SECTORAL EMPLOYMENT, WAGES AND THE EXCHANGE RATE:

EVIDENCE FROM THE U.S.

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INTRODUCTION

Appreciation of the U.S. dollar by almost 50 percent against major currencies in the early 80s was said to be contributing to a decline in U.S. exports and therefore in her domestic production. This necessitated the Plaza Agreement among the G5 countries to collective intervention in the foreign exchange market with a hope that devaluation of the dollar will reverse the trend. The issue is important and has macro implications in terms of creating jobs or fighting recession by devaluation.

The empirical evidence on the effects of currency depreciation on domestic production is rather mixed. For example, while Gylfason and Schmid [1983] show that currency depreciation has positive effect on domestic production of developed countries, Agenor [1991] shows that it has negative effects. Review of the literature by Bahmani-Oskooee and Miteza [2003] reveals that all studies have employed a measure of total output in trying to determine whether depreciation is expansionary or contractionary. Thus, they could be subject to aggregation bias, i.e., a positive association between the exchange rate and output of one sector could be more than offset by a negative one in another sector, rendering the results negative or insignificant. Policy makers could better formulate macro policies if they determine which sectors of the U.S. economy are relatively more sensitive to changes in the exchange rate.

Some recent studies have attempted to assess the effects of exchange rate changes on sectoral output (i.e., manufacturing, agriculture, forestry products etc.) of the United States and again have provided mixed conclusions. Glick and Hutchison [1990] report evidence that the effect of appreciation of the dollar on sectoral output is unstable and sample-specific. Assuming changes in the exchange rate are reflected in import prices, Revenga [1992] investigated the impact of increased import competition on employment and wages in U.S. manufacturing industries over the 1977-1988 period. He found that

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changes in import prices had large and significant effects on both employment and wages in the sample of industries considered. Burgess and Knetter [1996] examined the response of employment to exchange rate shocks at the industry level for G-7 countries. They found that employment adjustment appears to be quicker in the U.S., Japan, Canada, the U.K., and Italy. Goldberg, Tracy, and Aaronson [1999] examined the importance of dollar movements for worker displacement using the micro data on job-changing and industry-switching of a matched panel of workers drawn from consecutive March Current Population Surveys (CPS), covering the 1977-1997 period. They find that the effects of exchange rate changes on workers' job instability are most pronounced for employees in the manufacturing-nondurable sector and in non-manufacturing jobs outside the service sector. Kandil and Mirzaie [2003] investigate the effects of exchange rate fluctuations on sectoral employment and nominal wages in the United States using a rational expectation model that decomposes movements in the exchange rate into anticipated and unanticipated components. Their results showed that unexpected appreciation of the dollar had a negative effect on employment growth in construction and a positive effect on employment growth in the mining sector. Furthermore, they found that unexpected appreciation of the dollar had a negative effect on growth of nominal wages in manufacturing and transportation sectors only.

On the other hand, the following studies have provided evidence supporting the lack of any relation between the value of the dollar and sectoral output in the U.S. Campa and Goldberg [1997] investigated the links between the real exchange rate and employment, wages, and over time activity in manufacturing industries in the U.S.. They found that exchange rate movements do not have a large effect on the number of jobs or on hours worked across two-digit industry levels. According to their study, industries with low mark-ups and those with a less skilled workforce exhibit relatively larger employment elasticities. Bahmani-Oskooee and Mirzaie [2000], who looked at the cointegrating relation between sectoral output and the value of the dollar in the U.S., concluded that although there is a long-run relation between sectoral output and their determinants, the exchange rate does not seem to play any role in the long-run.

Except Bahmani-Oskooee and Mirzaie [2000], none of the studies reviewed above considered the cointegrating properties of the macro variables that they employed.[1] Bahmani-Oskooee and Mirzaie [2000] is the only study that considered the cointegration between sectoral output and the exchange rate. This paper differs from Bahmani-Oskooee and Mirzaie [2000] in that we investigate the long-run impact of depreciation of the dollar on employment, nominal wages and real wages of as many different sectors of the U.S. economy as data permit. Furthermore, since different cointegration techniques yield different results, in this paper we apply a relatively new technique known as bound testing approach or ARDL approach to cointegration that does not require pre-unit root testing. To that end, we present the models and the method in the next section. Empirical results are provided in the section after that. A summary is provided in the final section. Data definition and sources are cited in an Appendix.

THE MODELS AND THE METHOD

Since the methodology in this paper is based on cointegration analysis, we need reduced form models that link sectoral employment and wage rates to other determinants in addition to the exchange rate. Two such models have already been developed and derived from a macro model by Kandil and Mirzaie [2002]. The variables that enter in both models are simply the determinants of the aggregate demand and aggregate supply. It is usually assumed that the aggregate demand depends upon a measure of fiscal policy (G), a measure of monetary policy (M) and the exchange rate (S). Aggregate supply is assumed to depend upon energy prices (Z) and the exchange rate (S). Following Kandil and Mirzaie [2002] we assume that the determinants of sectoral employment and wages are the same determinants as those of aggregate demand and aggregate supply. Thus, the two reduced form models take the following log-linear forms:

(1) $$\log E_t = a_0 + a_1 \text{ Log } Z_t + a_2 \text{ Log } M_t + a_3 \text{ Log } G_t + a_4 \text{ Log } S + v_t$$

(2) $$\text{Log } W_t = b_0 + b_1 \text{ Log } Z_t + b_2 \text{ Log } M_t + b_3 \text{ Log } G_t + b_4 \text{ Log } S_t + u_t$$

where E is the full-time equivalent employees in each sector, W is the nominal wage per hour in each sector, Z is the energy price, M is the real money supply, G is government spending in real terms, S is the real effective exchange rate, and v and u are the error terms.

The effects of real exchange rate changes on labor employment and nominal wage are dominated by the demand and supply channels. Appreciation of the dollar (i.e., an increase in S) decreases the price of foreign goods relative to domestic goods, leading to a decline in the demand for home goods. This could lead to a reduction in labor demand, thus, to a decrease in employment and nominal wages. However, appreciation also lowers the cost of intermediate imported goods. This channel is likely to moderate the adverse effects of the dollar appreciation on employment and the nominal wage. Therefore, changes in employment and the nominal wage depend on the level of institutional rigidity, the amount of nominal wage adjustment and dependency of each sector on imported inputs. The ultimate impact depends on which channel dominates the adjustment process. Therefore, an estimate of a_4 and b_4 could be negative or positive.

Based on macroeconomic theory, employment is expected to vary negatively with changes in energy prices. Thus, we expect an estimate of $a_1<0$. At the same time, an increase in energy price (Z) is expected to increase prices and wages by increasing the cost of output. Thus, an estimate of b_1 is expected to be positive. Increase in money supply and government spending may increase wages as a response to the inflationary effect of expansionary policies, thus estimates of a_2, a_3, b_2, b_3 >0.

Equations (1) and (2) are long-run relationships among the variables that enter into the employment and wage models. In order to distinguish the short-run effects from the long-run effects, we need to incorporate the short-run dynamics into equations (1) and (2). We do this by specifying equations (1) and (2) in error-correction formats. Following Pesaran et al. [2001] and their new Autoregressive Distributed Lag (ARDL) approach, equations (1) and (2) are specified in error-correction formats as in equations (3) and (4).

$$\begin{aligned}\Delta LogE_t &= c' + \sum_{k=1}^{n1} d'_k \Delta LogE_{t-k} + \sum_{k=0}^{n2} e'_k \Delta LogZ_{t-k} + \sum_{k=0}^{n3} f'_k \Delta LogM_{t-k} \\ &+ \sum_{k=0}^{n4} g'_k \Delta LogG_{t-k} + \sum_{k=0}^{n5} h'_k \Delta LogS_{t-k} + \alpha_0 LogE_{t-1} + \alpha_1 LogZ_{t-1} + \\ &\alpha_2 LogM_{t-1} + \alpha_3 LogG_{t-1} + \alpha_4 LogS_{t-1} + \varepsilon_t\end{aligned} \tag{3}$$

and

$$\begin{aligned}\Delta LogW_t &= c + \sum_{k=1}^{n1} d_k \Delta LogW_{t-k} + \sum_{k=0}^{n2} e_k \Delta LogZ_{t-k} + \sum_{k=0}^{n3} f_k \Delta LogM_{t-k} + \\ &\sum_{k=0}^{n4} g_k \Delta LogG_{t-k} + \sum_{k=0}^{n5} h_k \Delta LogS_{t-k} + \beta_0 LogW_{t-1} + \beta_1 LogZ_{t-1} + \\ &\beta_2 LogM_{t-1} + \beta_3 LogG_{t-1} + \beta_4 LogS_{t-1} + \varepsilon_t\end{aligned} \tag{4}$$

Equations (3) and (4) are subject to empirical analysis in the next section.

EMPIRICAL RESULTS

In this section we estimate the error-correction models outlined by equations (3) and (4) by employing annual time-series data over the 1961-2000 period.[2] We consider eight major sectors of the United States economy that include Construction, Finance, Manufacturing, Mining, Retail Trade, Service, Transportation, and Wholesale Trade.[3] A detailed description and sources of all data are provided in an Appendix.

The first step in applying Pesaran et al.'s [2001] ARDL approach is to establish whether the dependent and independent variables in each model are cointegrated. The null of no cointegration, i.e., $\alpha_0 = \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$ in (3) and $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ in (4) is tested against the alternative of $\alpha_0 \neq \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0$ in (3) and $\beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ in (4) by means of the familiar F-test with new critical values. Pesaran et al. [2001] tabulate new critical values irrespective of whether variables are integrated of order one, I(1) or order zero, I(0). Thus, there is no need for pre unit-root testing.

In applying the F-test we must decide the order of lag length for each first differenced variable in each model. Bahmani-Oskooee and Brooks [1999] have demonstrated that the results of the F-test are sensitive to the choice of lag lengths. Due to a limited number of annual observations, we carry out the F-test as a preliminary exercise by imposing three lags on each first differenced variable and report the results in Table 1.

As can be seen from Table 1 there is more evidence of cointegration in the wage ARDL model than in the employment ARDL model. In the wage equation, the F-statistic is greater than its critical value in the cases of Manufacturing, Retail, Wholesale, and Services, supporting cointegration in these sectors. In the employment model the F-statistic is greater than its critical value only in the cases of Finance and Manufacturing. Lack of cointegration in most instances could be due to the fact that the lag length is arbitrarily selected. Thus, following Bahmani-Oskooee and Brooks [1999] we retain the lagged level of all variables in the ARDL models and rely upon a relatively more efficient estimation approach in which the number of optimum lags on each first- differenced variable is selected by the Akaike's Information Criterion (AIC). We first concentrate on the error-correction model pertaining to employment in each sector and report the results in Tables 2 and 3.

TABLE 1
The Results of the F-test for cointegration.

Sector	Employment Model	Wage Model
Construction	2.47	1.98
Finance	9.09	3.45
Manufacturing	4.11	5.40
Retail	0.55	9.53
Wholesale	1.12	6.62
Services	1.05	7.20
Transportation	2.77	3.15
Mining	1.51	2.03

Note: Critical bounds at the 95 percent level when there are four exogenous variables and a constant but no trend are 2.86-4.01. These come from Table CI(iii) Case III, Pesaran et al. [2001, 300]. Note that the procedure is already built into the MicroFit (MFIT4.0) statistical package by Pesaran and Pesaran [1997].

Table 2 reports the short-run estimates. As can be seen, at the 10 percent level of significance, we observe significant effect on employment in all sectors except in retail and services. The positive coefficients obtained for the first-differenced exchange rate variable should not be interpreted as an adverse effect of the depreciation of the dollar on each sector's employment. Hsiao [1981] has argued that these are coefficients of filtered data. If the model is expressed in terms of the original variables, then autoregressive coefficients could also take negative signs.[4] For this reason, we stay away from reading too much into the signs of the short-run estimates in this paper and comparing them to that of Kandil and Mirzaie [2003] whose results are also subject to Hsiao's [1981] interpretation. Next, we consider the long-run coefficient estimates which are reported in Table 3. Note that the long-run coefficients are normalized on the employment variable (E) by dividing the estimates of α_1- α_4 by - α_0 in the ARDL model (3). Only after normalization will we be able to determine whether the long-run coefficients carry signs that are in line with our theoretical expectations embodied in models (1) and (2), explained earlier.

From Table 3 we gather that in almost all cases, the exchange rate carries an insignificant coefficient, indicating that currency depreciation has no long-run effect on each sector's employment. Thus, the short-run effects in Table 2 seem to be transitory. These results are consistent with those of Bahmani-Oskooee and Mirzaie [2000] who showed that depreciation of the dollar has no long-run effect on sectoral production, though they used a different cointegration technique. Of the four independent variables, it appears that energy prices and real money supply have significant impact on sectoral employment. The energy prices (Z) carries its expected negative sign in all cases and it is significant in the construction, finance and transportation sectors.

The monetary variable (M) also carries its expected positive sign in all cases and it is highly significant in most cases which could provide assurance for the Federal Reserve's recent monetary policy when during 2001, interest rates were cut eleven times to stimulate the U.S. economy. Finally, the real government spending variable G carries an insignificant coefficient in almost all cases.[5]

TABLE 2
Coefficient Estimates of the ARDL Employment Model.

Regressor	Construction	Finance	Manufacturing	Retail	Wholesale	Services	Transportation	Mining
ΔLog E_{t-1}	0.53	0.79		0.56	0.58	0.66	0.40	
	(4.19)	(6.91)		(3.88)	(2.64)	(5.48)	(2.12)	
ΔLog E_{t-2}	0.52			-0.25	0.39		0.34	
	(3.27)			(1.76)	(1.46)		(1.57)	
ΔLog E_{t-3}								
ΔLog M_{t-0}	0.37	0.04	-0.33	0.02	0.08	-0.08	0.07	-0.32
	(1.84)	(0.52)	(2.05)	(0.17)	(0.72	(1.29)	(0.54)	(1.18)
ΔLog M_{t-1}	0.32	-0.13	-0.19		-0.18		-0.16	-0.67
	(1.48)	(1.67)	(0.94)		(1.33)		(1.26)	(2.23)
ΔLog M_{t-2}	1.12		0.52		0.32		0.29	
	(4.76)		(2.66)		(2.39)		(2.13)	
ΔLog M_{t-3}								
ΔLog G_{t-0}	-1.64	-0.21	-0.66	-0.09	-0.77	-0.11	-0.70	-1.45
	(4.25)	(2.39)	(2.04)	(1.60)	(3.18)	(2.79)	(2.93)	(2.91)
ΔLog G_{t-1}	1.19		0.75		0.48		0.56	1.09
	(3.37)		(2.27)		(2.28)		(2.72)	(2.34)
ΔLog G_{t-2}								
ΔLog G_{t-3}								
ΔLog Z_{t-0}	0.01	-0.01	-0.01	-0.04	0.01	-0.02	-0.02	0.15
	(0.29)	(0.39)	(0.08)	(2.80)	(0.37)	(2.46)	(0.45)	(1.62)
ΔLog Z_{t-1}	-0.26		-0.14		-0.07		-0.09	0.19
	(4.84)		(2.80)		(2.39)		(2.46)	(2.69)
ΔLog Z_{t-2}	-0.13				-0.04		-0.10	
	(2.28)				(1.44)		(3.01)	
ΔLog Z_{t-3}								
ΔLog S_{t-0}	0.27	0.05	0.07	0.02	0.11	0.02	0.14	0.29
	(2.61)	(1.96)	(0.73)	(0.68)	(1.67)	(1.07)	(1.83)	(1.84)
ΔLog S_{t-1}	0.62		0.18		0.18		0.24	
	(4.95)		(1.99)		(2.61)		(3.26)	
ΔLog S_{t-2}							0.16	
							(2.37)	
ΔLog S_{t-3}								
Constant	3.06	1.41	2.21	0.73	2.31	1.24	2.26	2.62
	(5.21)	(5.49)	(3.39)	(2.61)	(3.50)	(3.55)	(3.54)	(3.55)
ECM_{t-1}	-0.81	-0.56	-0.22	-0.19	-0.61	-0.24	-0.42	-0.19
	(5.45)	(5.35)	(1.79)	(2.03)	(2.38)	(3.48)	(2.57)	(1.48)
R-Bar Squared	0.82	0.71	0.62	0.58	0.50	0.62	0.52	0.69

Note: Number inside the parenthesis next to each coefficient is absolute value of the t-ratio.

As indicated before, in estimating each ARDL model, we retained the lagged values of the variables on the assumption that they are cointegrated. An alternative way of showing cointegration is to use the coefficient estimates from Table 3 and form an error-correction term, ECM_t. Pesaran et al. [2001] then suggest including ECM_{t-1} in place of the linear combination of the lagged level variables in the ARDL models to test for cointegration. A negative and significant coefficient obtained for ECM_{t-1} will be an indication of cointegration among the variables. Indeed, Kremers et al. [1992] have argued and Bahmani-Oskooee and Ardalani [2006] have demonstrated that the error-correction term is a more efficient way of establishing cointegration. After including the ECM_{t-1} in the ARDL model and after imposing the same number of lags obtained by the AIC criterion, the model is re-estimated and the coefficient estimates of ECM_{t-1} are reported at the bottom of Table 2. It is clear from the table that ECM_{t-1} carries its expected negative sign in all sectors and the estimated coefficient is highly significant in all cases except the manufacturing and mining sectors. These results support cointegration among the variables. However, the long-run coefficient estimates reported in Table 2 reveal that cointegration is due to strong relation among some of the variables (i.e., employment, money supply and energy prices) and not all of the variables (i.e., government spending and exchange rate).[6]

TABLE 3
Long-Run Coefficient Estimates of the Employment Model.

	Coefficient Estimates of			
	Log Z	**Log M**	**Log G**	**Log S**
Construction	-0.27	0.62	-0.45	-0.16
	(3.83)	(4.17)	(1.30)	(1.74)
Finance	-0.05	0.48	-0.14	0.08
	(2.07)	(9.49)	(1.27)	(1.85)
Manufacturing	-0.42	0.88	-2.35	-0.30
	(1.34)	(1.39)	(1.47)	(0.69)
Retail	-0.19	0.66	-0.50	0.09
	(1.58)	(2.94)	(1.05)	(0.55)
Wholesale	-0.09	0.49	-0.46	-0.03
	(1.37)	(3.21)	(1.21)	(0.37)
Services	-0.08	0.27	-0.47	0.06
	(1.81)	(3.10)	(2.01)	(0.91)
Transportation	-0.23	0.58	-0.82	-0.25
	(2.55)	(2.86)	(1.61)	(2.00)
Mining	-0.31	1.49	-5.19	0.43
	(1.06)	(1.07)	(1.49)	(0.89)

Note: Number inside each parenthesis is absolute value of the t-ratio.

We now turn to the estimates of the wage model outlined by equation (4). The results are reported in Tables 4 and 5.

First, from the results in Table 4 we gather that monetary variable (M), fiscal policy variable (G) and energy prices (Z) all have short-run significant impact on the wages in all sectors. However, the exchange rate seems to have its short-run significant effects only on the wages in construction, finance and service sectors. The ECM_{t-1} carries its highly significant negative coefficient in all cases (except the finance sector) supporting cointegration among the variables. Does the exchange rate belong to cointegrating space? We turn to the results in Table 5.

TABLE 4
Coefficient Estimates of the ARDL Wage Model.

Regressor	Construction	Finance	Manufacturing	Retail	Wholesale	Services	Transportation	Mining
ΔLog W_{t-1}	1.31	-0.39	0.79	0.81	0.98	-0.07	0.64	0.46
	(6.76)	(2.96)	(6.37)	(6.51)	(10.9)	(1.24)	(6.74)	(3.92)
ΔLog W_{t-2}	0.44	-0.40		0.34				
	(1.37)	(3.29)		(2.41)				
ΔLog W_{t-3}								
ΔLog M_{t-0}	-0.09	0.11	0.09	-0.14	-0.01	0.58	0.24	0.11
	(0.97)	(1.43)	(2.24)	(1.48)	(0.19)	(9.47)	(4.37)	(0.76)
ΔLog M_{t-1}	-0.70					-0.1	-0.29	
	(3.17)					(2.85)	(2.44)	
ΔLog M_{t-2}	-0.37							
	(2.13)							
ΔLog M_{t-3}								
ΔLog G_{t-0}	-0.56	0.00	-0.01	-0.21	-0.07	-0.44	-0.22	-0.21
	(2.18)	(0.01)	(0.16)	(2.22)	(2.63)	(2.72)	(2.55)	
ΔLog G_{t-1}	-0 .01	-0.30	0.75					
	(0.06)	(1.76)	(2.27)					
ΔLog G_{t-2}	0.53	0.36						
	(3.18)	(3.18)						
ΔLog G_{t-3}								
ΔLog Z_{t-0}	0.01	0.04	0.04	0.06	0.02	0.03	0.06	0.01
	(0.49)	(2.29)	(2.72)	(2.93)	(1.85)	(0.75)	(3.64)	(0.14)
ΔLog Z_{t-1}	0.16		0.01		-0.01	-0.04		0.07
	(3.69)		(0.17)		(1.20)	(1.00)		(2.01)
ΔLog Z_{t-2}	0.04		-0.03		-0.04	-0.11		
	(1.40)		(1.89)		(4.16)	(2.62)		
ΔLog Z_{t-3}								
ΔLog S_{t-0}	0.03	-0.05	-0.02	-0.01	0.01	0.08	-0.05	0.01
	(0.82)	(2.27)	(1.35)	(0.19)	(0.23)	(1.11)	(1.66)	(0.14)
ΔLog S_{t-1}	-0.16		-0.03		0.26			
	(2.57)		(0.70)		(3.36)			
ΔLog S_{t-2}					-0.07	0.2		
					(1.59)	(2.95)		
ΔLog S_{t-3}								
Constant	0.77	0.42	-0.15	-0.11	-0.04	-0.64	-0.37	-0.09
	(2.71)	(1.44)	(1.18)	(0.61)	(0.52)	(1.89)	(2.54)	(0.31)
ECM_{t-1}	-0.74	-0.08	-0.24	-0.65	-0.34	-0.85	-0.39	-0.40
	(2.51)	(0.64)	(2.15)	(5.11)	(4.87)	(14.2)	(4.90)	(2.20)
R-Bar Squared	0.89	0.77	0.91	0.78	0.94	0.62	0.90	0.81

Note: Number inside the parenthesis next to each coefficient is absolute value of the t-ratio.

From Table 5 it is clear that in most cases the exchange rate carries an insignificant coefficient. Only in the results for Construction, Retail and Services sectors does the exchange rate carry a significant coefficient. It appears that while in the construction and retail sector depreciation of the dollar lowers the wages in these two sectors, in the services sector it actually raises them. Of course, since in all three sectors estimated coefficients are too low, we may conclude that the impact is marginal. From Table 5 we also gather that an increase in energy prices (Z) raises the nominal wages in all sectors (except construction) in the long run, which is in line with our theoretical expectation. The monetary variable also carries its expected significant positive sign in all sectors except the finance sector. To our surprise the government spending variable carries a negative sign but it is only significant in the construction, retail and wholesale sectors.

TABLE 5
Long-Run Coefficient Estimates of the Wage Model.

	Coefficient Estimates of			
	Log Z	**Log M**	**Log G**	**Log S**
Construction	-0.10	0.86	-1.19	0.38
	(3.28)	(12.7)	(6.92)	(6.71)
Finance	1.18	-1.45	-0.25	-0.71
	(0.66)	(0.55)	(1.73)	(0.56)
Manufacturing	0.17	0.40	-0.02	-0.09
	(3.78)	(4.44)	(0.16)	(1.52)
Retail	0.11	0.32	-0.32	0.16
	(3.73)	(4.20)	(3.25)	(3.38)
Wholesale	0.11	0.35	-0.20	0.01
	(4.94)	(7.91)	(2.14)	(0.23)
Services	0.05	0.68	-0.08	-0.23
	(1.60)	(12.6)	(0.67)	(3.89)
Transportation	0.15	0.63	-0.12	-0.04
	(5.15)	(11.5)	(0.97)	(0.98)
Mining	0.09	0.81	-0.54	0.01
	0.09	0.81	-0.54	0.01

Note: Number inside each parenthesis is absolute value of the t-ratio.

TABLE 6
Long-Run Coefficient Estimates of a Real Wage Model

	Coefficient Estimates of			
	Log Z	**Log M**	**Log G**	**Log S**
Construction	-0.57	0.57	-0.44	0.80
	(3.47)	(2.63)	(6.92)	(0.04)
Finance	-0.28	0.37	-0.41	-0.10
	(7.85)	(5.43)	(2.57)	(1.62)
Manufacturing	-0.23	0.28	-0.17	-0.18
	(2.10)	(1.62)	(0.42)	(1.15)
Retail	-0.14	0.51	-1.60	0.46
	(1.83)	(3.38)	(4.35)	(4.88)
Wholesale	0.17	-0.09	-0.12	0.46
	(0.90)	(0.43)	(0.32)	(2.72)
Services	-0.25	0.40	-0.75	-0.06
	(4.62)	(3.55)	(2.94)	(0.81)
Transportation	-0.29	0.06	0.83	-0.05
	(1.21)	(0.11)	(0.48)	(0.16)
Mining	-2.33	3.37	-5.30	0.83
	-2.33	3.37	-5.30	0.83

Note: Number inside each parenthesis is absolute value of the t-ratio.

Since depreciation is always inflationary, real wages may react differently from nominal wages. To shed some light on this issue we re-estimated the wage model for each sector by replacing nominal wages with real wages. Since our concern is mostly long run, we only report the long-run coefficient estimates in Table 6.[7]

Once again it appears that real depreciation of the dollar has no significant impact on real wages in most sectors, a result similar to that of the nominal wage model reported in Table 5. In a case like the retail sector, the estimated coefficient of the exchange rate increases from 0.16 to 0.46 when we shift from the nominal wage to the real wage model. This is indeed due to the inflationary effect of depreciation. In the wholesale sector where depreciation had no significant impact on nominal wages, it has significant impact on real wages. The positive and significant coefficient obtained for the wholesale sector in Table 6 reflects the fact that inflationary effects of depreciation lowers the real wages. All in all, the impact of depreciation on real wages will depend on its impact on nominal wages and prices. If prices rise more than nominal wages, real wages could drop. On the other hand, if nominal wages rise more than prices, real wages could increase. This later case could be true of more unionized industries.

Before closing, we thought of decomposing the changes in the actual exchange rate into anticipated and unanticipated components. It is likely that anticipated depreciation is built into market participants' expectation influencing their decision to trade more or less. Specifically, anticipated depreciation raises expected cost of imported inputs which results in a reduction in aggregate supply. In turn, a decrease in aggregate supply reduces output and raises prices which have implications for nominal and real wage changes. On the aggregate demand side, anticipated depreciation makes exports cheaper, stimulating external demand. Increased foreign demand, in turn, raises domestic production and prices. Thus, the output response to anticipated depreciation will depend on the relative strength of the two channels. In generating the anticipated exchange rate we assume expectations are adaptive with more weights assigned to more recent past and less weights to distant past. This notion is captured by regressing the exchange rate on its own four lags and using the fitted value of the exchange rate as an anticipated component and the residuals from the regression as an unanticipated component. These results, available from the authors upon request, revealed lack of any long-run effect of anticipated and unanticipated exchange rate on each sector's employment. Only in the retail sector did we observe a significant effect indicating that anticipated depreciation of the dollar boosts employment in this sector.

These results are mostly similar to those reported in Table 3 when actual exchange rate was used. Similarly, the results for the nominal wage model were not that different from those reported in Table 5 when actual exchange rate was used. We only observed a significant long-run effect of unanticipated exchange rate in three sectors. It appeared that unanticipated depreciation raises nominal wages in construction and transportation sectors and lowers it in the finance sector. As for the response of real wages, neither anticipated nor unanticipated exchange rate had any long-run impact on the real wage-- results similar to those reported in Table 6.

SUMMARY AND CONCLUSION

Currency depreciation is said to increase the demand for a specific sector's output by making it attractive to the rest of the world. On the other hand, depreciation of the domestic currency raises the cost of imported inputs used by that sector, resulting in an increase in cost incurred by that sector. Depending on which effect is stronger, the sector could experience an expansion or a contraction. Furthermore, if wages in that sector adjust to the inflationary effect of depreciation, we would expect an increase in nominal wages. Real wages could react in either direction.

Previous research that investigated the relation between employment, wages, and the exchange rate did not consider the integrating properties of the variables involved and provided mixed results. In this paper we investigate the short-run as well as the long-run relation between employment and the value of the dollar and between wages and the value of the dollar. After using data over the 1961-2000 period from eight distinct sectors of the U.S. economy, i.e., Construction, Finance, Manufacturing, Mining, Retail Trade, Service, Transportation, and Wholesale Trade and applying cointegration and error-correction modeling techniques, our results could be best summarized by saying that depreciation of the dollar had a short-run impact on most sectors' employment and wages. In the long-run, it appeared that depreciation of the dollar is neutral. This finding holds even if we decompose the actual exchange rate into anticipated and unanticipated components. The finding that real depreciation of the dollar has short-run effect but not long-run effect is supported by the argument that depreciation, say, increases employment in a sector. But since the exchange rate reverses itself over time either due to market forces or due to government intervention, the positive effect is offset as time goes on. Furthermore, the results show that the long-run effect of real depreciation of the dollar on each sector is not sensitive to the size of the sector in terms of its market share. Neither the largest export sector (i.e., manufacturing) nor the smallest sector (i.e., service) has any long-run relation to the real value of the dollar.[8]

APPENDIX A
Data Sources and Definitions

Annual data over the 1961-2000 period are collected from the following sources:

a. The Bureau of Labor Statistics.
b. International Financial Statistics of the IMF.
c. Federal Reserve Bank of Dallas.
d. Gordon [1993].

Variables:

E = Full-time equivalent employees by industries. Data for each sector come from source a.

W = Average hourly earnings of production workers. Data for each sector come from source a.

Z = Energy prices. This variable is proxied by the prices of fuels, power and related products. The index (1992=100) comes from source a.

M = Real Supply of Money. Nominal M2 figures are deflated by the GDP deflator. Data come from source b.

G = Real Government Spending (1992 dollars), source c.

S = Real Effective Exchange Rate (1992=100). For 1960-92, the data come from source d. Updates for the years 1993-2000 are from source b. Minor adjustment is made for the later period by considering overlapping observations from both sources.

NOTES

Valuable comments of two anonymous referees are greatly appreciated. However, we are responsible for any error.

1. Note that Kandil and Mirzaie [2003] tested for cointegration among the variables of their model only to justify application of error-correction modeling. Since no long-run coefficient estimates were reported by Kandil and Mirzaie, one cannot judge the long-run impact of currency depreciation on employment and wages. They only discuss their short-run results.

2. Note that Hakkio and Rush [1991] have shown that the ability of the cointegration tests to detect cointegration depends on the sample length and not on the frequency of the data.
3. For agricultural sector we test only for employment since the wage data was not available. For some sector specific statistics like degree of openness, export share, import share, employment in selected years, see Kandil and Mirzaie [2003].
4. The same interpretation applies to coefficient estimates of all other first- differenced variables. As can be seen from Table 2, lagged coefficients obtained for monetary (M), fiscal (G) and energy (Z) variables are significant in most cases and they take positive or negative signs.
5. Different elasticity with respect to monetary supply and oil prices in different sectors could be due to different degrees of oil consumption and different degrees of credit availability.
6. Note that the ECM_{t-1} represents the extent of the disequilibrium between the level of dependent and independent variables in the previous period. Each error-correction model states that changes in the dependent variable depends not only on changes in independent variables but also on the extent of disequilibrium between the level of dependent and independent variables. Thus, if the change in dependent variable is to adjust toward equilibrium with all other variables, the measure of disequilibrium must decline implying a negative relation between the dependent variable and $ECM_{t-1.}$
7. Note that short-run results were similar to those of the nominal wage model.
8. For relative shares see Kandil and Mirzaie [2003, Table 7].

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