In [59]:
```
#曹越 3220200854
#仓库地址：https://github.com/caiji853/homework2_cy
import pandas as pd
import numpy as np
import os
import matplotlib.pyplot as plt
from collections import Counter
from statsmodels.formula.api import ols
```

读取并查看数据的整体情况,由于两个csv文件列属性的不一样，强行拼接会导致出现大量的nan数据，为避免这种情况，我们分别对两个csv文件进行频繁项和关联规则挖掘。

In [60]:
```
df1 = pd.read_csv('./archive/winemag-data_first150k.csv')
df2=pd.read_csv('./archive/winemag-data-130k-v2.csv')
print(df1.info())
df1.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150930 entries, 0 to 150929
Data columns (total 11 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   Unnamed: 0   150930 non-null  int64  
 1   country      150925 non-null  object 
 2   description  150930 non-null  object 
 3   designation  105195 non-null  object 
 4   points       150930 non-null  int64  
 5   price        137235 non-null  float64
 6   province     150925 non-null  object 
 7   region_1     125870 non-null  object 
 8   region_2     60953 non-null   object 
 9   variety      150930 non-null  object 
 10  winery       150930 non-null  object 
dtypes: float64(1), int64(2), object(8)
memory usage: 12.7+ MB
None
```

Out[60]:

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	variety	winery
0	0	US	This tremendous 100% varietal wine hails from ...	Martha's Vineyard	96	235.0	California	Napa Valley	Napa	Cabernet Sauvignon	Heitz
1	1	Spain	Ripe aromas of fig, blackberry and cassis are ...	Carodorum Selección Especial Reserva	96	110.0	Northern Spain	Toro	NaN	Tinta de Toro	Bodega Carmen Rodríguez
2	2	US	Mac Watson honors the memory of a wine once ma...	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sonoma	Sauvignon Blanc	Macauley
3	3	US	This spent 20 months in 30% new French oak, an...	Reserve	96	65.0	Oregon	Willamette Valley	Willamette Valley	Pinot Noir	Ponzi
4	4	France	This is the top wine from La Bégude, named aft...	La Brûlade	95	66.0	Provence	Bandol	NaN	Provence red blend	Domaine de la Bégude

In [61]:
```
print(df2.info())
df2.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 129971 entries, 0 to 129970
Data columns (total 14 columns):
 #   Column                 Non-Null Count   Dtype  
---  ------                 --------------   -----  
 0   Unnamed: 0             129971 non-null  int64  
 1   country                129908 non-null  object 
 2   description            129971 non-null  object 
 3   designation            92506 non-null   object 
 4   points                 129971 non-null  int64  
 5   price                  120975 non-null  float64
 6   province               129908 non-null  object 
 7   region_1               108724 non-null  object 
 8   region_2               50511 non-null   object 
 9   taster_name            103727 non-null  object 
 10  taster_twitter_handle  98758 non-null   object 
 11  title                  129971 non-null  object 
 12  variety                129970 non-null  object 
 13  winery                 129971 non-null  object 
dtypes: float64(1), int64(2), object(11)
memory usage: 13.9+ MB
None
```

Out[61]:

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_handle	title	
0	0	Italy	Aromas include tropical fruit, broom, brimston...	Vulkà Bianco	87	NaN	Sicily & Sardinia	Etna	NaN	Kerin O'Keefe	@kerinokeefe	Nicosia 2013 Vulkà Bianco (Etna)	
1	1	Portugal	This is ripe and fruity, a wine that is smooth...	Avidagos	87	15.0	Douro	NaN	NaN	Roger Voss	@vossroger	Quinta dos Avidagos 2011 Avidagos Red (Douro)	F

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_handle	title
2	2	US	Tart and snappy, the flavors of lime flesh and...	NaN	87	14.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine	Rainstorm 2013 Pinot Gris (Willamette Valley)
3	3	US	Pineapple rind, lemon pith and orange blossom ...	Reserve Late Harvest	87	13.0	Michigan	Lake Michigan Shore	NaN	Alexander Peartree	NaN	St. Julian 2013 Reserve Late Harvest Riesling ...
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	87	65.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine	Sweet Cheeks 2012 Vintner's Reserve Wild Child...

处理缺失数据，使用最高频数据来进行缺失值的填充

In [62]:
```
for attribute in df1.columns.values:
    df1[attribute] = df1[attribute].fillna(df1[attribute].mode()[0])
print(df1.info())
for attribute in df2.columns.values:
    df2[attribute] = df2[attribute].fillna(df2[attribute].mode()[0])
print(df2.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150930 entries, 0 to 150929
Data columns (total 11 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   Unnamed: 0   150930 non-null  int64  
 1   country      150930 non-null  object 
 2   description  150930 non-null  object 
 3   designation  150930 non-null  object 
 4   points       150930 non-null  int64  
 5   price        150930 non-null  float64
 6   province     150930 non-null  object 
 7   region_1     150930 non-null  object 
 8   region_2     150930 non-null  object 
 9   variety      150930 non-null  object 
 10  winery       150930 non-null  object 
dtypes: float64(1), int64(2), object(8)
memory usage: 12.7+ MB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 129971 entries, 0 to 129970
Data columns (total 14 columns):
 #   Column                 Non-Null Count   Dtype  
---  ------                 --------------   -----  
 0   Unnamed: 0             129971 non-null  int64  
 1   country                129971 non-null  object 
 2   description            129971 non-null  object 
 3   designation            129971 non-null  object 
 4   points                 129971 non-null  int64  
 5   price                  129971 non-null  float64
 6   province               129971 non-null  object 
 7   region_1               129971 non-null  object 
 8   region_2               129971 non-null  object 
```

```
 9   taster_name            129971 non-null  object
 10  taster_twitter_handle  129971 non-null  object
 11  title                  129971 non-null  object
 12  variety                129971 non-null  object
 13  winery                 129971 non-null  object
dtypes: float64(1), int64(2), object(11)
memory usage: 13.9+ MB
None
```

In [63]:
```
df1.head()
```

Out[63]:

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	variety	winery
0	0	US	This tremendous 100% varietal wine hails from ...	Martha's Vineyard	96	235.0	California	Napa Valley	Napa	Cabernet Sauvignon	Heitz
1	1	Spain	Ripe aromas of fig, blackberry and cassis are ...	Carodorum Selección Especial Reserva	96	110.0	Northern Spain	Toro	Central Coast	Tinta de Toro	Bodega Carmen Rodríguez
2	2	US	Mac Watson honors the memory of a wine once ma...	Special Selected Late Harvest	96	90.0	California	Knights Valley	Sonoma	Sauvignon Blanc	Macauley
3	3	US	This spent 20 months in 30% new French oak, an...	Reserve	96	65.0	Oregon	Willamette Valley	Willamette Valley	Pinot Noir	Ponzi
4	4	France	This is the top wine from La Bégude, named aft...	La Brûlade	95	66.0	Provence	Bandol	Central Coast	Provence red blend	Domaine de la Bégude

In [64]:
```
df2.head()
```

Out[64]:

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_handle	title	va
0	0	Italy	Aromas include tropical fruit, broom, brimston...	Vulkà Bianco	87	20.0	Sicily & Sardinia	Etna	Central Coast	Kerin O'Keefe	@kerinokeefe	Nicosia 2013 Vulkà Bianco (Etna)	W B
1	1	Portugal	This is ripe and fruity, a wine that is smooth...	Avidagos	87	15.0	Douro	Napa Valley	Central Coast	Roger Voss	@vossroger	Quinta dos Avidagos 2011 Avidagos Red (Douro)	Portug
2	2	US	Tart and snappy, the flavors of lime flesh and...	Reserve	87	14.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine	Rainstorm 2013 Pinot Gris (Willamette Valley)	Pinot
3	3	US	Pineapple rind, lemon pith and orange blossom ...	Reserve Late Harvest	87	13.0	Michigan	Lake Michigan Shore	Central Coast	Alexander Peartree	@vossroger	St. Julian 2013 Reserve Late Harvest Riesling ...	Ries
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	87	65.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine	Sweet Cheeks 2012 Vintner's Reserve Wild Child...	Pinot

使用apriors算法计算频繁项,keys表示频繁项集，key表示频繁项，C表示D中每一项的支持计数

In [65]:
```
def aproiri(D,minSup):
    C1={}

    for T in D:
        for i in T:
            if i in C1:
                C1[i]+=1
            else:
                C1[i]=1

    _keys1=C1.keys()


    keys1 = []
    for i in _keys1:
        keys1.append([i])
    n = len(D)

    cutKeys1=[]
    for k in keys1[:]:
        if C1[k[0]]*1.0/n >= minSup:
            cutKeys1.append(k)
    cutKeys1.sort()
    keys = cutKeys1
    all_keys = []
    all_sups = []
    while keys != []:
        C=getC(D,keys)
        cutKeys,sups = getCutKeys(keys,C,minSup,len(D))

        for key in cutKeys:
            all_keys.append(key)
        for sup in sups:
            all_sups.append(sup)
        keys = aproiri_gen(cutKeys)
    return all_keys,all_sups

#获得每个Key的计数
def getC(D,keys):
    C= []
    for key in keys:
```

```
        c=0
        for T in D:
            flag =True
            for k in key:
                if k not in T:
                    flag =False
            if flag:
                c+=1
        C.append(c)
    return(C)

#剪枝操作
def getCutKeys(keys,C,minSup,length):
    kk =[]
    sups=[]
    for i,key in enumerate(keys):
        if float(C[i])/length>=minSup:
            kk.append(key)
            sups.append(float(C[i])/length)
    return kk,sups

#判断key是否在数据库某一元组T中
def keyInT(key,T):
    for k in key:
        if k not in T:
            return False
    return True

#连接频繁项
def aproiri_gen(keys1):
    keys2=[]
    for k1 in keys1:
        for k2 in keys1:
            if k1!=k2:
                key = []
                for k in k1:
                    if k not in key:
                        key.append(k)
                for k in k2:
                    if k not in key:
                        key.append(k)
                key.sort()
```

```
                if key not in keys2:
                    keys2.append(key)
    return keys2
```

计算频繁项集和支持度

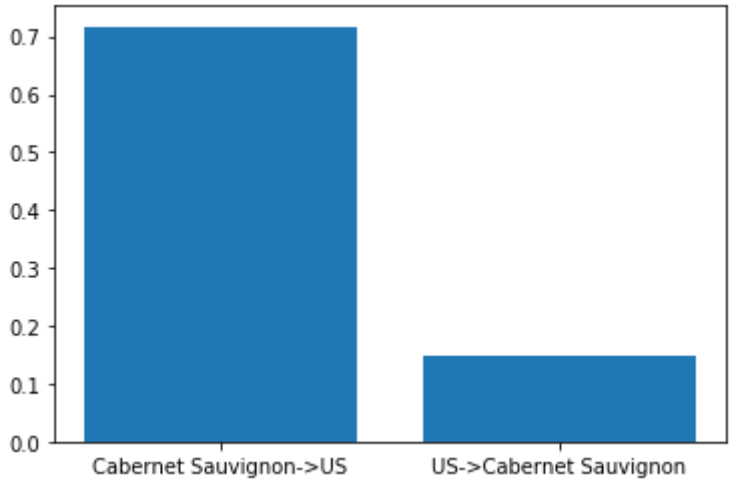
In [71]:
```
df1_copy= df1[['country','province','region_1','variety','winery']]
df1_array = df1_copy.values
fre,sup = aproiri(df1_array,0.05)
print(fre)
print(sup)
```

```
[['Cabernet Sauvignon'], ['California'], ['Chardonnay'], ['France'], ['Italy'], ['Napa Valley'], ['Pinot Noir'], ['Red Blend'], ['S
pain'], ['US'], ['Washington'], ['Cabernet Sauvignon', 'US'], ['California', 'Pinot Noir'], ['California', 'US'], ['Chardonnay', 'U
S'], ['Pinot Noir', 'US'], ['US', 'Washington'], ['California', 'Pinot Noir', 'US']]
[0.08480752666799178, 0.29492479957596235, 0.09595176571920758, 0.13978665606572582, 0.15555555555555556, 0.20717551182667462, 0.09
468627840720864, 0.06666666666666667, 0.05478036175710594, 0.4134499436825018, 0.06459948320413436, 0.060809646856158486, 0.0505929
9012787385, 0.29492479957596235, 0.05384615384615385, 0.06852845690054993, 0.06459948320413436, 0.05059299012787385]
```

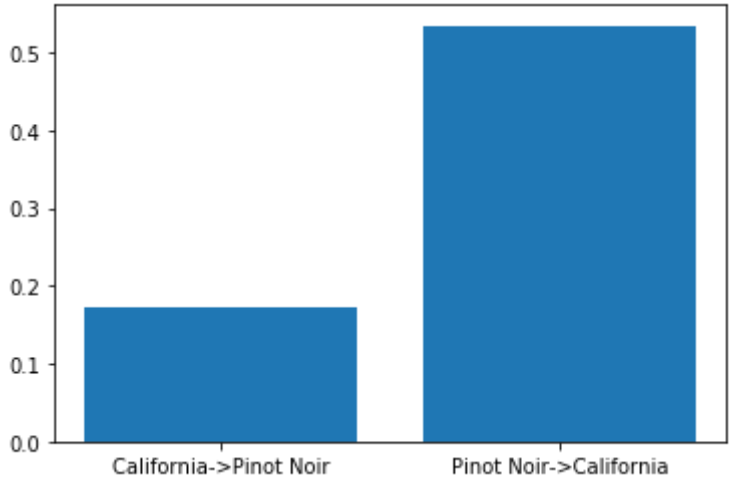
找出关联规则，计算置信度,由于我们的算法只能判断频繁项集，并不能找出关联规则，因此从x->y与y->x我们在这都计算一遍。

In [116]:
```
#使用p（B\A）=P(A∩B)/P(A)来计算置信度
for i in range(len(fre)):
    config =sup[i]
    c =[]
    names = []
    if len(fre[i])==1:
        continue
    if len(fre[i])==2:
        for j in range(len(fre)):
            if fre[j][0] == fre[i][0] and len(fre[j])==1:
                temp = config / sup[j]
                c.append(temp)
                ss = fre[i][0] +'->'+fre[i][1]
                names.append(ss)
        for j in range(len(fre)):
            if fre[j][0] == fre[i][1] and len(fre[j])==1:
                temp = config / sup[j]
                c.append(temp)
                ss = fre[i][1]+ '->'+fre[i][0]
                names.append(ss)
    if len(fre[i])==3:
        continue
    print(c)
    plt.bar(names,c)
    plt.show()
```

```
[0.71703125, 0.14707861927502325]
```

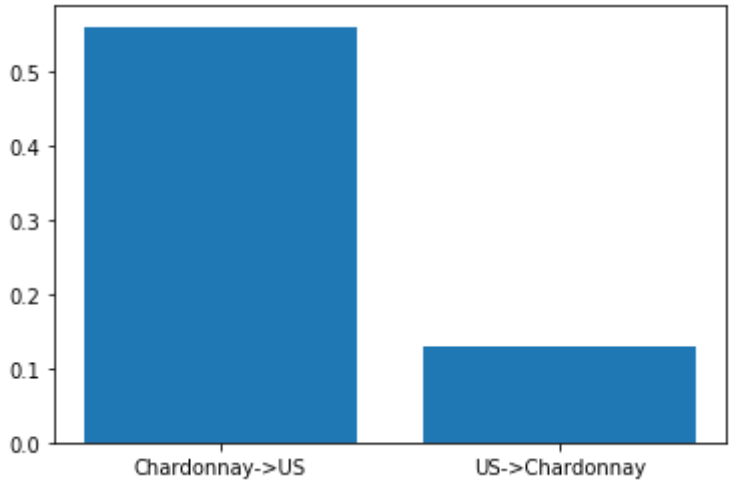


[0.17154539123402152, 0.534322300748723]

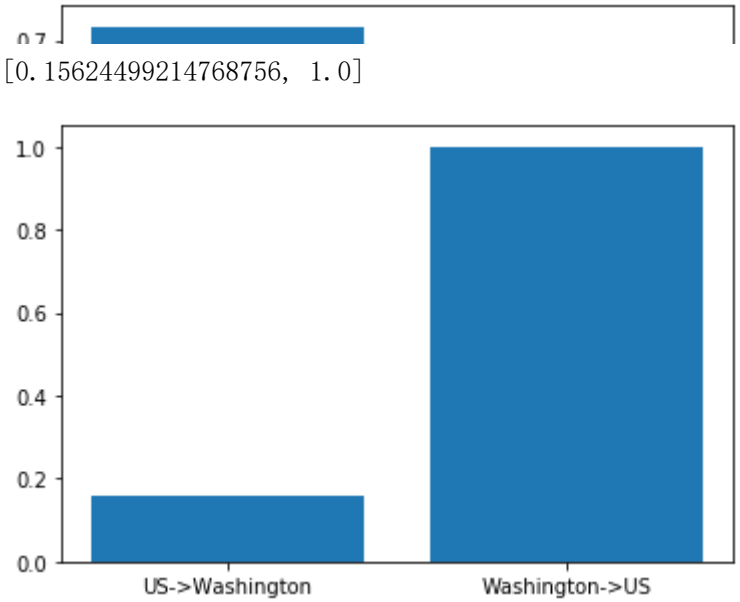


[1.0, 0.7133264959456427]

[0.5611793951111725, 0.1302362103778725]

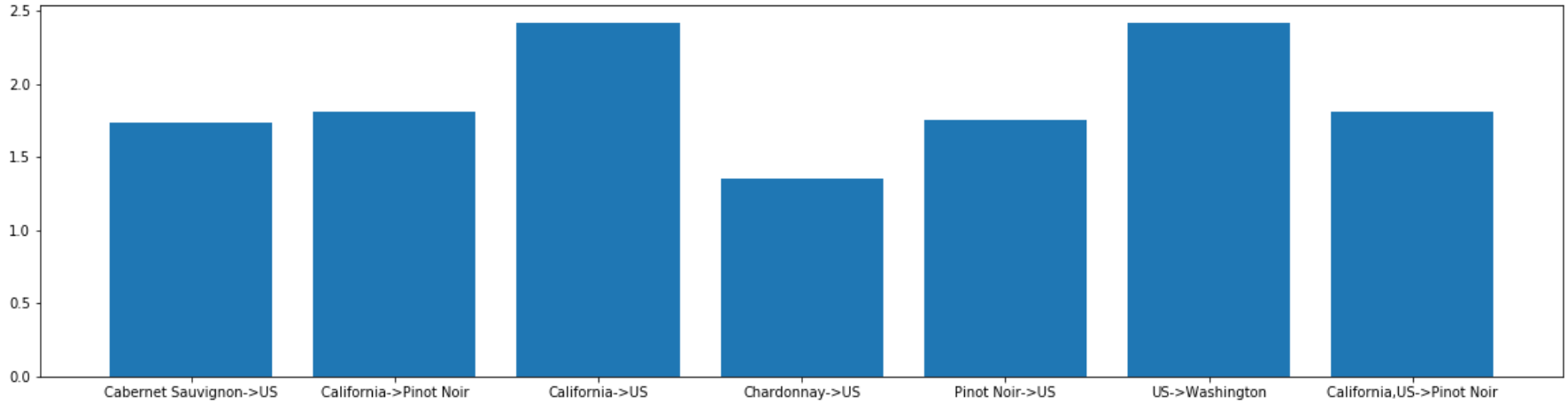


[0.7237422153803094, 0.16574789269574694]



计算提升度，考虑到提升度的公式分解下来和箭头的方向无关，因此可以用x->y的支持度同时除以x，y的支持度得到，便于计算

In [99]:
```
#使用Lift(A->B)=p（B\A）/P(B)=P(A∩B)/P(A)P(B)来计算置信度
c =[]
names = []
for i in range(len(fre)):
    config =sup[i]
    if len(fre[i])==1:
        continue
    if len(fre[i])==2:
        for j in range(len(fre)):
            if fre[j][0] == fre[i][0] and len(fre[j])==1:
                temp = config / sup[j]
                ss = fre[i][0] +'->'+fre[i][1]
                names.append(ss)
        for j in range(len(fre)):
            if fre[j][0] == fre[i][1] and len(fre[j])==1:
                temp = temp / sup[j]
                c.append(temp)
    if len(fre[i])==3:
        temp=config / sup[13]/sup[6]
        c.append(temp)
        ss = fre[i][0]+','+ fre[i][2]+'->'+ fre[i][1]
        names.append(ss)
plt.figure(figsize=(20,5))
plt.bar(names,c)
plt.show()
```



计算第二个数据集的三个值，由于第二个数据集添加了tastername，因此要将这个属性考虑进去

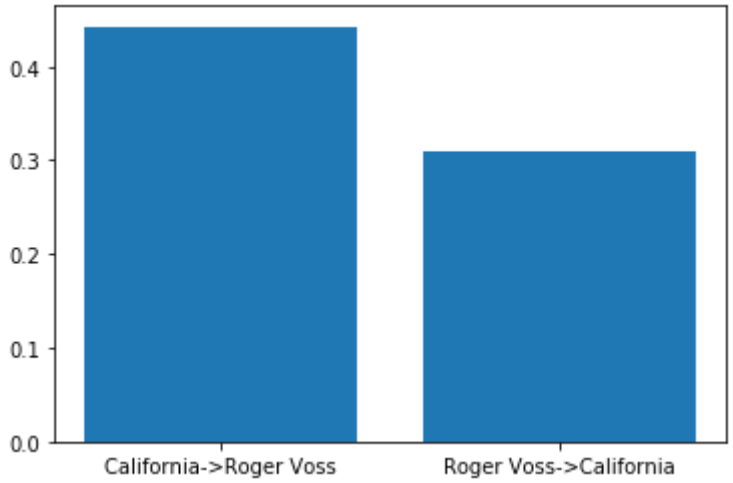
In [100]:
```
df2_copy= df2[['country','province','region_1','variety','winery','taster_name']]
df2_array = df2_copy.values

fre2,sup2 = aproiri(df2_array,0.1)
print(fre2)
print(sup2)
```

```
[['California'], ['France'], ['Italy'], ['Michael Schachner'], ['Napa Valley'], ['Pinot Noir'], ['Roger Voss'], ['US'], ['California', 'Roger Voss'], ['California', 'US'], ['France', 'Roger Voss'], ['Roger Voss', 'US'], ['California', 'Roger Voss', 'US']]
[0.27937001331066164, 0.16998407337021335, 0.15034122996668486, 0.11644135999569134, 0.19794415677343408, 0.10212278123581414, 0.39822729685853, 0.4198398104192474, 0.12369682467627394, 0.27937001331066164, 0.14516315178001246, 0.12909033553638888, 0.12369682467627394]
```

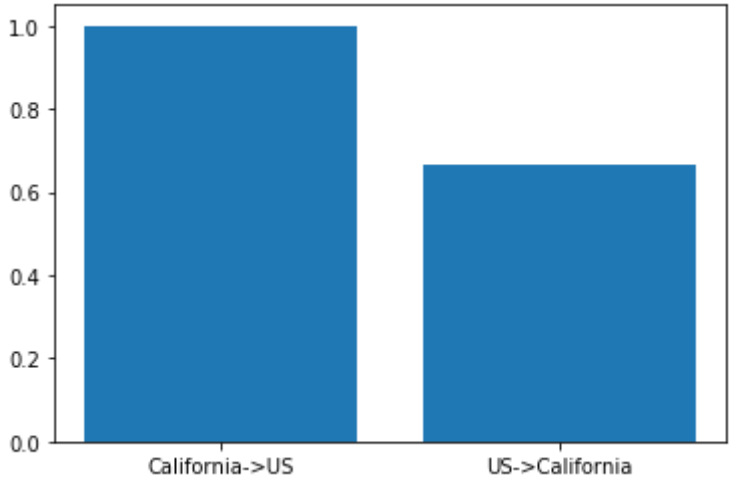
In [114]:

```
for i in range(len(fre2)):
    c =[]
    names = []
    config =sup2[i]
    if len(fre2[i])==1:
        continue
    if len(fre2[i])==2:
        for j in range(len(fre2)):
            if fre2[j][0] == fre2[i][0] and len(fre2[j])==1:
                temp = config / sup2[j]
                c.append(temp)
                ss = fre2[i][0] +'->'+fre2[i][1]
                names.append(ss)
        for j in range(len(fre2)):
            if fre2[j][0] == fre2[i][1] and len(fre2[j])==1:
                temp = config / sup2[j]
                c.append(temp)
                ss = fre2[i][1] +'->'+fre2[i][0]
                names.append(ss)
    if len(fre2[i])==3:
        temp = config / sup2[9]
        c.append(temp)
        ss = fre2[i][0]+' '+ fre2[i][2]+'->'+ fre2[i][1]
        names.append(ss)
    print(c)
    #plt.figure(figsize=(20,5))
    plt.bar(names,c)
    plt.show()
```

```
[0.4427705866152575, 0.3106186483248966]
```

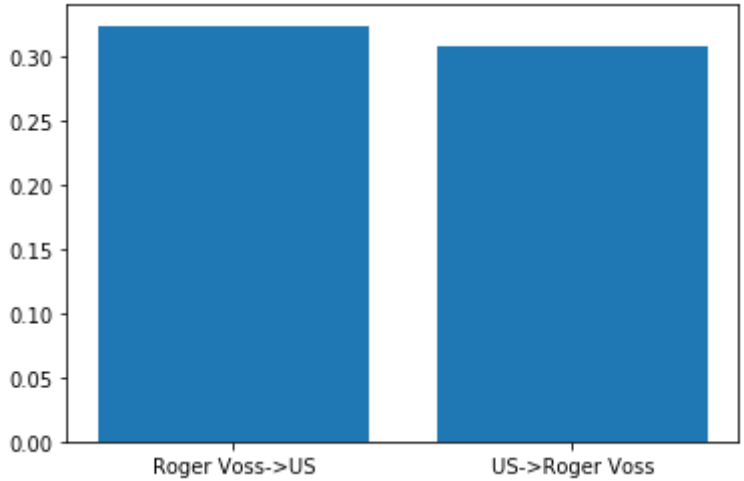


[1.0, 0.665420492238899]

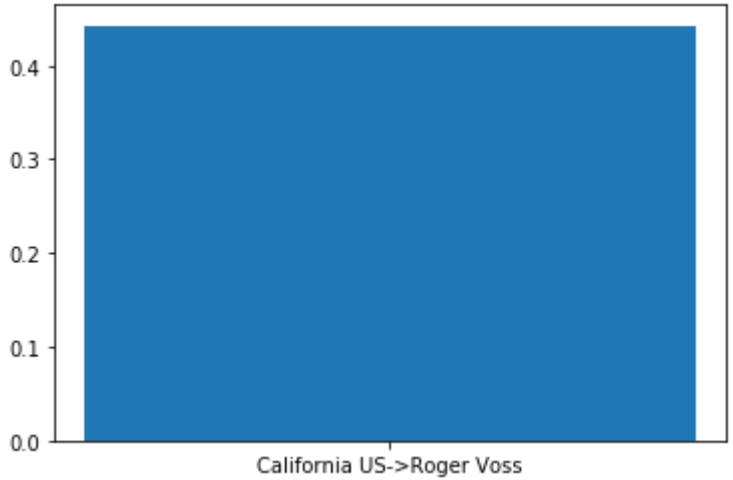


[0.853980898927262, 0.3645233587078326]

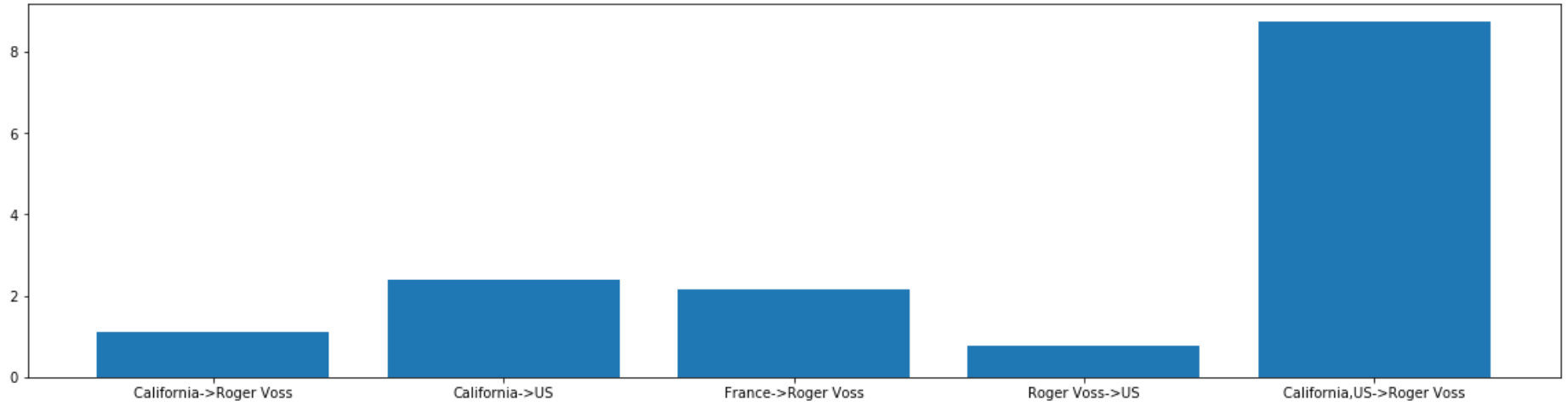
[0.32416244831716834, 0.30747521395715355]



[0.4427705866152575]



In [115]:
```
c =[]
names = []
for i in range(len(fre2)):
    config =sup2[i]
    if len(fre2[i])==1:
        continue
    if len(fre2[i])==2:
        for j in range(len(fre2)):
            if fre2[j][0] == fre2[i][0] and len(fre2[j])==1:
                temp = config / sup2[j]
                ss = fre2[i][0] +'->'+fre2[i][1]
                names.append(ss)
        for j in range(len(fre2)):
            if fre2[j][0] == fre2[i][1] and len(fre2[j])==1:
                temp = temp / sup2[j]
                c.append(temp)
    if len(fre2[i])==3:
        temp=config / sup2[9]/sup[12]
        c.append(temp)
        ss = fre2[i][0]+','+ fre2[i][2]+'->'+ fre2[i][1]
        names.append(ss)
plt.figure(figsize=(20,5))
plt.bar(names,c)
plt.show()
```



In [ ]: