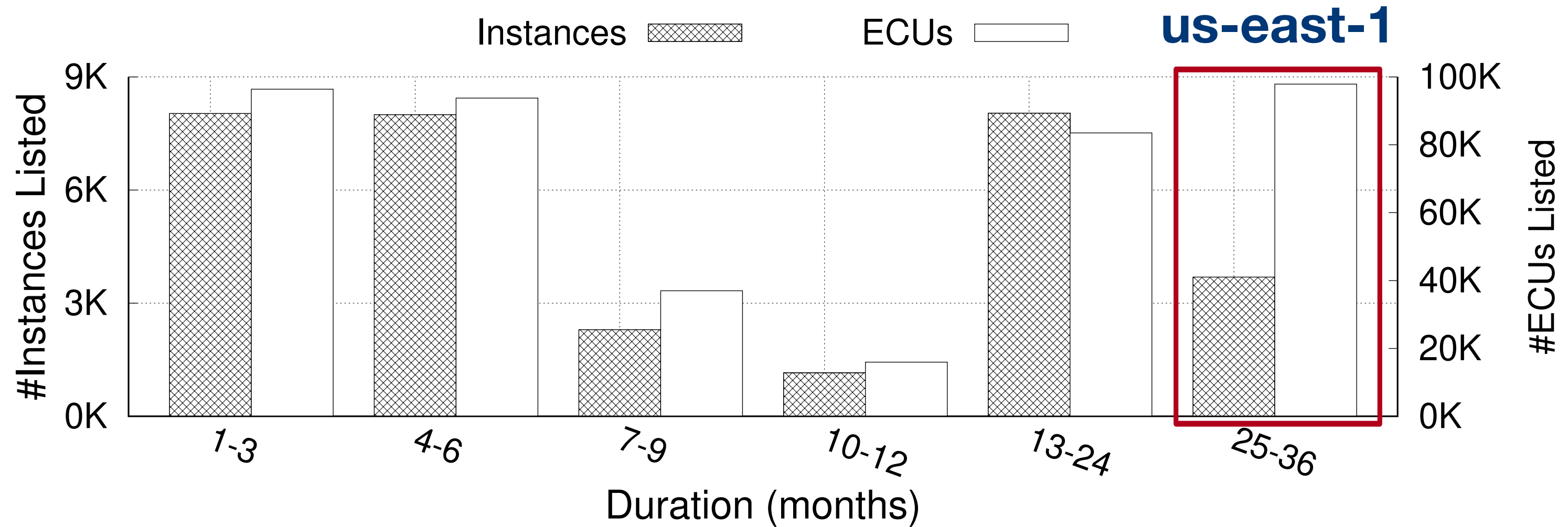
RIM lagging indicator of instance type popularity

Listing Volume vs. Term Duration



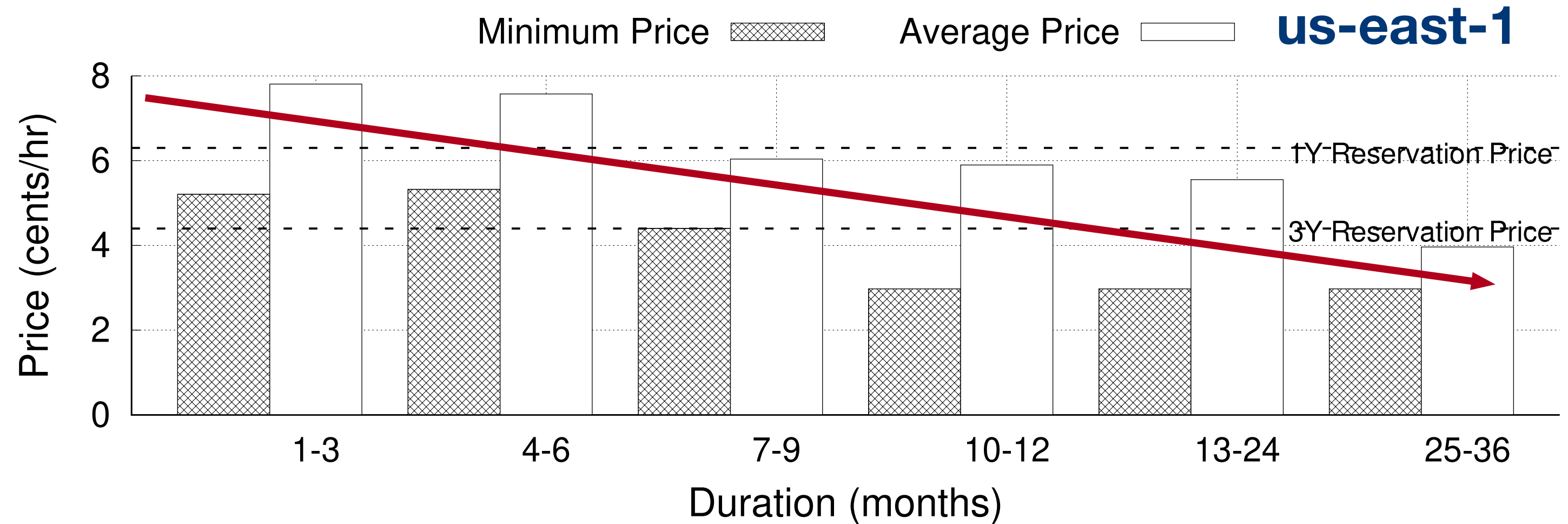
Short and long term durations more plentiful

Listing Volume vs. Term Duration



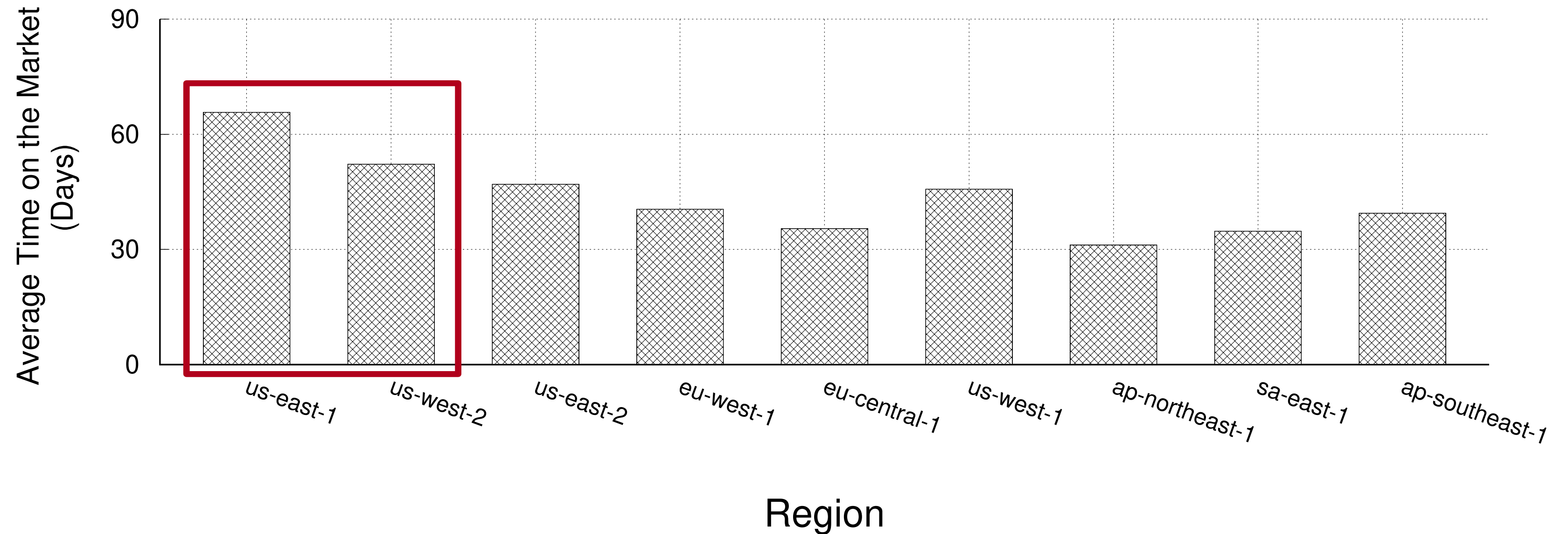
Discrepancy at 25-36 months may indicate buyer's remorse

Listing Price (c4.large) vs. Term Duration



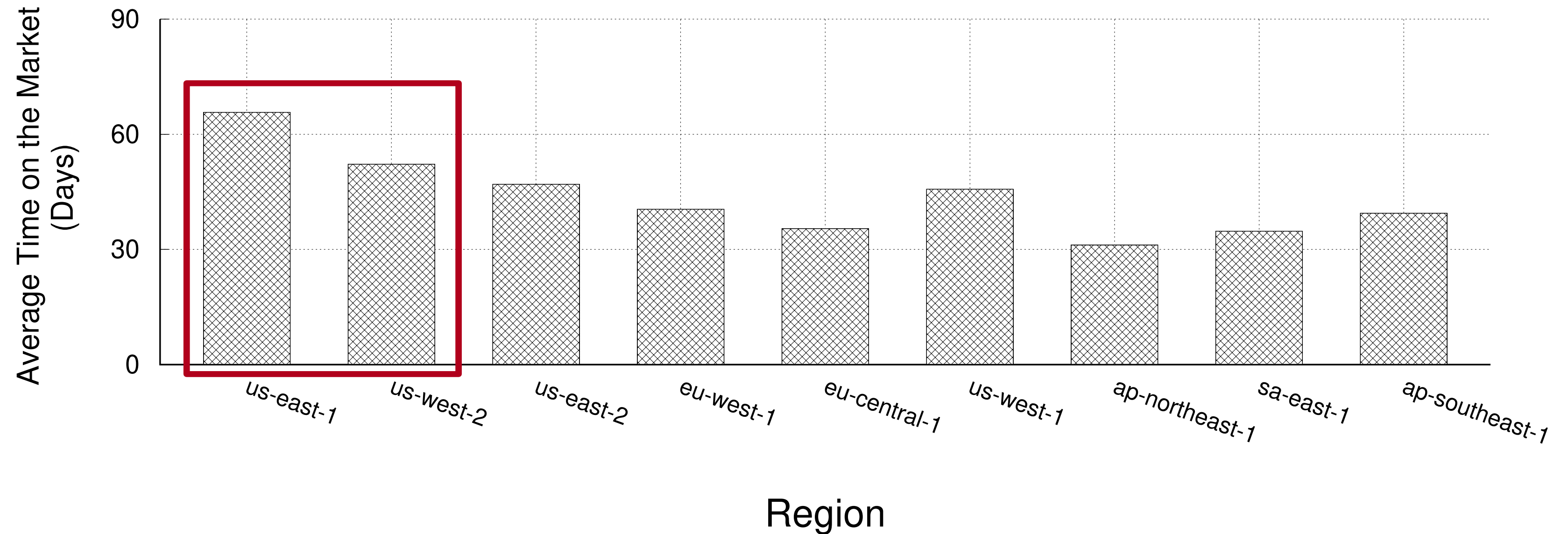
Average listing price decreases (nearly) linearly

Time-on-the-Market across Regions



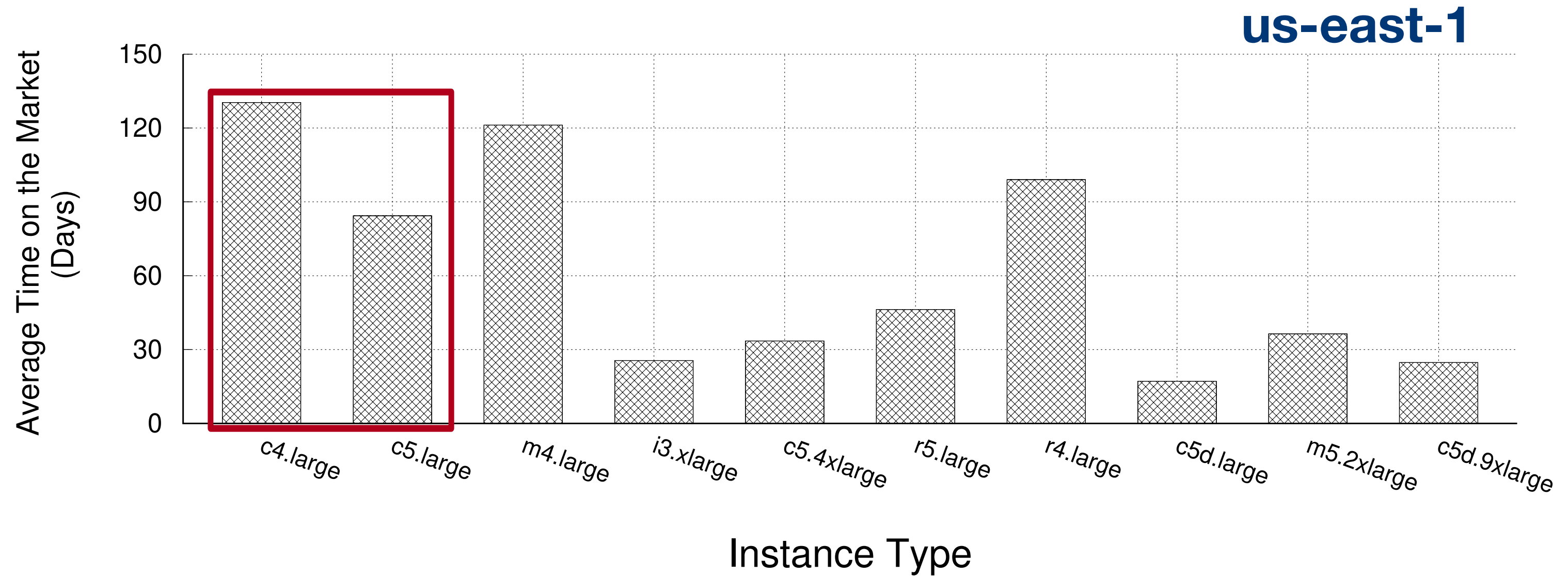
Largest regions have the longest average time on the market

Time-on-the-Market across Regions



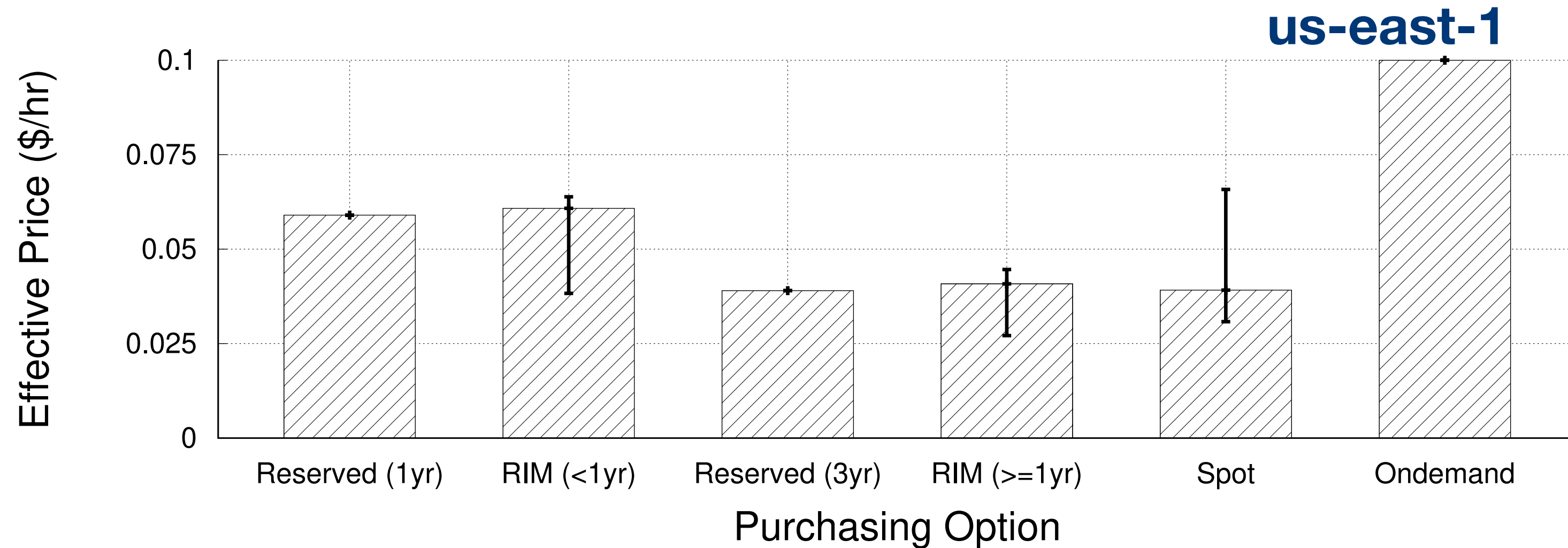
Indicates that demand is less relative to the supply

Time-on-the-Market by VM type



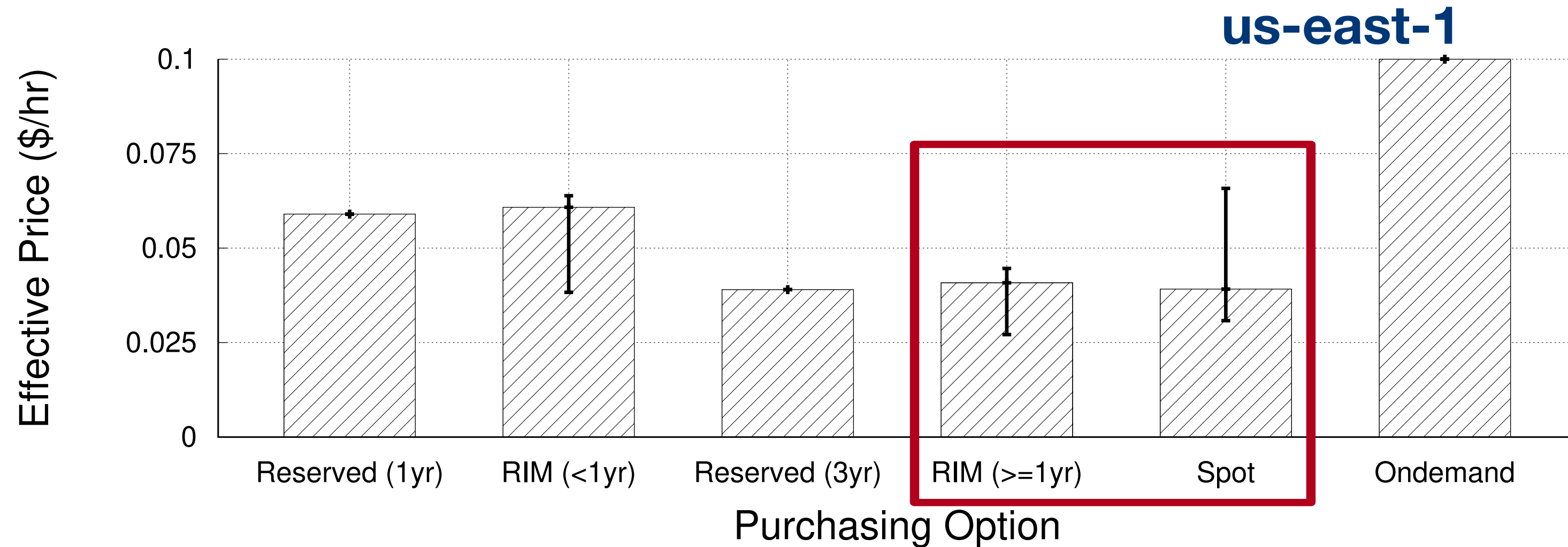
Popular VM types have longest average time on the market

Comparing VM Purchasing Options



Users neither lose nor make money on average in the RIM

Comparing VM Purchasing Options



RIM listings (≥ 1 yr) price close to spot

Conclusion

- Provides a first look at Amazon RIM data
 - Analyzed RIM data from 2018/9 to 2020/5 to reveal key market characteristics
 - Publicly released data at UMass Trace Repository
 - <http://traces.cs.umass.edu/index.php/Main/Cloud>
- Future work
 - More in-depth analysis of RIM data
 - Use RIM data to mitigate demand risk and optimize long-term cloud costs



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