There are 5 reactions and 4 species in the OMM model.

The stoichiometric matrix is S =

```
  -1   1   1  0   0
  -1   1   0  1   0
   1  -1  -1  0   0
   0   0   1  0  -1
```

The vector of reaction velocities is v, where

```
  v(1) = k1*x1*x2
  v(2) = k2*x3
  v(3) = k3*x3
  v(4) = k4
  v(5) = k5*x4
```

The vector of mass balance equations is xdot = S*v, where

```
  xdot(1) = k2*x3 + k3*x3 - k1*x1*x2
  xdot(2) = k4 + k2*x3 - k1*x1*x2
  xdot(3) = k1*x1*x2 - k3*x3 - k2*x3
  xdot(4) = k3*x3 - k5*x4
```

Let the map psi_p be given by

```
  k1  |-->  p2
  k2  |-->  p3
  k3  |-->  p4
  k4  |-->  y4
  k5  |-->  p5
  x1  |-->  y1
  x2  |-->  p1
  x3  |-->  y2
  x4  |-->  y3
```

This results in a linear velocity vector psi_p(v), where

```
  psi_p(v(1)) = p1*p2*y1
  psi_p(v(2)) = p3*y2
  psi_p(v(3)) = p4*y2
  psi_p(v(4)) = y4
  psi_p(v(5)) = p5*y3
```

We can express psi_p(v) as the product P*y, where y is the vector [y1,...,y4]^T and P =

```
  p1*p2   0   0  0
      0  p3   0  0
      0  p4   0  0
      0   0   0  1
      0   0  p5  0
```

From this we calculate the coefficient matrix, C = S*P =

```
  -p1*p2    p3 + p4    0  0
  -p1*p2         p3    0  1
   p1*p2  - p3 - p4    0  0
       0         p4  -p5  0
```

C is row equivalent to the reduced matrix Crref =

```
  1  0  0  -(p3 + p4)/(p1*p2*p4)
  0  1  0                 -1/p4
  0  0  1                 -1/p5
  0  0  0                     0
```

```
The null space of C is spanned by the columns of N =

  (p3 + p4)/(p1*p2*p4)
                  1/p4
                  1/p5
                     1

Let ybar = N*q, where q is given by

  q(1) = q1

This gives

  ybar(1) = (q1*(p3 + p4))/(p1*p2*p4)
  ybar(2) = q1/p4
  ybar(3) = q1/p5
  ybar(4) = q1

From ybar we construct the composite forward map psi_py :

  k1  |-->  p2
  k2  |-->  p3
  k3  |-->  p4
  k4  |-->  q1
  k5  |-->  p5
  x1  |-->  (q1*(p3 + p4))/(p1*p2*p4)
  x2  |-->  p1
  x3  |-->  q1/p4
  x4  |-->  q1/p5

The steady state reaction velocity vector vbar is given by psi_py(v), where

  vbar(1) = (q1*(p3 + p4))/p4
  vbar(2) = (p3*q1)/p4
  vbar(3) = q1
  vbar(4) = q1
  vbar(5) = q1

The mapping function psi_q^-1 is given by

  q1  |-->  y4

The composite inverse map psi_qp^-1:

  p1  |-->  x2
  p2  |-->  k1
  p3  |-->  k2
  p4  |-->  k3
  p5  |-->  k5
  q1  |-->  k4

The complete steady state map psi_ss is therefore

  k1  |-->  k1
  k2  |-->  k2
  k3  |-->  k3
  k4  |-->  k4
  k5  |-->  k5
  x1  |-->  (k4*(k2 + k3))/(k1*k3*x2)
  x2  |-->  x2
  x3  |-->  k4/k3
  x4  |-->  k4/k5

The unsubstituted steady state reaction velocity vector vbar = psi_ss(v) is
given by

  vbar(1) = (k4*(k2 + k3))/k3
  vbar(2) = (k2*k4)/k3
```

```
  vbar(3) = k4
  vbar(4) = k4
  vbar(5) = k4
```

Verify steady state. xdot = S * vbar, where

```
  xdot(1) = 0
  xdot(2) = 0
  xdot(3) = 0
  xdot(4) = 0
```