Morocco and the US Free Trade Agreement: A specific factors model with unemployment and energy imports

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A B S T R A C T
This paper examines the impact in Morocco of its pending free trade agreement with the US in a specific factors model with unemployment and energy imports. Projected price scenarios across eight industries lead to adjustments in outputs, energy imports, rural wages, urban wages, and the unemployment rate. The model predicts substantial adjustments for reasonable price scenarios. Rural wages fall unless agriculture is subsidized. Unemployment, assumed inversely related to output, is sensitive to price changes. Factor substitution only affects the degree of output adjustments. Adjustments in capital returns lead to industrial investment and subsequent long run output adjustments.

The US Morocco Free Trade Agreement USMFTA promises to eliminate trade barriers between the two countries over a period of 25 years. Morocco will import more agricultural products, manufacturing, telecommunications, and financial services from the US. The net gains from trade, however, will come with economic adjustments. Brown, Kiyota, and Stern (2005) predict that USMFTA will have small employment effects in Morocco. The present specific factors model separates urban from rural labor, adds energy imports, and finds more substantial effects. Adjustments in energy imports and outputs across the eight industries are also substantial under various price scenarios.

The model includes unemployment in the urban sector based on Okun’s (1962) law linking the unemployment rate to output. The present application is the first to include Okun’s law in a general equilibrium model as developed by Thompson (1989). The model of production and trade developed is developed by Jones (1965), Jones and Scheinkman (1977), Chang (1979), Takayama (1982), and Thompson (1995).

The present specific factors model includes eight industrial capital inputs with urban labor, rural labor, and imported energy mobile between industries. There is ample motivation to include energy imports, critical to the economy of Morocco. Separate adjustments in the returns to industrial capital lead to long run investment and output adjustments. The paper includes sensitivity analysis for a number of assumptions including the degree of factor substitution and various price change scenarios.

The World Bank ranks Morocco as a middle income developing country. Morocco is similar to California in both land area and has a population of 34 million. About half the labor force is rural with very low wages. Labor intensive agriculture accounts for one fifth of GDP and one third of export revenue. Urban wages are much higher but unemployment is endemic. The economy is fairly diversified. Morocco has about two thirds of global phosphate reserves and is the third largest producer. Mining accounts for 6% of GDP and includes barite, cobalt, fluor spar, and lead. Tourism is the second source of foreign exchange following remittances. Table 1 lists the major merchandise trade categories. Leading imports from the US are aircraft, soybeans, corn, and wheat. Morocco has been integrating into the global economy with privatization, more transparent business regulation, and open foreign investment (USITC, 2004). Economic and trade ties are mostly with the EU due to proximity and history. France, Portugal, and Spain account for almost all foreign direct investment. USMFTA is likely to increase investment from the US.

Table 2 summarizes tariff rates in Morocco and the US. Tariff rates in Morocco are quite high. Tariff rate quotas on agricultural imports reach over 300%. The average tariff rate on US imports is over 20% suggesting sizeable industrial price changes under USMFTA.

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The first section below presents the model, followed by sections on the data and the comparative static elasticities. The fourth section discusses projected price scenarios followed by a section on the resulting economic adjustments in the specific factors model. A sixth section considers sensitivity analysis and long run adjustments due to industrial investment.

1. The specific factors model with unemployment and energy imports

The present model assumes neoclassical production with competitive markets for products and factors of production. Each of the eight industries has its own capital input $K_j$. Shared inputs are urban labor $L_U$, rural labor $L_R$, and imported energy $E$. Industrial prices $p_j$'s are projected to change in USMFTA leading to comparative static adjustments in the urban wage $w_{Uj}$, rural wage $w_{Rj}$, industry capital returns $r_j$, outputs $x_j$, national output $Y$, and the unemployment rate $u$. The model extends to the effects of long term industrial investment responding to adjusting capital returns in USMFTA.


$$\Delta u = \beta Y'$$

where $'$ represents percentage change.

The International Monetary Fund (2010) reports that the average $\beta$ has increased during the recent decades, from 0.25 during the 1990s to 0.36 in the 2000s after some decline in the 1980s. Spain has the highest $\beta$ at 0.8. Sweden and the UK have high $\beta$'s reflecting labor market reforms. Norway and Denmark have the lowest $\beta$'s. France, Germany, Italy, and the US have average $\beta$'s with high volatility.

Output $Y$ is exhausted by factor payments,

$$Y = w_U N + w_R L_R + E + \Sigma r_j K_j.$$  \hspace{1cm} (2)

where $N$ is the number of employed urban workers, $e$ is the international price of imported energy, and $K_j$ is the capital input in industry $j$.

The endogenous unemployment rate $u$ is linked to the endogenous number of employed urban workers $N$ according to $N = (1 - u)L_U$ implying

$$N' = L_U' + (1-u)^{-1} du.$$  \hspace{1cm} (3)

The first equation in the comparative static system (9) below is based on full employment of urban labor, $N = \Sigma a_{ij}X_{ij}$ where $a_{ij}$ is the cost minimizing amount of urban labor per unit of output in industry $j$. Differentiate to find $dN = \Sigma a_{ij}dx_{ij} + \Sigma a_{ij}dX_{ij}$. Unit inputs are functions of input prices assuming homothetic production. Introducing elasticities leads to

$$N' = a_{ij}w_{Uj} + a_{ij}w_{Rj} + a_{ij}e' + \Sigma a_{ij}r_j' + \Sigma a_{ij}x_j',$$  \hspace{1cm} (4)

where $a_{ij}$ is the substitution elasticity of urban workers with respect to the price of input i and $a_{ij}$ is the industry share of urban workers in industry $j$. The first equation in Eq. (9) combines Eqs. (3) and (4). The second equation in Eq. (9) is a similar condition for employment of rural labor $L_R$.

Substitution elasticities in each industry are derived from Allen (1938) cross price elasticities $\xi_{ij}$ between the input of factor $i$ and the payment to factor $j$ in industry $j$ according to $\xi_{ij} \equiv \partial x_{ij}/\partial w_{ij} = \theta_i \theta_j$. The own price elasticity $\theta_i$ is derived assuming linear homogeneity, $\Sigma \theta_i = 0$. Cobb–Douglas production implies unit Allen elasticities, $\xi_{ij} = 1$. Economy wide substitution elasticities are weighted across industries, $\gamma_{ik} \equiv \Sigma \lambda_j \xi_{ik}$. Cobb–Douglas production implies $\gamma_{ik} = \Sigma \lambda_j \theta_j$. Sensitivity to substitution is examined with constant elasticity of substitution CES that scales the Allen elasticity to values other than one. For instance, the stronger CES elasticity of 2 doubles the Cobb–Douglas substitution elasticities.

The third equation in Eq. (9) is energy imports $E = \Sigma a_{ij}X_{ij}$. Differentiating and introducing substitution elasticities similar to Eq. (4),

$$E' = a_{ij}w_{Uj} + a_{ij}w_{Rj} + a_{ij}e' + \Sigma a_{ij}r_j' + \Sigma a_{ij}x_j'. \hspace{1cm} (5)$$

The international price of energy $e$ is exogenous, the small open economy assumption. Energy imports $E$ are endogenous.

Similar to labor employment, each of the eight industrial capital inputs are fully utilized according to $K_j = a_{0j}X_{ij}$. Differentiating

$$K_j' = a_{0j}w_{Uj} + a_{0j}w_{Rj} + a_{0j}e' + \theta_j x_j' + x_j'. \hspace{1cm} (6)$$

Substitution elasticities for capital inputs with respect to input prices vary by industry. Capital input in an industry is not sensitive to prices of other industrial capital inputs.

Competitive pricing for each industry is stated $p_j = a_{ij}w_{Uj} + a_{ij}w_{Rj} + a_{ij}e + a_{ij}r_j$. Differentiate and apply the cost minimizing envelope rule to find

$$p_j' = \theta_{ij}w_{Uj} + \theta_{ij}w_{Rj} + \theta_{ij}e' + \theta_{ij}r_j'. \hspace{1cm} (7)$$

where $\theta_{ij}$ is the factor share of revenue in industry $j$ paid to factor $i$. The competitive pricing condition (7) provides a set of eight equations in Eq. (9).

The next to the last equation in Eq. (9) accounts for changes in output $Y$. The total differential is $dY = Ndw_{Uj} + L_E dw_{Rj} + EdE + \Sigma \beta dU + \Sigma \beta dR + \Sigma \beta dE + \Sigma \beta dK_j + \Sigma \beta dx_j$.
w_0dN + w_ddl + edE + Σ_θjK_j. In elasticity form substituting for N' in Eq. (3).

Y' = θ_U w_U' + θ_R w_R' + θ_E e' + Σ_θ_jl_j' + θ_uU (1-u)^{-1} du + θ_R L_R' + θ_E E' + Σ_θ_jk_j'.

The last equation in Eq. (9) is Okun's law in Eq. (1).

The comparative static system collects exogenous variables on the right hand side,

\( \begin{pmatrix} \alpha_{U1} & \alpha_{UR} & \lambda_{U1} \\ \alpha_{U2} & \alpha_{UR} & \lambda_{U2} \\ \alpha_{U3} & \alpha_{UR} & \lambda_{U3} \\ \phi_{U1} & \phi_{R1} & \theta_{U1} \\ \phi_{U2} & \phi_{R2} & \theta_{U2} \\ \phi_{U3} & \phi_{R3} & \theta_{U3} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} w_U' \\ w_R' \\ E' \\ \lambda_{U1}' \\ \lambda_{U2}' \\ \lambda_{U3}' \\ \theta_{UR} \\ \theta_{UR} \\ \theta_{UR} \end{pmatrix} + \begin{pmatrix} \lambda_{UL} - \alpha_{UL} e' \\ \lambda_{UR} - \alpha_{UR} e' \\ \lambda_{UL} - \alpha_{UL} e' \\ \theta_{UR} - \phi_{R1} t_1 \\ \theta_{UR} - \phi_{R2} t_2 \\ \theta_{UR} - \phi_{R3} t_3 \\ 0 \\ 0 \end{pmatrix} dE + \begin{pmatrix} \lambda_{U1}' \\ \lambda_{U2}' \\ \lambda_{U3}' \end{pmatrix} dK_j \). In elasticity form substituting for N' in Eq. (3),

\( Y' = \theta_U w_U' + \theta_R w_R' + \theta_E e' + \sum_j \theta_{jU} + ... 0.05 0.24 0.15 \\ Services 0.27 0.35 0.33 0.05 1.3 0.15 \)

Table 4 reports portions of value added for factor i in industry j. For instance, value added in agriculture is Dh209 billion from Table 3 implying that the rural labor factor share is 123/209 = 59%. Agriculture employs very little energy or urban labor. The largest factor shares for industrial capital K_j are in manufacturing M and hotels H. The largest factor shares for urban labor U are in textiles T and construction C. The largest factor shares for energy E are in services S, fisheries F, and mining P. The 8 × 11 factor share matrix θ includes zeroes for other industrial capital inputs.

Table 6 reports substitution elasticities α for Cobb–Douglas production. Constant elasticity of substitution CES scales elasticities accordingly. For instance CES = 2 doubles the substitution elasticities in Table 6. The strongest own price Cobb–Douglas elasticity is −1.76 for energy E and the weakest is −0.38 for textile capital K_T. Energy and labor inputs have stronger own substitution than industrial capital. There is stronger substitution relative to the urban wage w_U than to the rural wage w_R. Factors are generally weak substitutes with Cobb-Douglas production.

Table 7 reports comparative static elasticities of factor prices with respect to product prices derived by inverting the system matrix in Eq. (1). The effects are uneven with some factor prices rising and others falling. Every 1% decrease in the agricultural price p_A lowers the return r_A to capital in agriculture by −2.41% and the rural wage w_R by −0.27%. The rural wage w_R has fairly strong positive links with prices in textile capital inputs and textiles T.
A higher industrial price raises that output, attracting labor and energy from other industries where outputs generally fall. The only exception to this pattern is for agriculture output \( x_A \) that increases with prices in fisheries \( p_T \), mining \( p_M \), and hotels \( p_H \). A decrease of \(-1\%\) in the price of agriculture \( p_A \) lowers its output by \(-1.41\%\), suggesting quite a bit at stake in USMFTA. The largest own output elasticities are 2.72 for textiles \( x_T \) and 2.03 for services \( x_S \).

In the moderate price scenario MOD the price of agriculture \( p_A \) falls by \(-10\%\), the price of textiles \( p_T \) is held constant, and the other prices all increase 5\%.

In the strong price scenario STR the price of agriculture \( p_A \) falls by \(-20\%\) while prices of manufactures \( p_M \) and textiles \( p_T \) fall by \(-5\%\) and other prices rise 5\%.

In the polarized price scenario POL the agriculture price \( p_A \) falls by \(-20\%\), prices of manufactures \( p_M \) and textiles \( p_T \) are constant, and all other prices rise 10\%.

The agriculture scenario AGR assumes that subsidies maintain \( p_A \) with the other price changes set to the moderate price scenario MOD.

To find the factor price adjustments in Table 9 multiply the matrix of factor price elasticities in Table 7 by the vector of price changes. In the moderate price scenario MOD the urban wage \( w_U \) increases 5\% while the rural wage \( w_R \) decreases by \(-2\%\). The largest increased capital return is for services \( r_S \) at 14\%. The agriculture capital return \( r_A \) decreases by \(-27\%\). Capital returns rise considerably in fisheries \( r_F \) at 11\% and mining \( r_P \) at 10\%. The falling textiles capital return \( r_T \) is substantial at \(-10\%\). Effects on specific capital returns are larger than price changes due to the Jones (1965) magnification effect. Labor mobility mitigates wage adjustments that are smaller than capital return adjustments. National output \( Y \) falls by \(-3\%\) leading to the increase in the unemployment rate \( u \) by 1 point.

Output adjustments in Table 9 are found by multiplying the vector of predicted price changes by the matrix of price elasticities in Table 8. Adjustments in industrial outputs generally shadow their capital returns. In the moderate scenario MOD agriculture output \( x_A \) suffers the largest decline at \(-17\%\). The only other industrial decline is for textiles \( x_T \) at \(-10\%\). The services industry is the largest winner with output \( x_S \) rising 9\%. Fisheries output \( x_F \) rises 6\% and mining output \( x_P \) 5\%. Energy imports \( E \) decline by \(-1\%\).

The strong price scenario STR assumes a 20\% reduction in the agriculture price \( p_A \) coupled with decreases in manufactures \( p_M \) and textiles \( p_T \) of \(-5\%\) and increases of 5\% in other prices. The outcome is catastrophic for agriculture with reductions in the capital return \( r_A \) of \(-48\%\) and output \( x_A \) of \(-29\%\). The rural wage \( w_R \) falls by \(-6\%\) while the urban wage rises 3\%. Outputs and capital returns in manufactures and textiles fall considerably while other industries expand. The aggregate outcome is positive with output rising 14\% and unemployment falling 6 points. Energy imports fall by \(-5\%\). This scenario is the best for the aggregate economy but by far the worst for agriculture.

The polarized scenario POL leads to larger adjustments across industries but smaller aggregate effects. The urban wage \( w_U \) rises 9\% but national output \( Y \) rises only 1\% and unemployment \( u \) falls by only 1 point. Even with no changes in prices of manufacturing and textiles, these industries decline due to rising prices in other industries. Services, fisheries, and mining are the big winners. Energy imports fall by \(-2\%\).
The agricultural subsidy in scenario AGR rescues agriculture by keeping its price constant. Output $x_A$ and the return to capital $r_A$ both nevertheless fall slightly due to the other expanding industries. The rural wage $w_R$ rises 1% but falls 4% relative to the urban wage. Output $Y$ falls by $-8$% and unemployment $u$ rises 4 points in the worst outcome for the aggregate economy. Energy imports $E$ increase 3%. The textile industry suffers considerably even with its constant price. Galal and Lawrence (2003) point to restrictive factor price adjustments that force apparel manufacturers to use higher cost inputs and further weaken the industry. Effects on other industries are moderate since labor does not leave agriculture to the same extent as the other scenarios.

One basic lesson of the simulations is that the unemployment rate is sensitive to price changes. It falls in the strong STR and polar POL scenarios but increases in the moderate MOD and agriculture subsidy AGR scenarios.

The relative rural wage $w_R/w_U$ falls in every scenario ranging from $-12$% in POL to $-4$% in AGR. Skilled workers earn six times the unskilled wage according to Karshenas (1994). Löfgren (1999) notes that employment in kind represents over half of rural income. Ravillion and Lokshin (2003) analyze changes in household welfare due to trade liberalization and find the losers will be the rural poor. The outlook for rural labor is grim under USMFTA even with agriculture subsidies.

While free trade leads to aggregate gains Thompson (1986) shows that wages may polarize between countries when there are three or more factors. Goldberg and Pavcnik (2007) document evidence that trade has raised the wage gap between skilled and unskilled labor across a number of developing countries. Helpman, Itskhioki, and Redding (2008) show trade can increase the wage gap and unemployment given labor market frictions consistent with the present model. The present results suggest that rural wage inequality will evolve as a critical issue under USMFTA.

### 6. Substitution and long run adjustments

In the applied production literature, estimated substitution elasticities are typically larger than Cobb–Douglas with cross price elasticities ranging up to 1. Consider simulations with the CES elasticity set to 2 implying substitution elasticities twice as large as those in Table 6.

Thompson and Toledo (2005) show for any degree of CES substitution that the factor price adjustments are identical to those in Table 7. The energy import elasticity is also the same as in Table 7. Adjustments to the various price scenarios are also identical for national output and the unemployment rate to those in Table 9. Output adjustments, however, would be twice as large as those in Table 8.

Regarding sensitivity to price changes, the adjustments in Table 9 scale to monotonic price changes. For instance, doubling the price change vectors doubles all of the adjustments.

Results are robust to a wide range of values for the Okun β. With β about half as large as $-2$ the only noticeable differences are somewhat smaller effects on national output adjustments of $(-1\%,-3\%,-2\%)$ in price scenarios (MOD, STR, POL, AGR).

Output adjustments are more modest than capital return adjustments but long run investment would generate larger output adjustments. The percentage adjustment in an industry output is about equal to the percentage change in its industrial capital stock. Assuming unit elasticity of the capital stock with respect to its return, outputs adjust in the same direction. Long run output adjustments add percentage adjustments in their capital returns to the output adjustments in Table 9. With such long run industrial investment, the economy becomes much more specialized. For instance, in moderate scenario MOD the long run decline in agriculture output $x_A$ climbs to $-44$%.

### 7. Conclusion

The present specific factors model provides insight into the substantial economic adjustments facing Morocco as it moves toward free trade with the US. There will be gains for export industries including mining, fishing, and manufacturing. Import competing industries including agriculture and textiles, however, stand to lose. The urban wage rises while the rural wage falls. Energy imports fall. Subsidies for agriculture would support the rural wage but be costly for the economy.

### Table 7

<table>
<thead>
<tr>
<th>Prices factor prices</th>
<th>$\beta_A$</th>
<th>$\beta_F$</th>
<th>$\beta_P$</th>
<th>$\beta_M$</th>
<th>$\beta_T$</th>
<th>$\beta_C$</th>
<th>$\beta_H$</th>
<th>$\beta_S$</th>
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<tr>
<td>$w_R$</td>
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<td>$0.23$</td>
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<td>$-0.02$</td>
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<td>$-0.10$</td>
<td>$0.00$</td>
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<tr>
<td>$r_S$</td>
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<td>$0.07$</td>
<td>$0.15$</td>
<td>$-0.02$</td>
<td>$-0.42$</td>
<td>$-0.04$</td>
<td>$0.12$</td>
<td>$-0.77$</td>
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<td>$r_T$</td>
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<td>$2.86$</td>
<td>$-0.22$</td>
<td>$-0.18$</td>
<td>$-0.41$</td>
<td>$-0.25$</td>
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<td>$-0.48$</td>
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<td>$r_P$</td>
<td>$-0.29$</td>
<td>$-0.24$</td>
<td>$2.60$</td>
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<td>$-0.21$</td>
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<td>$-0.08$</td>
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<td>$-0.45$</td>
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<td>$-0.19$</td>
<td>$3.03$</td>
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</table>

U urban labor, R rural labor, A agriculture, F fisheries.
P mining, M manufacturing, T textiles, C construction, H hotels, S services.

### Table 8

<table>
<thead>
<tr>
<th>Prices outputs, energy</th>
<th>$\beta_E$</th>
<th>$\beta_U$</th>
<th>$\beta_Y$</th>
<th>$\beta_A$</th>
<th>$\beta_F$</th>
<th>$\beta_P$</th>
<th>$\beta_M$</th>
<th>$\beta_T$</th>
<th>$\beta_C$</th>
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<td>$-0.77$</td>
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<tr>
<td>$x_P$</td>
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U urban labor, R rural labor, E energy, A agriculture, F fisheries.
P mining, M manufacturing, T textiles, C construction, H hotels, S services.
National income and unemployment will depend on industrial price changes. Under any price scenario, there are noticeable adjustments in outputs and industrial capital returns. In the long run, investment will follow capital returns leading to substantial output adjustments.

Table 9
Price scenarios, %Δ.

| MOD | STR | POL | AGR | MOD | STR | POL | AGR | MOD | STR | POL | AGR |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| $p_k$ | $-10$ | $-20$ | $-20$ | $0$ | $w_U$ | $5$ | $3$ | $9$ | $5$ | $Y$ | $-3$ | $14$ | $1$ | $-8$ |
| $p_r$ | $5$ | $5$ | $10$ | $5$ | $r_A$ | $-27$ | $-48$ | $-53$ | $-3$ | $x_A$ | $-17$ | $-28$ | $-33$ | $-2$ |
| $p_m$ | $5$ | $-5$ | $0$ | $5$ | $r_F$ | $11$ | $18$ | $24$ | $8$ | $x_F$ | $6$ | $13$ | $14$ | $3$ |
| $p_F$ | $0$ | $-5$ | $0$ | $0$ | $r_T$ | $10$ | $16$ | $22$ | $7$ | $x_T$ | $5$ | $11$ | $12$ | $2$ |
| $p_c$ | $5$ | $5$ | $10$ | $5$ | $r_M$ | $7$ | $8$ | $-2$ | $6$ | $x_M$ | $2$ | $-3$ | $2$ | $1$ |
| $p_H$ | $5$ | $5$ | $10$ | $5$ | $r_P$ | $-10$ | $-21$ | $-16$ | $-13$ | $x_P$ | $-10$ | $-16$ | $-16$ | $-13$ |
| $p_S$ | $5$ | $5$ | $10$ | $5$ | $r_S$ | $8$ | $13$ | $17$ | $6$ | $x_S$ | $3$ | $8$ | $7$ | $1$ |
| $E$ | $-1$ | $-5$ | $-2$ | $3$ | $r_U$ | $14$ | $24$ | $31$ | $9$ | $x_U$ | $9$ | $19$ | $21$ | $4$ |

References

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