In [5]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
df = pd.read_csv("laptop_prices.csv",encoding="ISO-8859-1")
df.head()
```

Out[5]:

	Company	Product	TypeName	Inches	Ram	OS	Weight	Price_euros	Screen	ScreenW	...	RetinaDisplay	CPU_compa
0	Apple	MacBook Pro	Ultrabook	13.3	8	macOS	1.37	1339.69	Standard	2560	...	Yes	Int
1	Apple	Macbook Air	Ultrabook	13.3	8	macOS	1.34	898.94	Standard	1440	...	No	Int
2	HP	250 G6	Notebook	15.6	8	No OS	1.86	575.00	Full HD	1920	...	No	Int
3	Apple	MacBook Pro	Ultrabook	15.4	16	macOS	1.83	2537.45	Standard	2880	...	Yes	Int
4	Apple	MacBook Pro	Ultrabook	13.3	8	macOS	1.37	1803.60	Standard	2560	...	Yes	Int

5 rows × 23 columns

In [7]:
```
df.shape
```

Out[7]: (1275, 23)

In [9]:
```
df.isnull().sum()
```

Out[9]:
```
Company                0
Product                0
TypeName               0
Inches                 0
Ram                    0
OS                     0
Weight                 0
Price_euros            0
Screen                 0
ScreenW                0
ScreenH                0
Touchscreen            0
IPSpanel               0
RetinaDisplay          0
CPU_company            0
CPU_freq               0
CPU_model              0
PrimaryStorage         0
SecondaryStorage       0
PrimaryStorageType     0
SecondaryStorageType   0
GPU_company            0
GPU_model              0
dtype: int64
```

In [11]:
```
from sklearn.preprocessing import LabelEncoder

# Separate features and target
X = df.drop('Price_euros', axis=1)
y = df['Price_euros']

# Label encode categorical columns
categorical_columns = [
    'Company', 'Product', 'TypeName', 'OS', 'Screen',
    'Touchscreen', 'IPSpanel', 'RetinaDisplay', 'CPU_company',
    'CPU_model', 'PrimaryStorageType', 'SecondaryStorageType',
    'GPU_company', 'GPU_model'
]

label_encoders = {}
```

```
for col in categorical_columns:
    le = LabelEncoder()
    X[col] = le.fit_transform(X[col])
    label_encoders[col] = le  # Store encoder for potential inverse transform
```

In [13]:
```
X.head()
```

Out[13]:

	Company	Product	TypeName	Inches	Ram	OS	Weight	Screen	ScreenW	ScreenH	...	RetinaDisplay	CPU_company	CPU_
0	1	300	4	13.3	8	8	1.37	3	2560	1600	...	1	1	
1	1	301	4	13.3	8	8	1.34	3	1440	900	...	0	1	
2	7	50	3	15.6	8	4	1.86	1	1920	1080	...	0	1	
3	1	300	4	15.4	16	8	1.83	3	2880	1800	...	1	1	
4	1	300	4	13.3	8	8	1.37	3	2560	1600	...	1	1	

5 rows × 22 columns

In [15]:
```
y
```

Out[15]:
```
0       1339.69
1        898.94
2        575.00
3       2537.45
4       1803.60
         ...
1270     638.00
1271    1499.00
1272     229.00
1273     764.00
1274     369.00
Name: Price_euros, Length: 1275, dtype: float64
```

In [17]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2,random_state=10)
X_train.shape,X_test.shape,y_train.shape,y_test.shape
```

Out[17]: ((1020, 22), (255, 22), (1020,), (255,))

In [19]:
```
from sklearn.linear_model import LinearRegression
le=LinearRegression()
le.fit(X_train,y_train)
```

Out[19]:
```
LinearRegression()
```

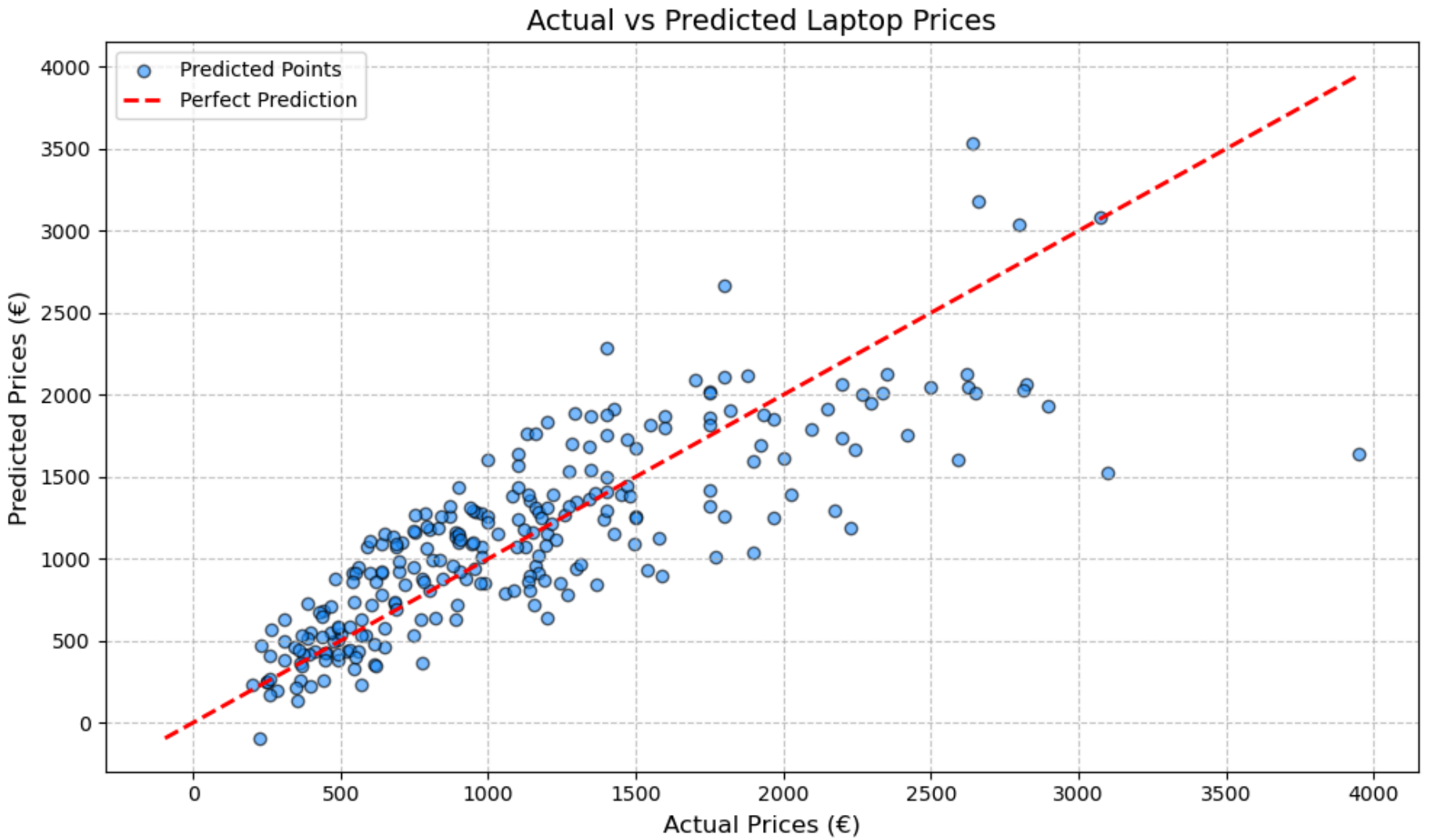
In [21]:
```
y_pred=le.predict(X_test)
```

In [23]:
```
from sklearn.metrics import mean_absolute_error,mean_squared_error,r2_score
mae=mean_absolute_error(y_pred,y_test)
mse=mean_squared_error(y_pred,y_test)
r2_score=r2_score(y_pred,y_test)
print('The mean absolute error is:',mae)
print('The mean squared error is:',mse)
print('The r2 score is:',r2_score)
```

```
The mean absolute error is: 281.79787366099055
The mean squared error is: 147774.93208603014
The r2 score is: 0.5704532857865052
```

In [25]:
```
import matplotlib.pyplot as plt
import numpy as np

plt.figure(figsize=(10, 6))

# Scatter plot of actual vs predicted prices
plt.scatter(y_test, y_pred, color='dodgerblue', alpha=0.6, edgecolors='black', label='Predicted Points')

# Reference line for perfect prediction
min_val = min(min(y_test), min(y_pred))
max_val = max(max(y_test), max(y_pred))
plt.plot([min_val, max_val], [min_val, max_val], color='red', linestyle='--', linewidth=2, label='Perfect Predictio

# Add grid, labels, and title
plt.grid(True, linestyle='--', alpha=0.7)
```

```
plt.xlabel("Actual Prices (€)", fontsize=12)
plt.ylabel("Predicted Prices (€)", fontsize=12)
plt.title("Actual vs Predicted Laptop Prices", fontsize=14)
plt.legend()
plt.tight_layout()
plt.show()
```



In [27]:
```
from sklearn.ensemble import RandomForestRegressor
rfr=RandomForestRegressor()
```

In [29]:
```
rfr.fit(X_train,y_train)
```

Out[29]:
```
RandomForestRegressor
RandomForestRegressor()
```

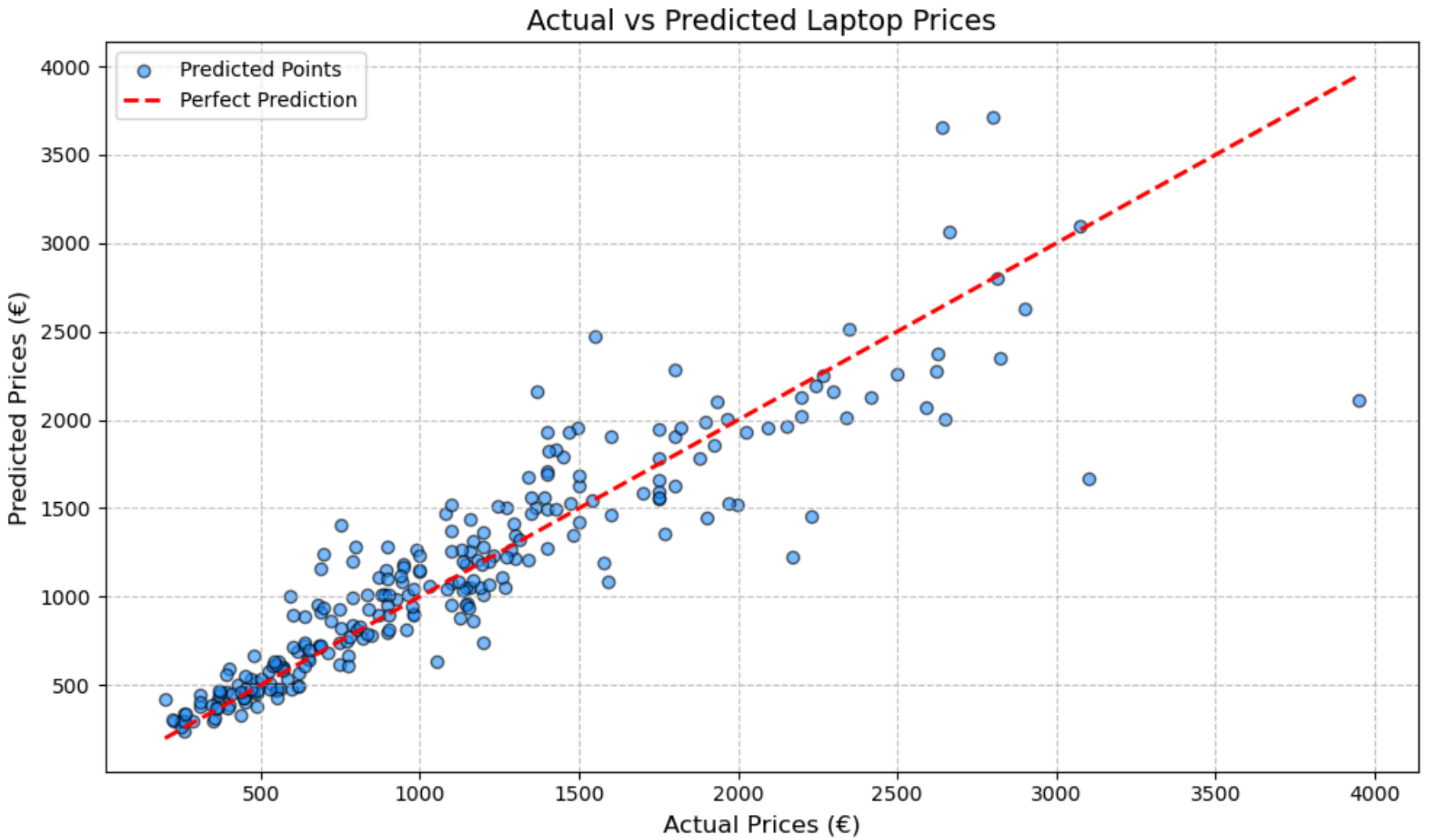
In [31]:
```
y_pred1=rfr.predict(X_test)
```

In [33]:
```
from sklearn.metrics import mean_absolute_error,mean_squared_error,r2_score
mae1=mean_absolute_error(y_pred1,y_test)
mse1=mean_squared_error(y_pred1,y_test)
r2_score1=r2_score(y_pred1,y_test)
print('The mean absolute error is:',mae1)
print('The mean squared error is:',mse1)
print('The r2 score is:',r2_score1)
```

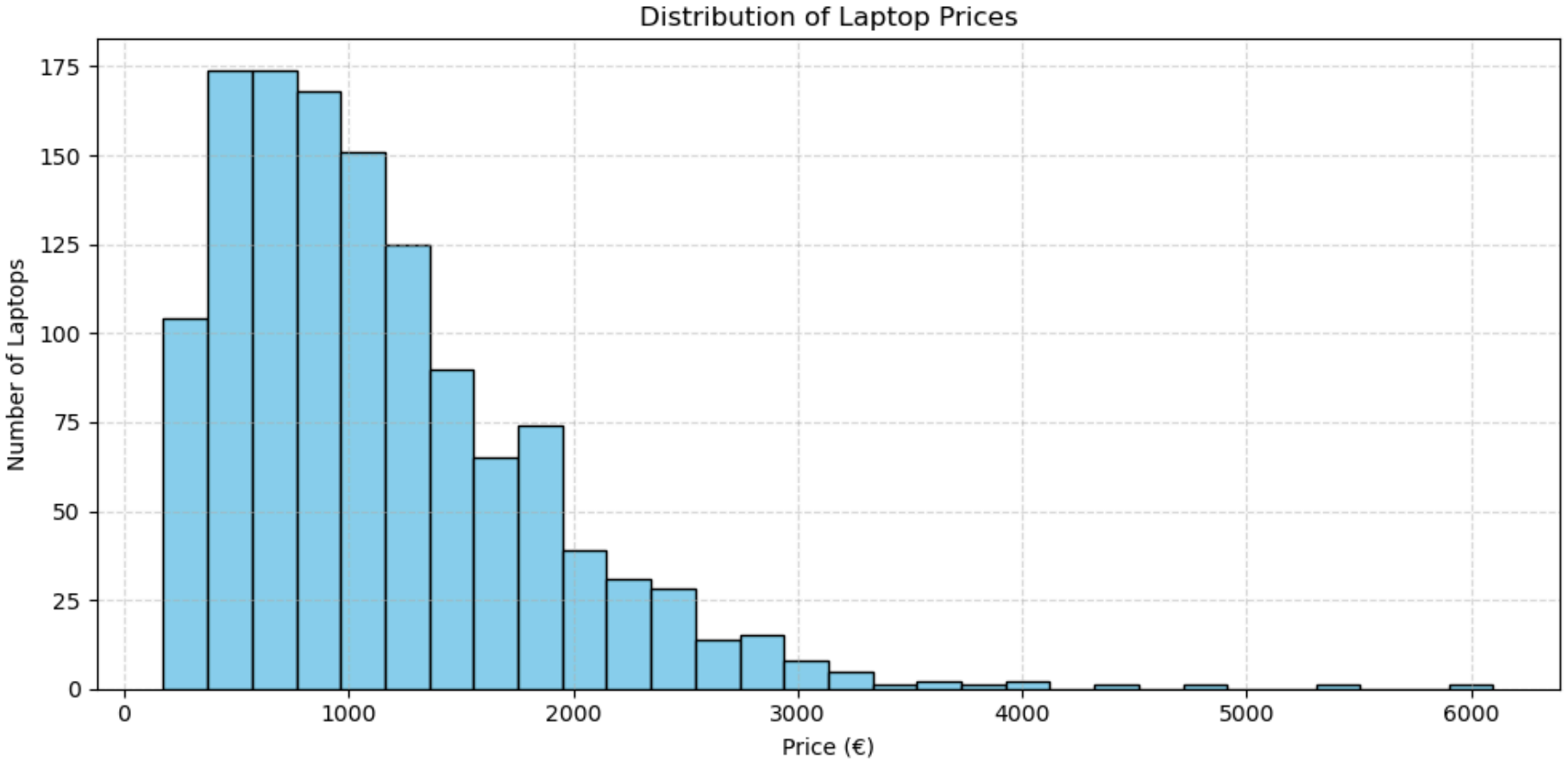
```
The mean absolute error is: 178.10724626143792
The mean squared error is: 80139.10304219375
The r2 score is: 0.7991965927408159
```

In [35]:
```
import matplotlib.pyplot as plt
import numpy as np

plt.figure(figsize=(10, 6))

# Scatter plot of actual vs predicted prices
plt.scatter(y_test, y_pred1, color='dodgerblue', alpha=0.6, edgecolors='black', label='Predicted Points')

# Reference line for perfect prediction
min_val = min(min(y_test), min(y_pred1))
max_val = max(max(y_test), max(y_pred1))
plt.plot([min_val, max_val], [min_val, max_val], color='red', linestyle='--', linewidth=2, label='Perfect Predictio

# Add grid, labels, and title
plt.grid(True, linestyle='--', alpha=0.7)
```

```
plt.xlabel("Actual Prices (€)", fontsize=12)
plt.ylabel("Predicted Prices (€)", fontsize=12)
plt.title("Actual vs Predicted Laptop Prices", fontsize=14)
plt.legend()
plt.tight_layout()
plt.show()
```

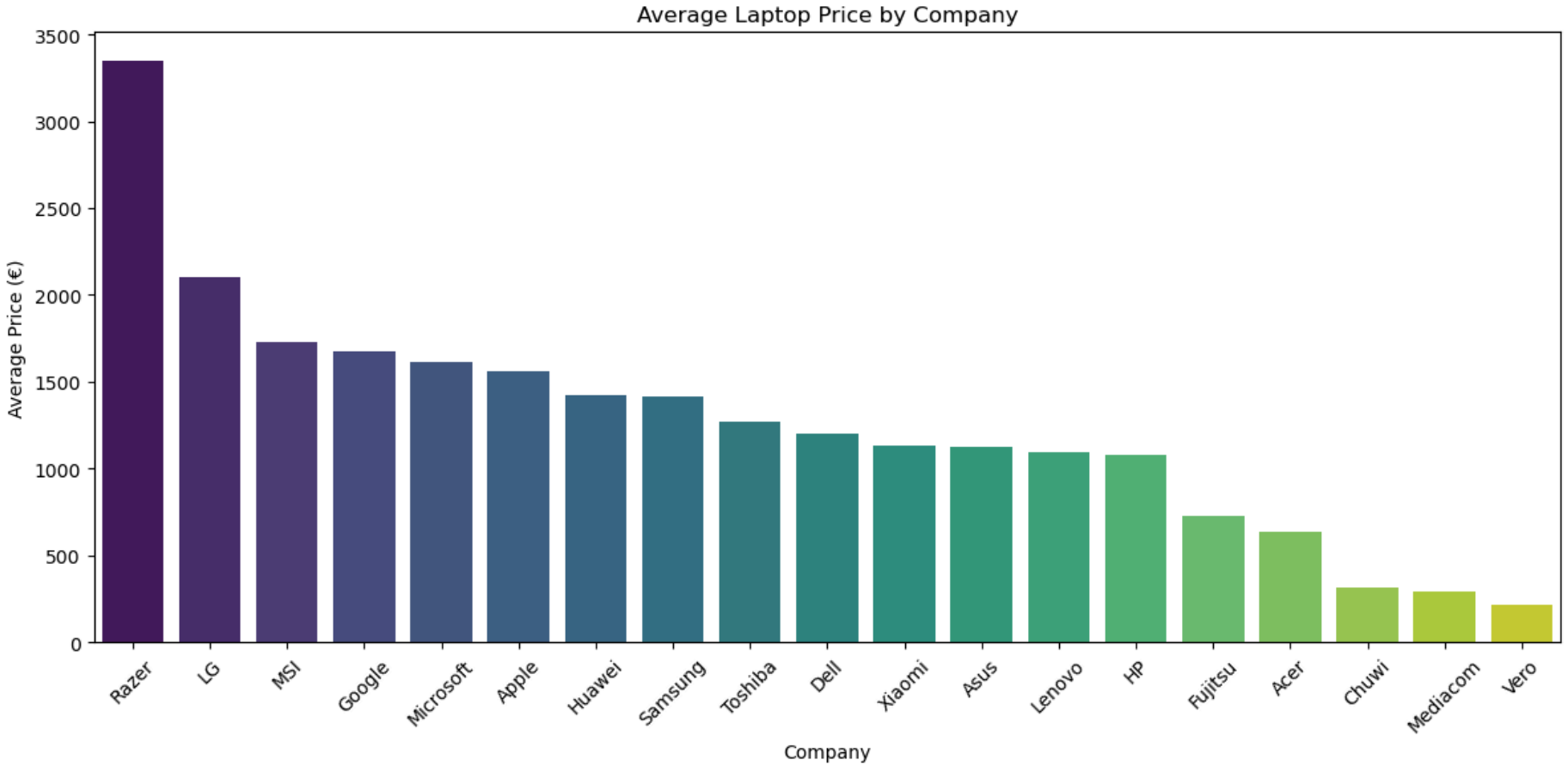


In [37]:
```
#Distribution of Laptop Prices
import matplotlib.pyplot as plt

plt.figure(figsize=(10, 5))
plt.hist(df['Price_euros'], bins=30, color='skyblue', edgecolor='black')
plt.title('Distribution of Laptop Prices')
plt.xlabel('Price (€)')
plt.ylabel('Number of Laptops')
plt.grid(True, linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()
```



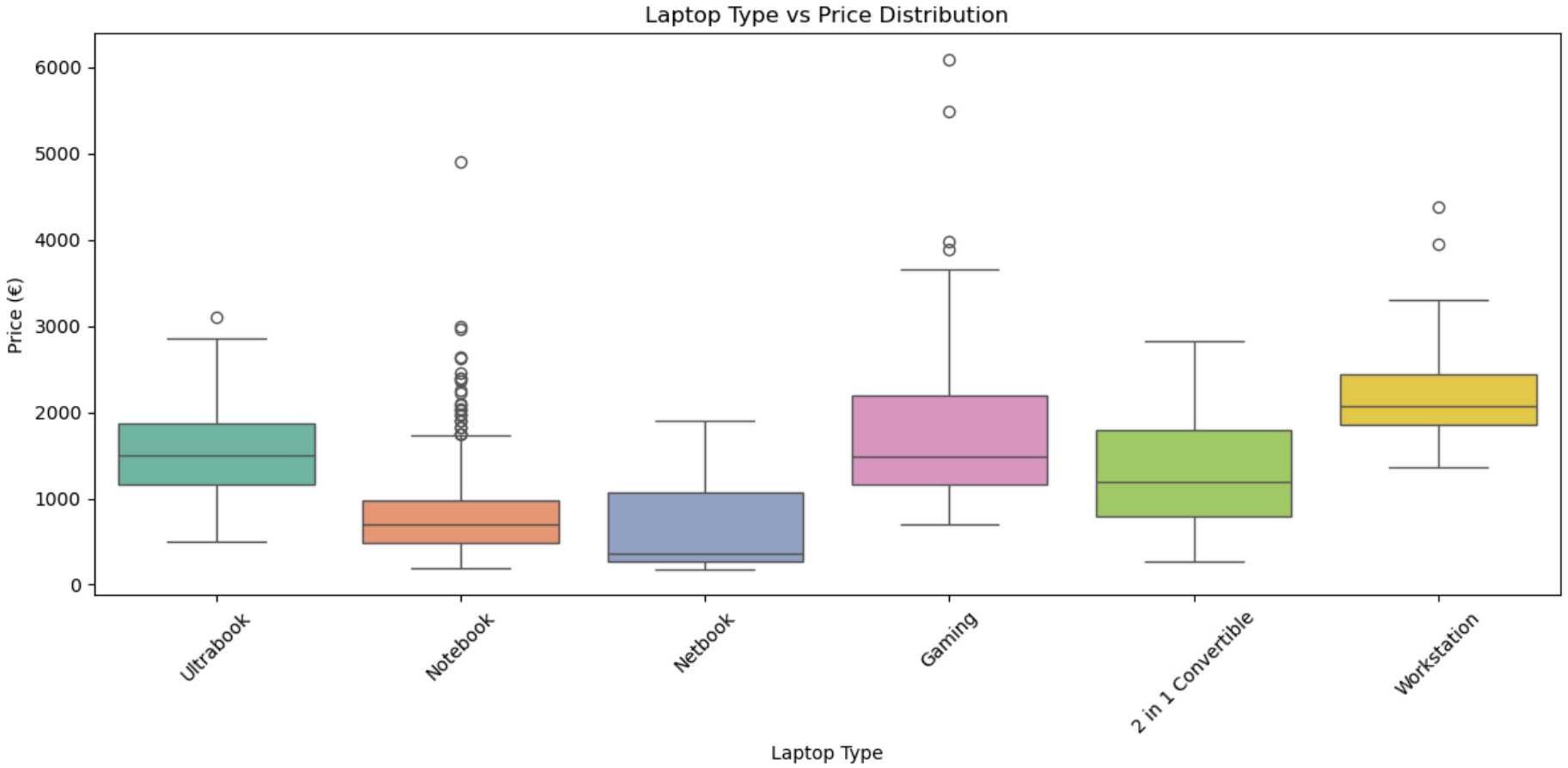
In [39]:
```
#Average Price of Laptop by company
import seaborn as sns

plt.figure(figsize=(12, 6))
avg_price_by_company = df.groupby('Company')['Price_euros'].mean().sort_values(ascending=False)
sns.barplot(x=avg_price_by_company.index, y=avg_price_by_company.values, palette='viridis')
plt.xticks(rotation=45)
plt.title('Average Laptop Price by Company')
plt.ylabel('Average Price (€)')
plt.xlabel('Company')
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_6688/629283051.py:6: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x=avg_price_by_company.index, y=avg_price_by_company.values, palette='viridis')
```



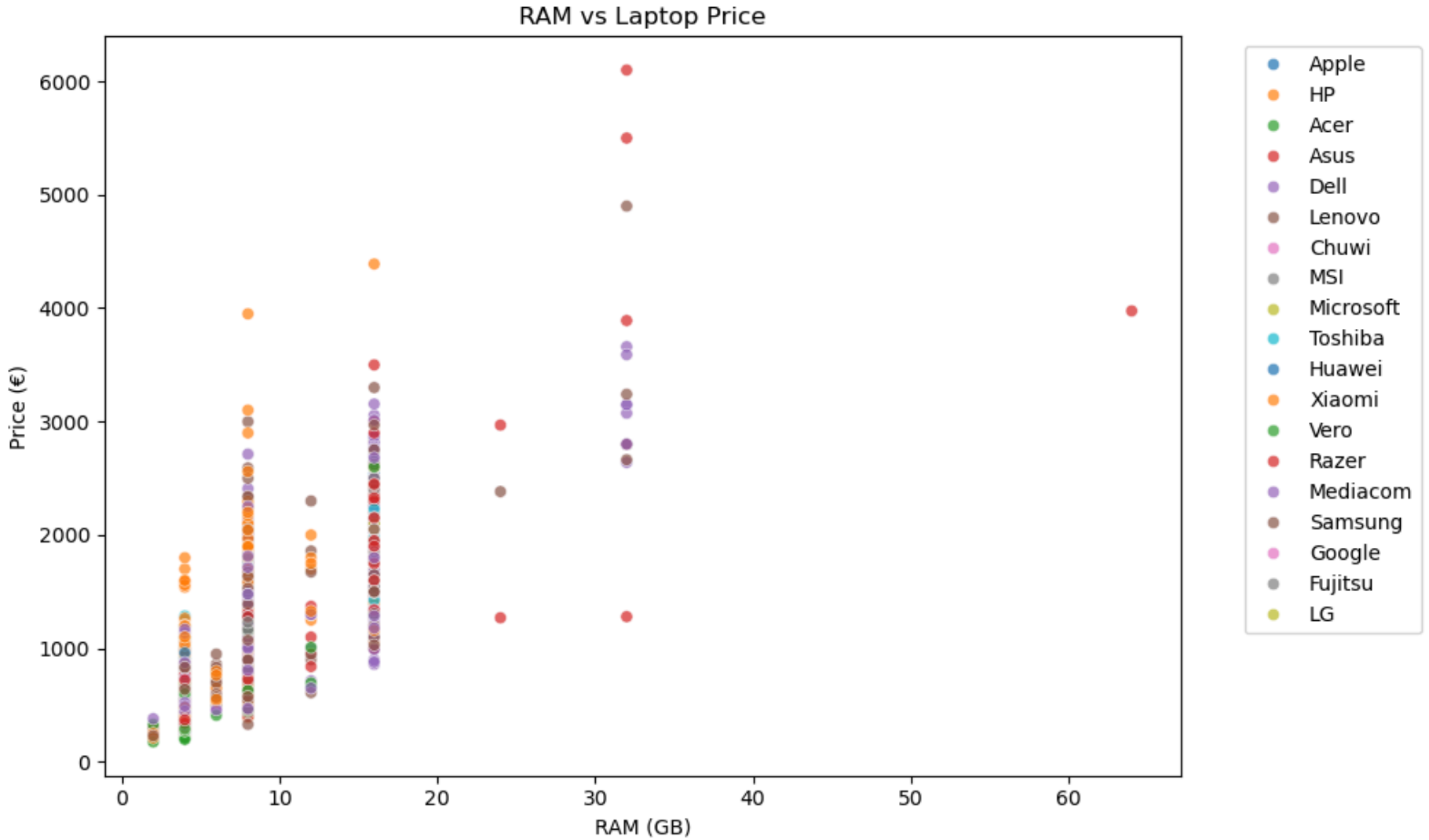
In [37]:
```
#Laptop price Vs Price Distribution
plt.figure(figsize=(12, 6))
sns.boxplot(x='TypeName', y='Price_euros', data=df, palette='Set2')
plt.xticks(rotation=45)
plt.title('Laptop Type vs Price Distribution')
plt.xlabel('Laptop Type')
plt.ylabel('Price (€)')
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_6036/859585806.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(x='TypeName', y='Price_euros', data=df, palette='Set2')
```



In [41]:
```
#RAM Vs Price
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Ram', y='Price_euros', data=df, hue='Company', palette='tab10', alpha=0.7)
plt.title('RAM vs Laptop Price')
plt.xlabel('RAM (GB)')
plt.ylabel('Price (€)')
```

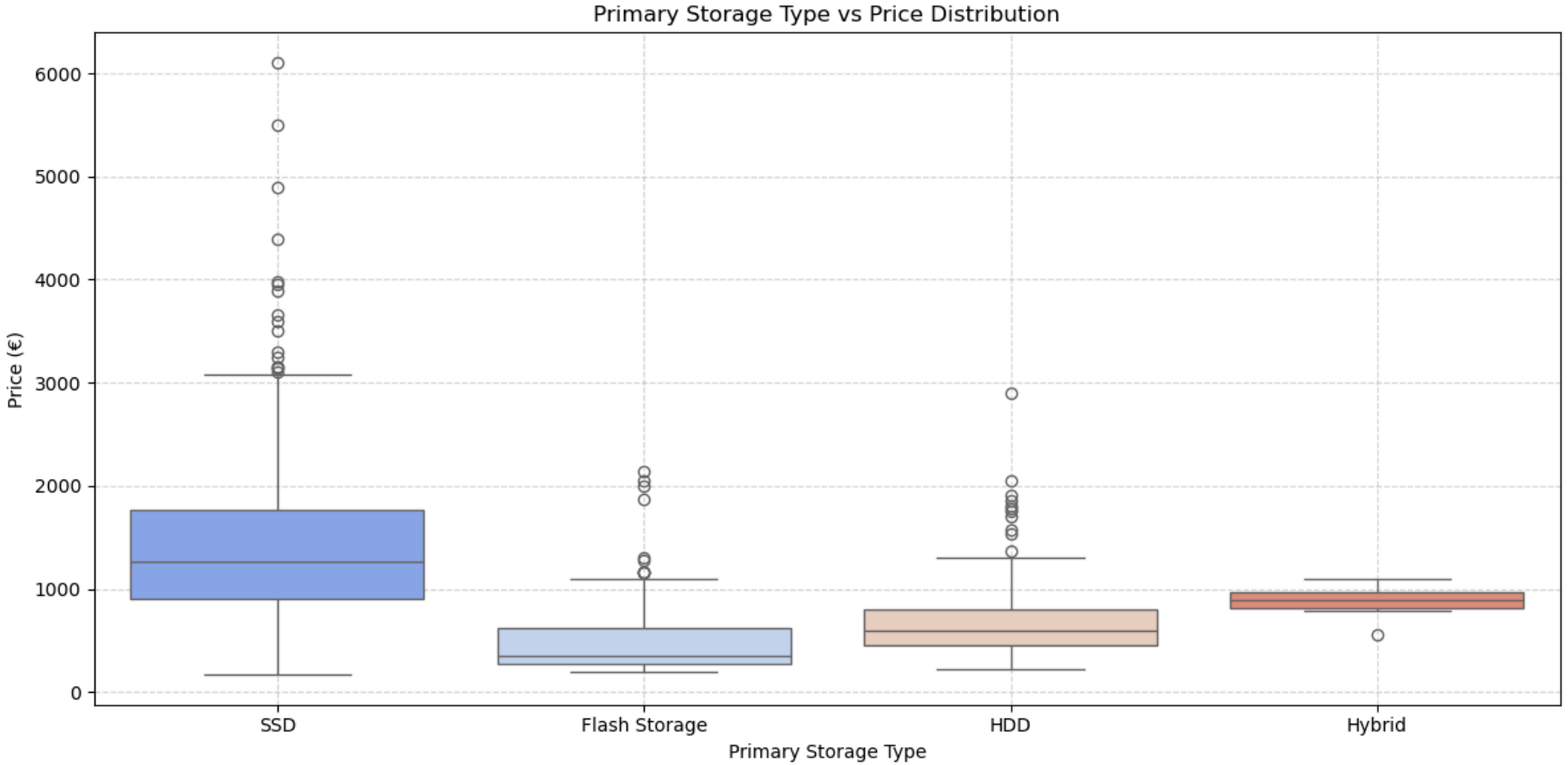
```
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left')
plt.tight_layout()
plt.show()
```



In [77]:
```
#Storage type vs Price
plt.figure(figsize=(12, 6))
sns.boxplot(x='PrimaryStorageType', y='Price_euros', data=df, palette='coolwarm')
plt.title('Primary Storage Type vs Price Distribution')
```

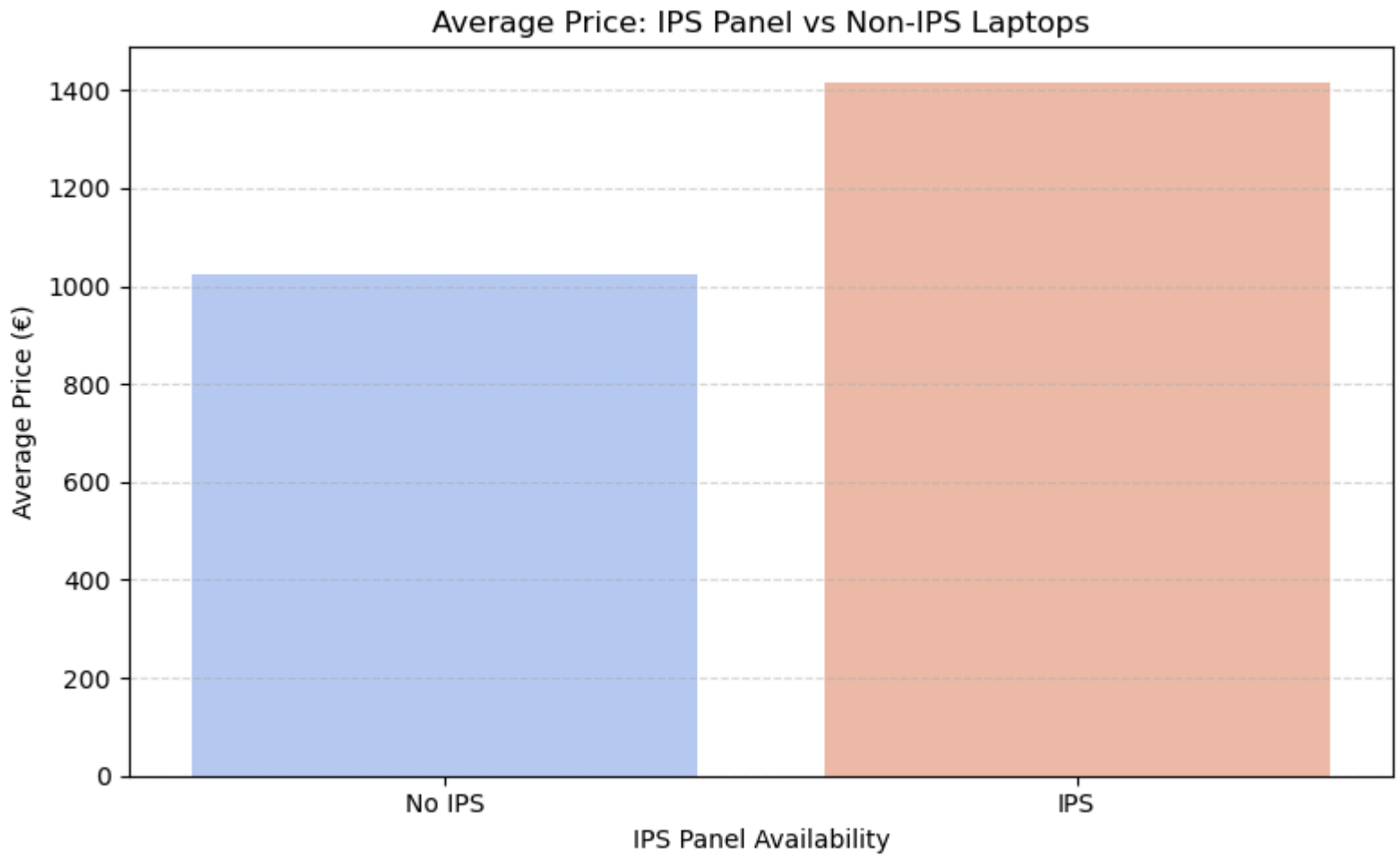
```
plt.xlabel('Primary Storage Type')
plt.ylabel('Price (€)')
plt.grid(True, linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_1258/609379220.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(x='PrimaryStorageType', y='Price_euros', data=df, palette='coolwarm')
```



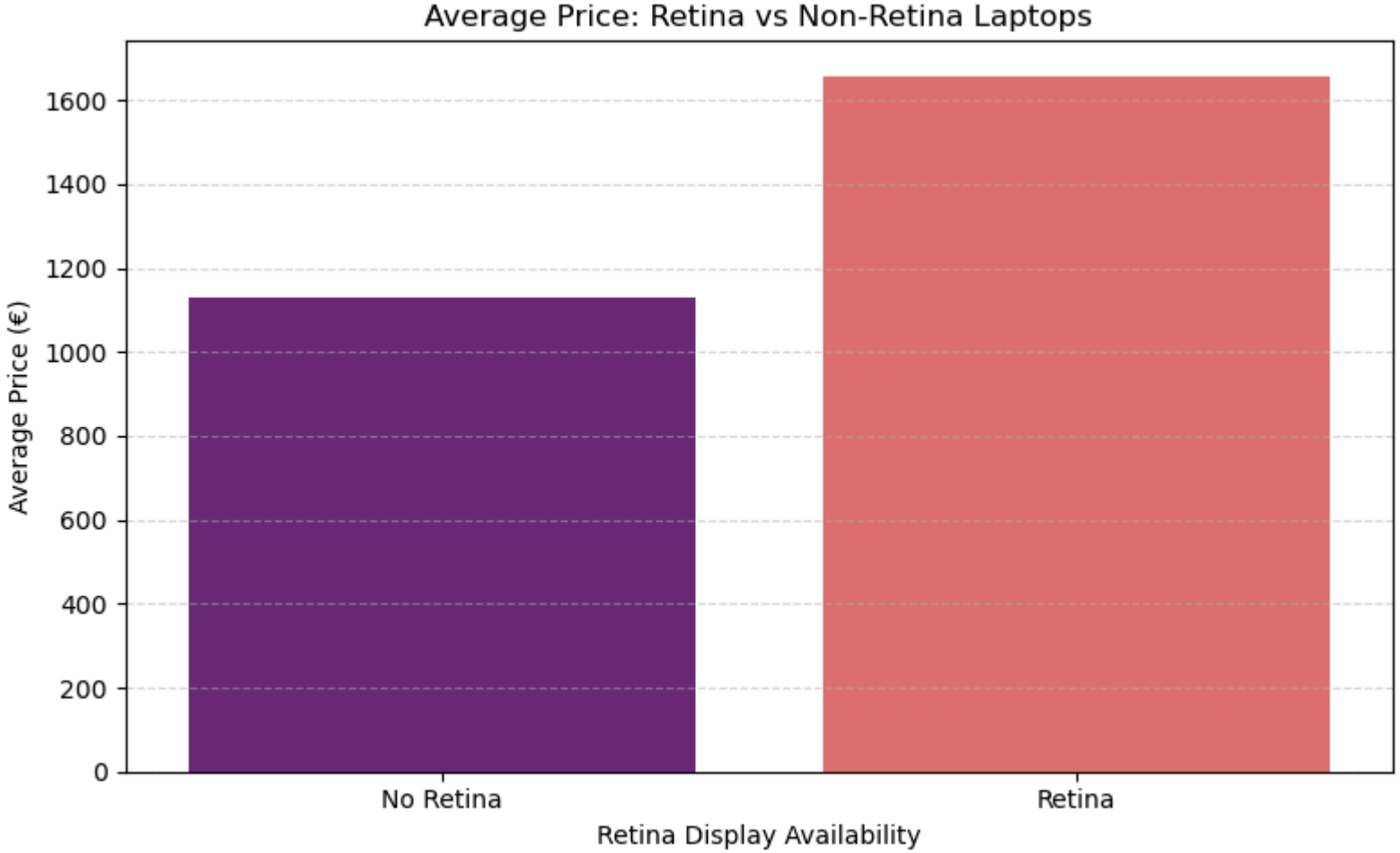
In [43]:
```
plt.figure(figsize=(8, 5))
ips_avg_price = df.groupby('IPSpanel')['Price_euros'].mean()
sns.barplot(x=ips_avg_price.index, y=ips_avg_price.values, palette='coolwarm')
plt.xticks([0, 1], ['No IPS', 'IPS'])
plt.title('Average Price: IPS Panel vs Non-IPS Laptops')
plt.ylabel('Average Price (€)')
plt.xlabel('IPS Panel Availability')
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_6688/1794520785.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x=ips_avg_price.index, y=ips_avg_price.values, palette='coolwarm')
```



In [83]:
```
plt.figure(figsize=(8, 5))
retina_avg_price = df.groupby('RetinaDisplay')['Price_euros'].mean()
sns.barplot(x=retina_avg_price.index, y=retina_avg_price.values, palette='magma')
plt.xticks([0, 1], ['No Retina', 'Retina'])
plt.title('Average Price: Retina vs Non-Retina Laptops')
plt.ylabel('Average Price (€)')
plt.xlabel('Retina Display Availability')
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_1258/3488182014.py:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x=retina_avg_price.index, y=retina_avg_price.values, palette='magma')
```



In [45]:
```
plt.figure(figsize=(10, 6))
sns.violinplot(x='RetinaDisplay', y='Price_euros', data=df, palette='magma', inner="quartile")
plt.xticks([0, 1], ['No Retina', 'Retina'])
plt.title('Price Distribution: Retina vs Non-Retina Laptops')
```

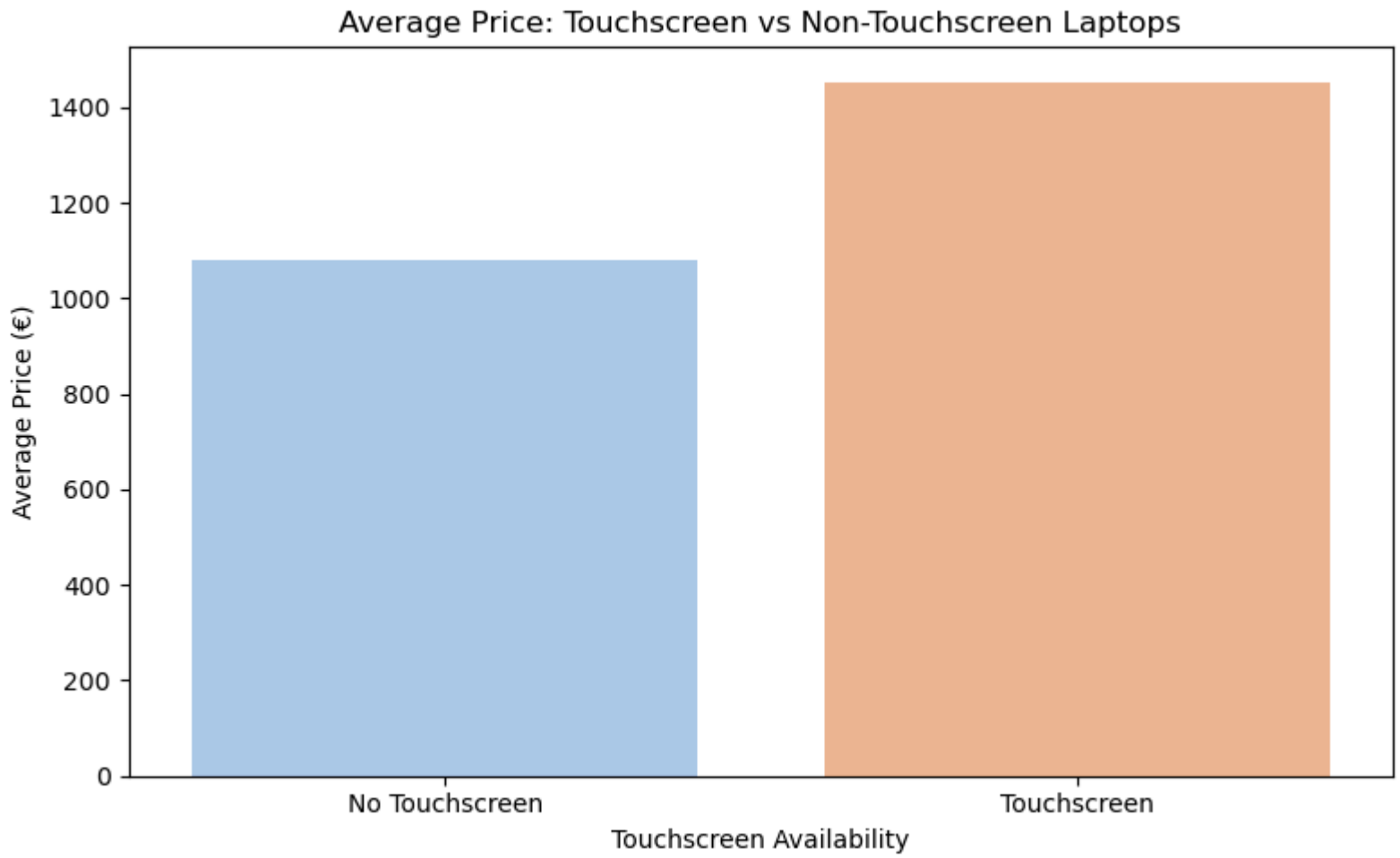
```
plt.xlabel('Retina Display Availability')
plt.ylabel('Price (€)')
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_6688/1621181651.py:2: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.violinplot(x='RetinaDisplay', y='Price_euros', data=df, palette='magma', inner="quartile")
```

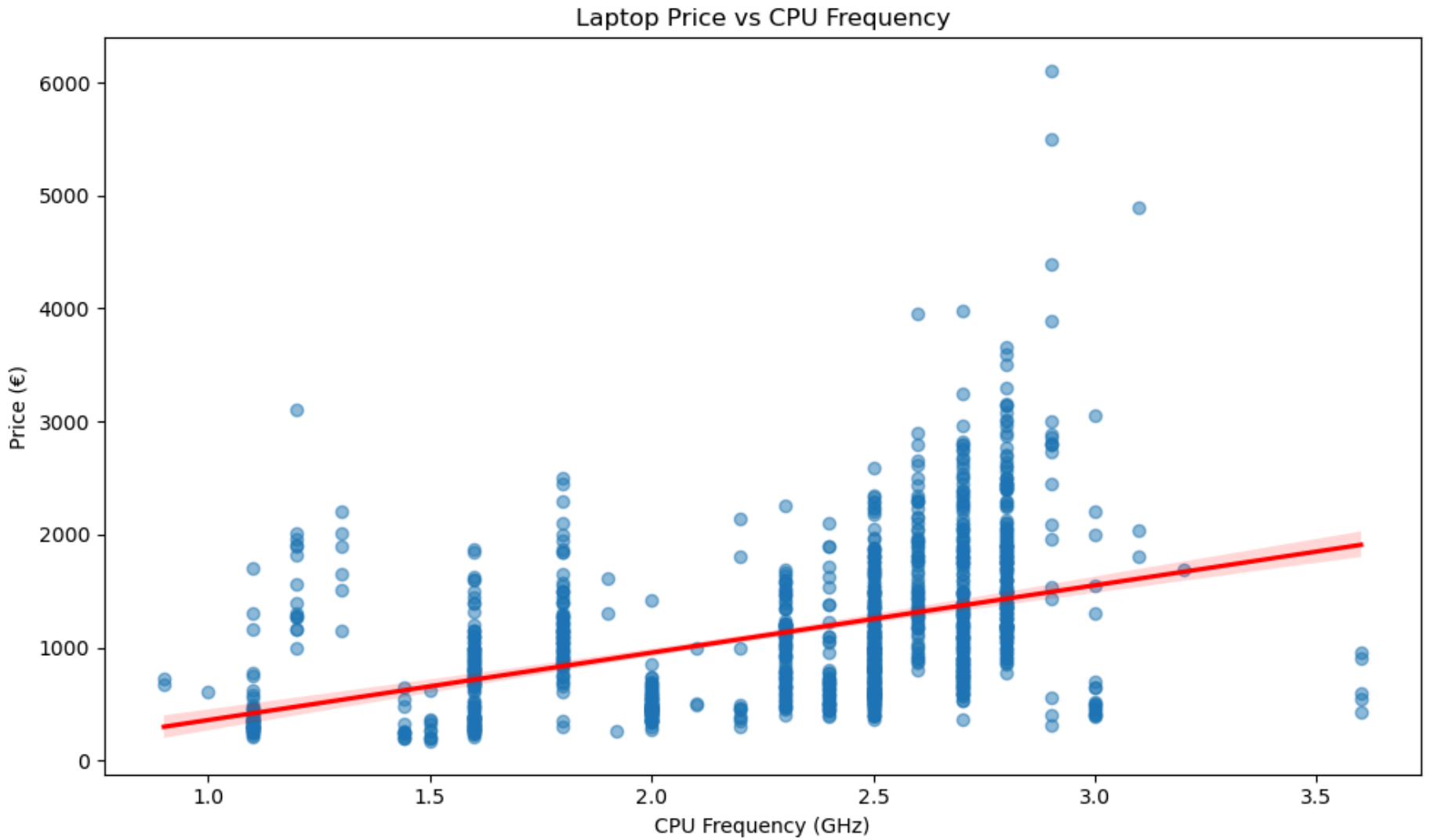
In [87]:
```
#Touchscreen vs Price
plt.figure(figsize=(8, 5))
touchscreen_counts = df.groupby('Touchscreen')['Price_euros'].mean()
sns.barplot(x=touchscreen_counts.index, y=touchscreen_counts.values, palette='pastel')
plt.xticks([0, 1], ['No Touchscreen', 'Touchscreen'])
plt.title('Average Price: Touchscreen vs Non-Touchscreen Laptops')
plt.ylabel('Average Price (€)')
```

```
plt.xlabel('Touchscreen Availability')
plt.tight_layout()
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_1258/3123336635.py:4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x=touchscreen_counts.index, y=touchscreen_counts.values, palette='pastel')
```

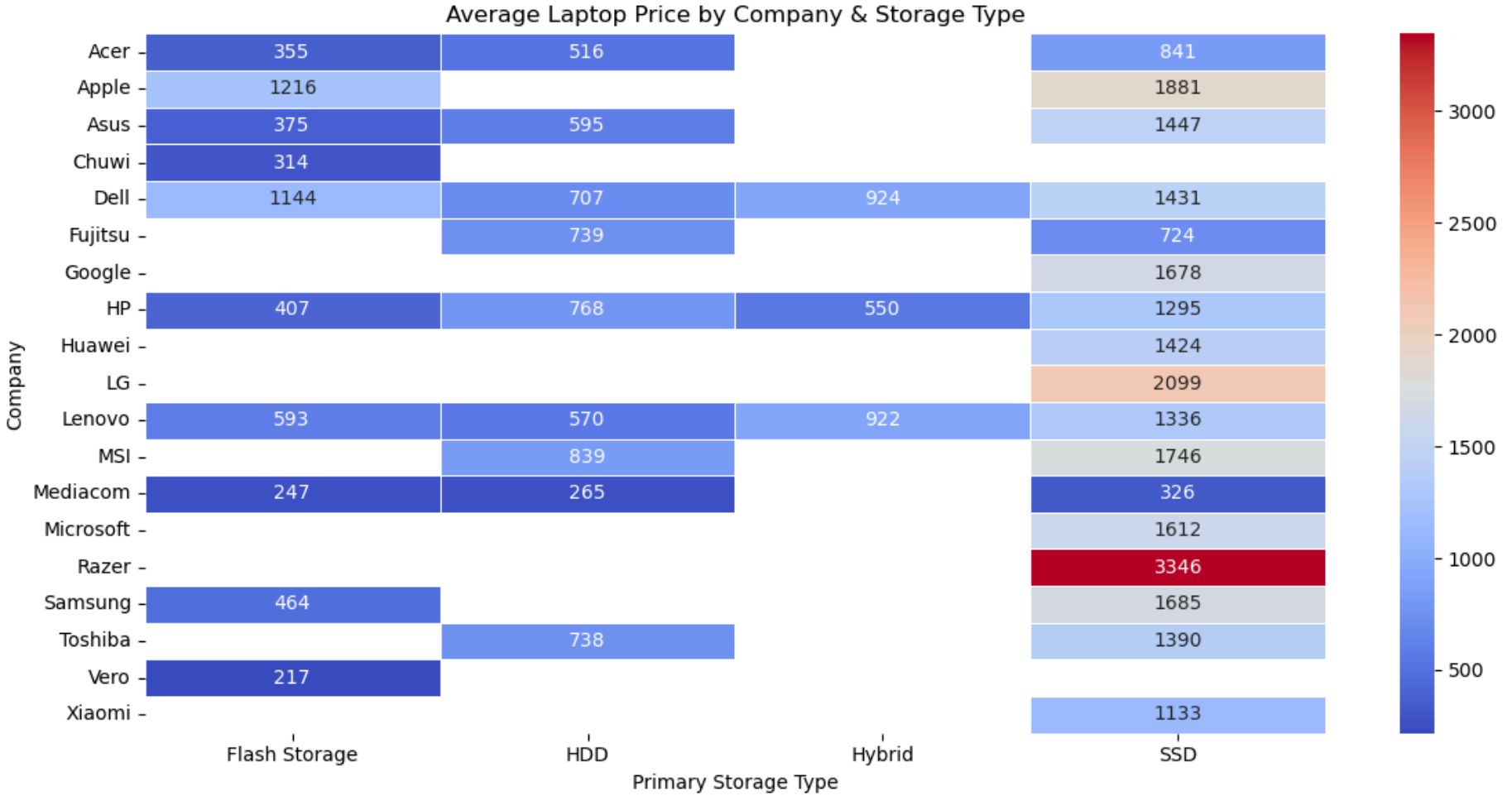


In [47]:
```
#Price vs CPU Frequency (Regression Line)
plt.figure(figsize=(10, 6))
sns.regplot(x='CPU_freq', y='Price_euros', data=df, scatter_kws={'alpha':0.5}, line_kws={'color':'red'})
plt.title('Laptop Price vs CPU Frequency')
plt.xlabel('CPU Frequency (GHz)')
plt.ylabel('Price (€)')
plt.tight_layout()
plt.show()
```



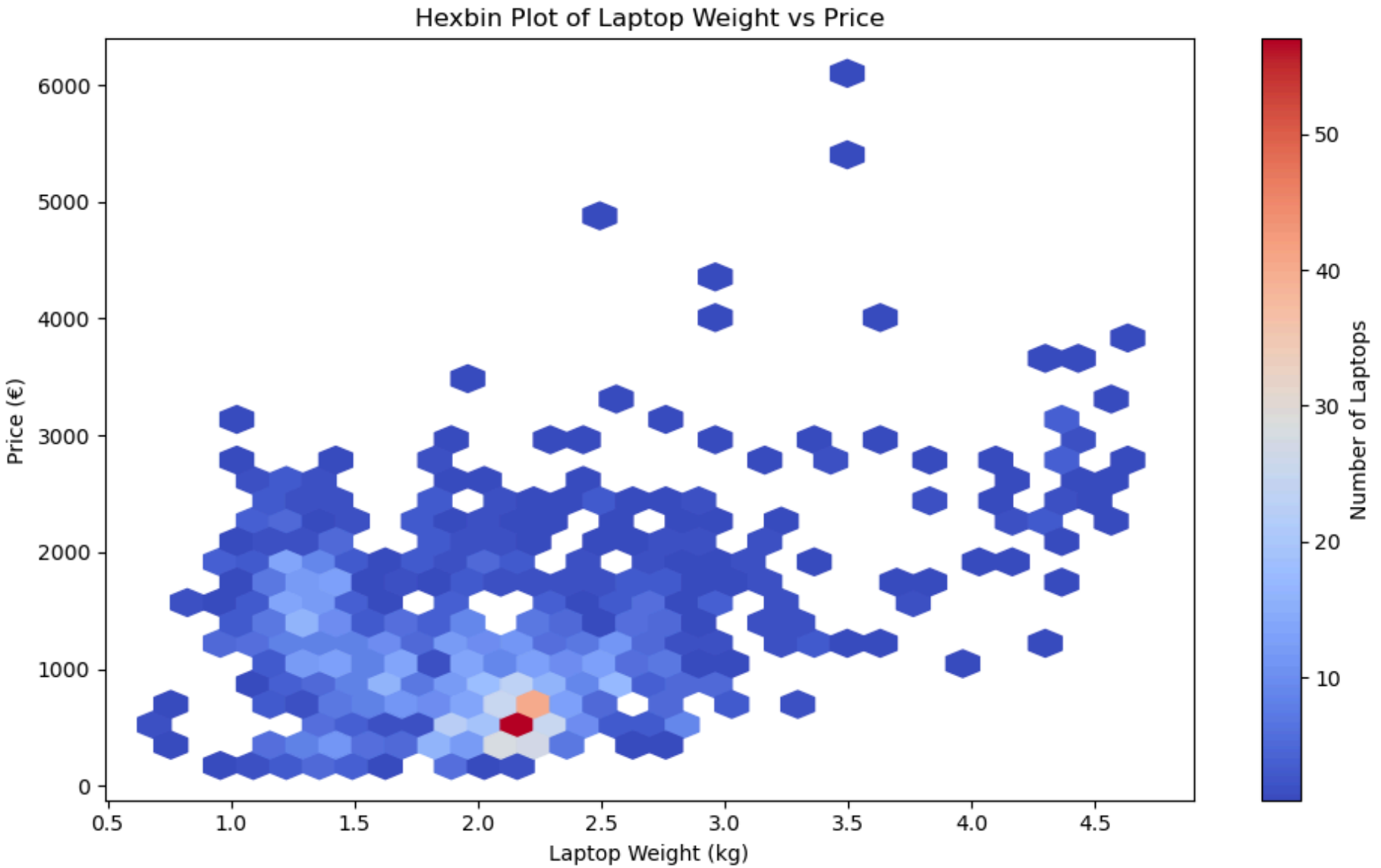
In [49]:
```
#Heatmap of Categorical Features vs Price

plt.figure(figsize=(12, 6))
pivot_table = df.pivot_table(values='Price_euros', index='Company', columns='PrimaryStorageType', aggfunc='mean')
sns.heatmap(pivot_table, cmap='coolwarm', annot=True, fmt='.0f', linewidths=0.5)
plt.title('Average Laptop Price by Company & Storage Type')
plt.xlabel('Primary Storage Type')
```

```
plt.ylabel('Company')
plt.tight_layout()
plt.show()
```

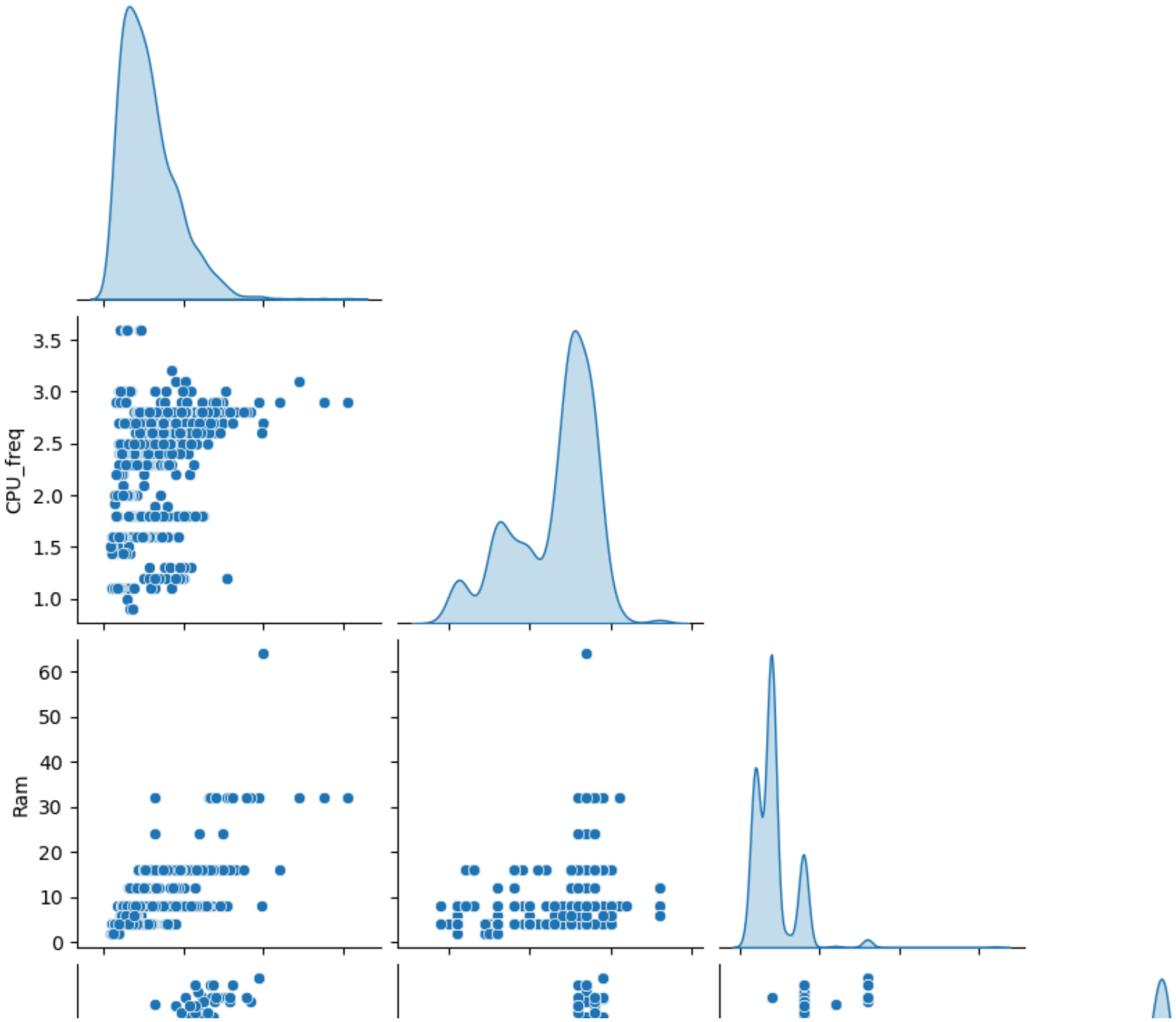


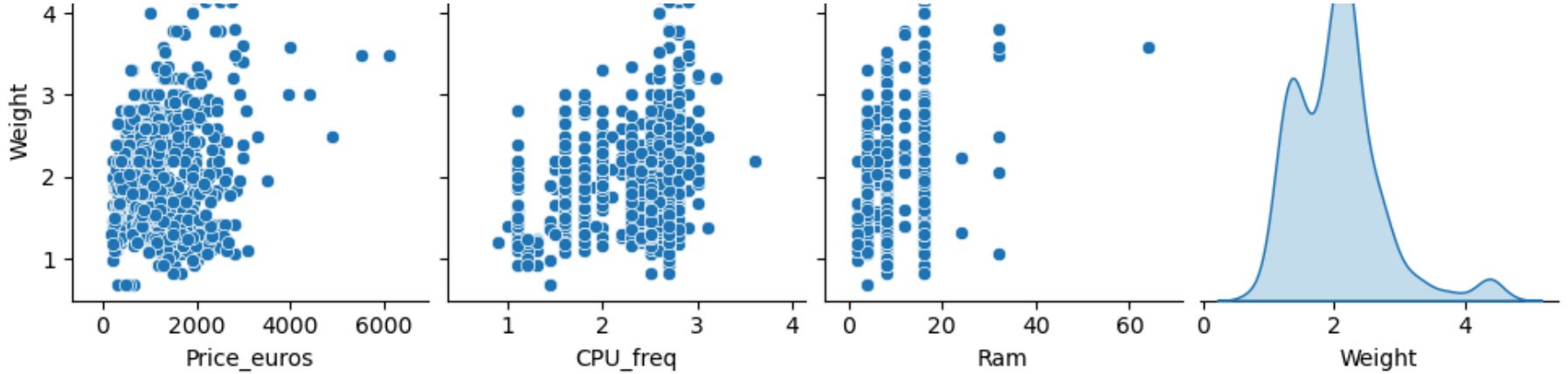
In [51]:
```
plt.figure(figsize=(10, 6))
plt.hexbin(df['Weight'], df['Price_euros'], gridsize=30, cmap='coolwarm', mincnt=1)
plt.colorbar(label='Number of Laptops')
plt.xlabel('Laptop Weight (kg)')
plt.ylabel('Price (€)')
plt.title('Hexbin Plot of Laptop Weight vs Price')
```

```
plt.tight_layout()
plt.show()
```



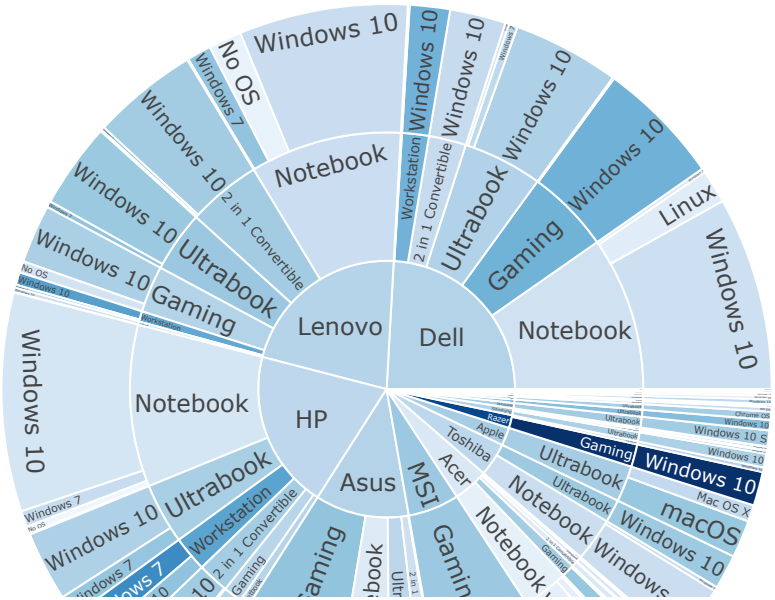
In [53]:
```
sns.pairplot(df[['Price_euros', 'CPU_freq', 'Ram', 'Weight']], diag_kind='kde', markers='o', corner=True)
plt.show()
```


CPU_freq
Ram
3.5
3.0
2.5
2.0
1.5
1.0
60
50
40
30
20
10
0



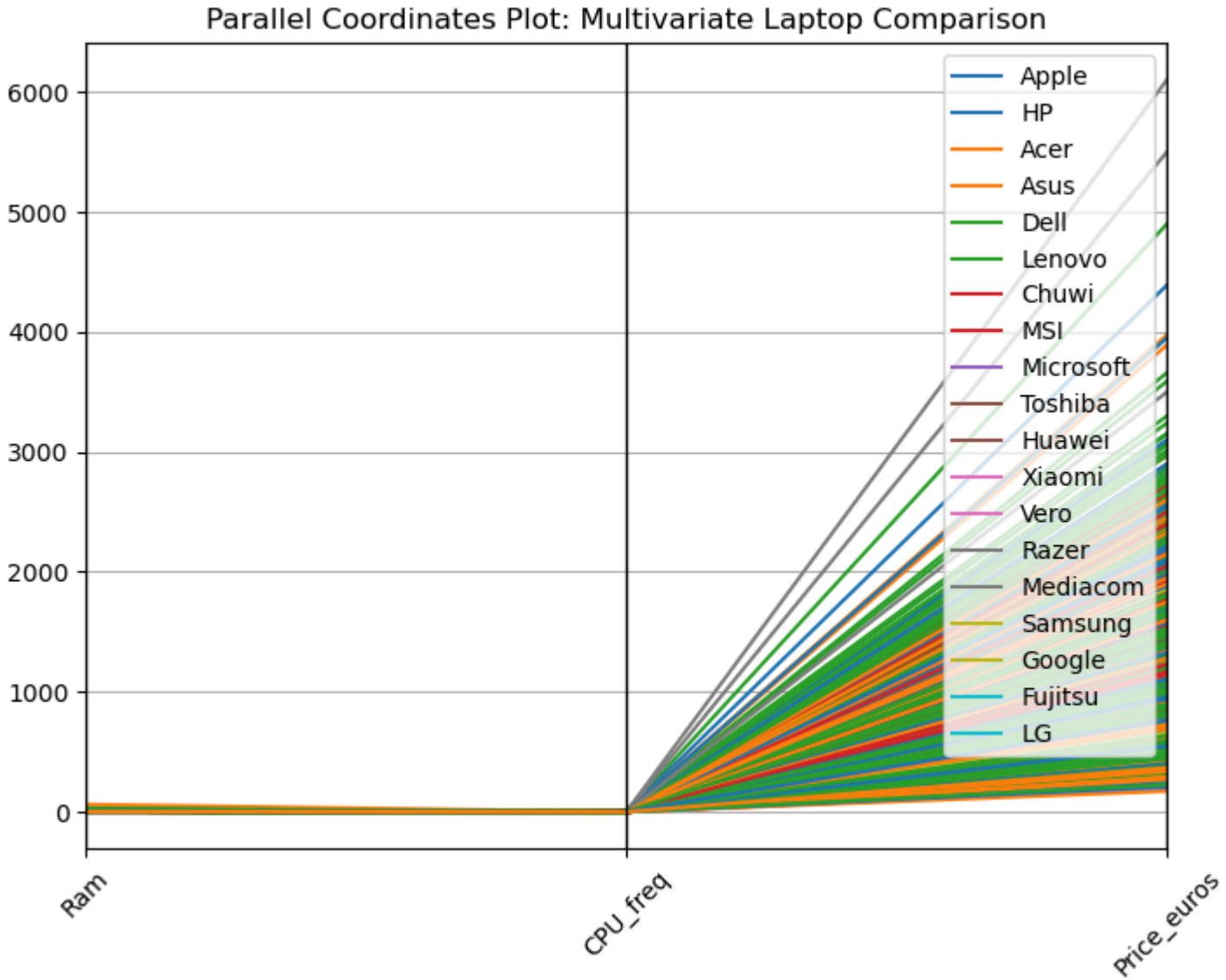
In [55]:
```
import plotly.express as px

fig = px.sunburst(df, path=['Company', 'TypeName', 'OS'], values='Price_euros', color='Price_euros', color_continuo
fig.update_layout(title='Sunburst Chart: Brand, Type & OS Market Share')
fig.show()
```

Sunburst Chart: Brand, Type & OS Market Share

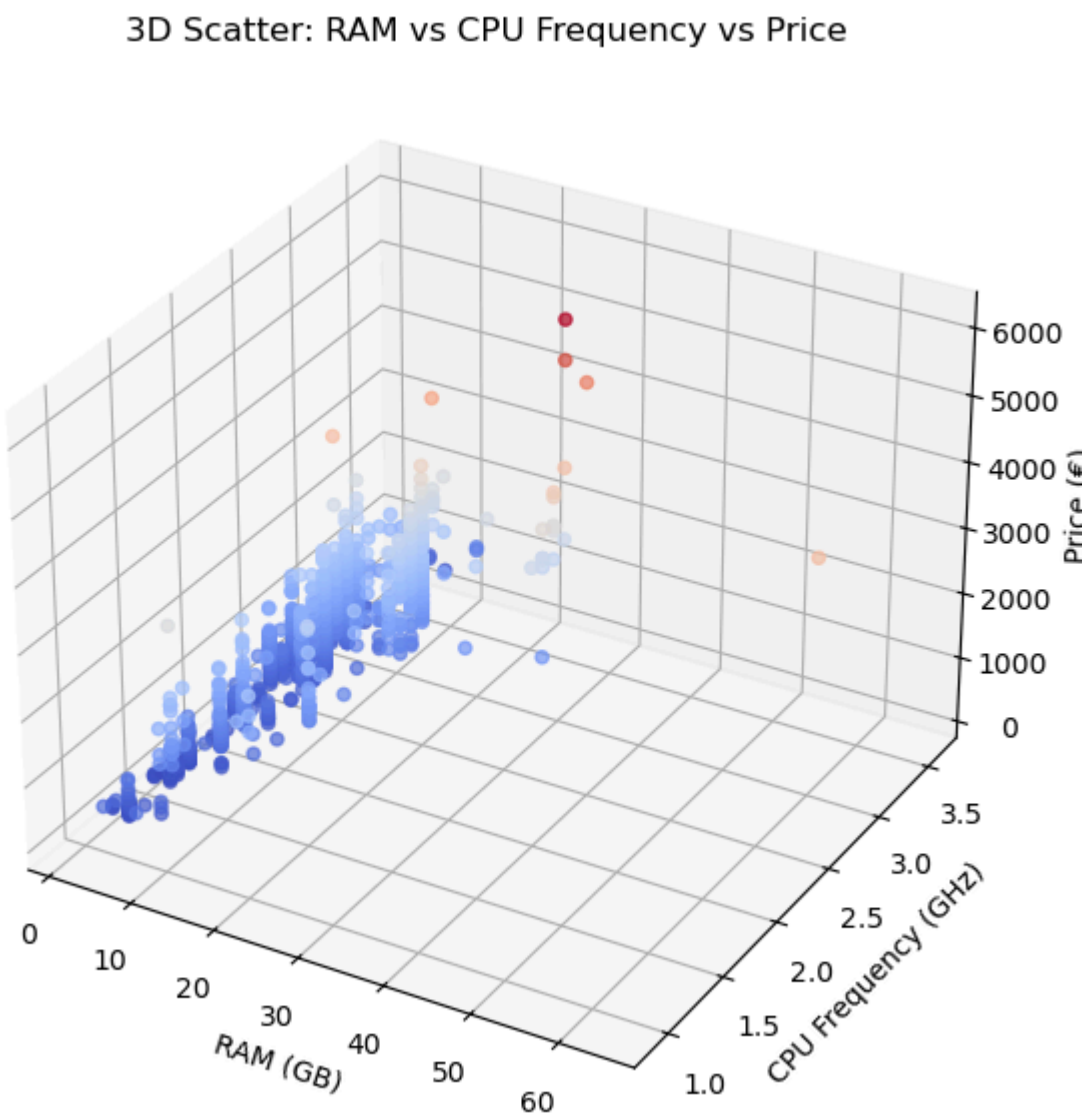


In [57]:
```
from pandas.plotting import parallel_coordinates

plt.figure(figsize=(8, 6))
parallel_coordinates(df[['Company', 'Ram', 'CPU_freq', 'Price_euros']], 'Company', colormap=plt.cm.get_cmap('tab10'
plt.xticks(rotation=45)
plt.title('Parallel Coordinates Plot: Multivariate Laptop Comparison')
plt.show()
```

```
/var/folders/pm/cnlmdnjj5g1ct4r7rrx83vnr0000gn/T/ipykernel_6688/3621600638.py:4: MatplotlibDeprecationWarning:

The get_cmap function was deprecated in Matplotlib 3.7 and will be removed two minor releases later. Use ``matplotli
b.colormaps[name]`` or ``matplotlib.colormaps.get_cmap(obj)`` instead.
```



In [59]:
```
from mpl_toolkits.mplot3d import Axes3D

fig = plt.figure(figsize=(10, 7))
ax = fig.add_subplot(111, projection='3d')

ax.scatter(df['Ram'], df['CPU_freq'], df['Price_euros'], c=df['Price_euros'], cmap='coolwarm', alpha=0.7)

ax.set_xlabel('RAM (GB)')
ax.set_ylabel('CPU Frequency (GHz)')
ax.set_zlabel('Price (€)')
ax.set_title('3D Scatter: RAM vs CPU Frequency vs Price')

plt.show()
```


3D Scatter: RAM vs CPU Frequency vs Price
RAM (GB)
CPU Frequency (GHz)
Price (€)
0
10
20
30
40
50
60
1.0
1.5
2.0
2.5
3.0
3.5
0
1000
2000
3000
4000
5000
6000

In [ ]: