NOMINAL WAGE AND PRICE DYNAMICS IN EGYPT: AN EMPIRICAL ANALYSIS

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Abstract

This study aims to explain how nominal wages in the private and public sectors in Egypt behaved in response to changes in domestic prices during the period 1985–2009. A vector error correction model (VECM) is estimated to investigate the short-run dynamics among nominal wages, and the urban consumer price index (CPI), while accounting for the underlying macro determinants of price inflation, namely, the bilateral (LE/US dollar) nominal exchange rate, domestic credit and real gross domestic product (GDP).

The empirical findings show that nominal wages in both the public and private sectors exhibit some "stickiness" in response to a price shock, leaving real wages to be eroded in the short-run. Nominal wage adjustments in the public sector seem to seek compensation for higher domestic prices, regardless of developments in economic activity. By contrast, the nominal wage in the private sector undergoes smaller adjustments in response to price shocks. As such, the nominal wage in the private sector is more reflective of economic activity, and thus its adjustments are in line with developments in real GDP. Finally, it is shown that although nominal wages contribute to CPI growth in the long run, shocks in the nominal exchange rate and in the CPI itself remain more important as sources of variation in consumer prices.

ملخص

تبحث هذه الدراسة في عملية استجابة الأجور الاسمية في القطاعين الخاص والعام إزاء التطورات الاقتصادية الكلية في مصر، خاصة تلك المرتبطة بالأسعار المحلية خلال الفترة ١٩٨٥-٢٠٠٩. ويتم تقدير نموذج تصحيح الخطأ في متجهات التكامل المشترك بغرض دراسة العلاقات قصيرة الأجل بين الأجور الاسمية، والرقم القياسي لأسعار المستهلكين في الحضر، وسعر الصرف الاسمي الثنائي (الجنيه/الدولار)، والائتمان المحلي، والناتج المحلي الإجمالي الحقيقي.

وتوضح النتائج التجريبية التي توصلت إليها هذه الدراسة أن استجابة الأجور الاسمية في كل من القطاعين العام والخاص إزاء الصدمات السعرية تتسم ببعض "الجمود"، الأمر الذي يترتب عليه تراجع الأجور الحقيقية في الأجل القصير. ويبدو أن الأجور الاسمية في القطاع العام يتم تعديلها باستمرار للتعويض عن الارتفاع في الأسعار المحلية بغض النظر عن التطورات في النشاط الاقتصادي. وعلى النقيض، تتسم استجابة الأجور الاسمية في القطاع الخاص إزاء الصدمات السعرية بأنها أقل مقارنة بالقطاع العام، ولكنها تعكس النشاط الاقتصادي بصورة أفضل، ومن ثم فإن التعديلات التي تشهدها تكون متسقة مع التطورات في الناتج المحلي الإجمالي الحقيقي. وأخيرا، تشير نتائج الدراسة إلى أنه على الرغم من أن الأجور الاسمية تساهم في زيادة الرقم القياسي لأسعار المستهلكين في الأجل الطويل، إلا أن الصدمات في سعر الصرف الاسمي وفي الرقم القياسي لأسعار المستهلكين ذاته تظل هي المصادر الأكثر أهمية للتغير في أسعار المستهلكين.

JEL classifications: C32, E31, E60, E64

Keywords: nominal wages, price inflation, nominal wage and price dynamics, fiscal view of inflation, balance-of-payments view of inflation, vector error correction models, Egypt

I. INTRODUCTION

The interdependencies between nominal wages and prices are an integral part of macroeconomic dynamics. Nominal wage increases may be induced by price increases that arise from positive aggregate demand shocks. Also, a wage increase in itself may cause a price spike, and lead to supply-side "cost-push" inflation, and/or contribute to prolonged inflation episodes. The objective of this study is to examine how prices and nominal wages interact together in the face of important macro shocks that prevail in the Egyptian economy. The motivation for this arises from the crucial implications that price and wage dynamics hold for people's real income and standards of living. Further, understanding how the macro-determinants of the price level interact with the nominal wage in the Egyptian economy will inform the ongoing policy debate regarding the design of both macroeconomic as well as wage adjustment policies.

Data on nominal wages in the private sector and public sector in Egypt are available from the Central Agency for Public Mobilization and Statistics' annual bulletin "Employment, Wages and Labor Hours" for the period 1985–2009. A preliminary assessment of the evolution of nominal wages shows that the public sector wage accelerated since 1998/99, and fluctuations in the public sector wage started to become sharper than those that the domestic price level exhibited. The higher trend that the public sector wage took on since 1998/99 coincided with lax fiscal conditions and a widening overall budget deficit, in addition to some major political milestones to which public sector wage raises could be (at least partially) attributed. By contrast, the private sector wage seemed more consistently linked with developments in the domestic price level throughout the whole period under study, with evident sharper fluctuations in the private sector wage since 2003, after the step devaluations (and later on depreciation) of the Egyptian pound vis-à-vis the US dollar.

Against this background, we conduct several empirical tests for the purpose of investigating nominal wage and price dynamics in Egypt. Our analysis highlights the fact that nominal wage and price dynamics are a central element of macroeconomic dynamics.[1] And so the empirical tests include the following variables: the nominal exchange rate, net domestic

[1] See Blanchard (1986) for a rigorous explanation of how the wage price spiral dynamics is "a central element of macroeconomic dynamics."

credit, and real gross domestic product. The choice of the variables has been made in light of theory as well as previous empirical studies of inflation dynamics in Egypt.

We first empirically investigate the existence of a long-run relationship between nominal wages and the domestic price level, while taking into account the main macro drivers of price inflation in Egypt. The presence of a long-run equilibrium relationship allows us to estimate a vector error correction model (VECM) and draw conclusions on the way prices and nominal wages react to their own shocks and to the other important macro shocks.

The remainder of this paper is organized as follows: Section II dwells on the theoretical and empirical links between prices and nominal wages, and concludes with a survey of the empirical studies conducted on the Egyptian case. Section III traces the evolution of nominal wages in the private and public sectors in Egypt, and draws some links with the developments in the domestic price level, and its underlying macro drivers. The section ends with a description of the variables that are used later in the empirical part, and discusses their relevance to the investigation of nominal wage and price dynamics in Egypt. Section IV presents the empirical tests' results and finally, Section V concludes.

II. Theoretical and Empirical Research on Links between Wages and Prices

A positive aggregate demand shock (such as an exogenous increase in government spending, or a devaluation of the exchange rate) increases the demand for domestic goods, which in turn creates upward pressure on the domestic price level. The higher price level associated with the higher aggregate demand would raise the demand for labor, thus leading to an increase in the equilibrium nominal wage (Blanchard 1986).

On the other hand, if firms try to increase their mark-up profits (i.e., mark-up of prices above wages) or when workers try to increase their real wages, or when both firms and workers try to maintain the same price and wage in the face of a negative supply shock, this may give rise to "cost-push" inflation (Blanchard 1986). And according to the "new structuralist" tradition, an increase in the real wage demanded by workers may trigger an unstable spiral between nominal wages and prices (Agénor and Hoffmaister 1997).

The literature on wages and prices also tackled the role of wages in the transmission of fiscal and exchange rate impulses to prices, as well as the contribution of wage adjustment

mechanisms in prolonging inflationary pressures.[2] Moreover, regardless of the fiscal, monetary or exchange rate impulses, an exogenous change in the wage bargaining process, for instance, could exert an independent impulse effect on inflation which could be permanent in the presence of an accommodative monetary policy (Agénor and Hoffmaister 1997).

Although the role of wages in the inflationary process is well recognized, few empirical studies have attempted to capture the dynamics between nominal wages and prices, especially for developing countries. Montiel (1989) analyzed high-inflation episodes in Argentina (1976 Q3–1985Q1), Brazil (1975Q2–1985Q4), and Israel (1973Q2–1985Q2) by empirically testing the dynamic relationships among prices, base money, nominal exchange rate, nominal wages and real output using a vector auto-regression (VAR) technique. For Israel, nominal wage movements—that are subsequently accommodated by changes in base money and the nominal exchange rate—seemed to be the main driver of inflation. In fact, nominal wage movements accounted for more than three quarters of the variance of the forecast error for the inflation rate in Israel. Conversely, the evidence for Brazil and Argentina suggested that movements in base money and the nominal exchange rate were more important determinants of the time path of the inflation rate, but still part of the influence could be traced to the effects of nominal wage movements. Similarly, Agénor and Hoffmaister (1997) examined the short-run links between money growth, exchange rate depreciation, nominal wage growth, the output gap and inflation in Chile, Korea, Mexico and Turkey using a generalized vector auto-regression model. The impulse responses showed that an innovation (shock) in the rate of growth of nominal wages increased inflation in all countries, with evidence of a considerably persistent effect across time in Mexico and Korea.

As for empirical studies on Egypt, few of those explaining inflation dynamics took account of the interaction between nominal wages and the domestic price level. More emphasis was given to exchange rate movements, money growth and fiscal variables as determinants of inflation, rather than nominal wage developments as a determinant (and/or cause) of inflation.[3] Among the few studies that explicitly included wages as an important

[2] The experiences of Chile in the 1980s and Brazil in the 1990s have drawn attention to the contribution of wage indexation to inflation inertia (Agénor and Hoffmaister 1997). The role of wage indexation in the transmission of exchange rate movements to domestic prices has been emphasized by Liviatan and Pitterman (1986). Their argument was that, given the inflationary pressures induced by exchange rate movements, the frequency with which nominal wages are adjusted tends to further raise inflation.

[3] See Helmy (2009) for a review of empirical studies on determinants of inflation in Egypt.

driver of inflation in Egypt were Metwally and Al-Sowaidi (2004) and Fares and Ibrahim (2009). Metwally and Al-Sowaidi (2004) used a simultaneous-equations model to investigate the nature and causes of inflation in Egypt during the period 1986–2002. Their results showed that nominal wages responded to lagged changes in the rate of inflation. Current and lagged inflation rates were found to have a positive effect on wage inflation, but lagged inflation turned out to be a stronger determinant of wage inflation (i.e., wages responded to ex-post, more than to ex-ante, inflation). This was explained by the lack of collective bargaining power due to largely unorganized trade unions. On the other hand, their results suggested that increases in wages also lead to inflation. However, according to the Metwally and Al-Sowaidi simultaneous-equations model, the inflation rate in Egypt was found to be more sensitive to expansionary fiscal and monetary policies than to increases in wages and import prices.[4]

In the other study, Fares and Ibrahim (2009) investigated the price-wage causality in Egypt during the period (1990–2005) by running a Granger-causality test to see whether lagged wage inflation contains predictive content for the current price inflation rate, or the opposite is true (that is, lagged price inflation helps forecast current wage inflation). The Granger-causality test was performed including nominal wage growth in both the private and public sectors, and the rate of change in consumer prices. The results of the Granger-causality test showed that changes in the private sector wage are linked to price inflation, whereas movements in the public sector wage are independent of price inflation. Regarding the direction of causality between private sector wage growth and the inflation rate, Fares and Ibrahim found that the effect of wage growth on inflation is more pronounced in the short-run, whereas the effect of price inflation on wage growth is more pronounced in the long-run. That

[4] Metwally and Al-Sowaidi's model included the endogenous variables: (inflation rate, rate of change in wages, and real output growth); and the predetermined variables: (import prices growth, government spending growth, money supply growth, rate of change in exports, change in domestic absorption and the previous period's inflation rate). A serious concern about the reliability of the results of Metwally and Al-Sowaidi's model arises from including government spending and domestic absorption as "predetermined variables", as such variables must have an endogenous component in them; meaning that they must be responding (at least partially) to increases in the price level.

is to say, nominal wages in the private sector generally take a longer time to adapt to a rise in the domestic price level, leaving real wages to deteriorate in the short-run.[5]

In light of the above recount of the previous empirical studies, we turn now to the analysis of nominal wage and price interdependencies in Egypt, and their links with important macro variables.

III. The Evolution of Nominal Wages in Egypt: Links with Inflation and Its Underlying Macro Determinants

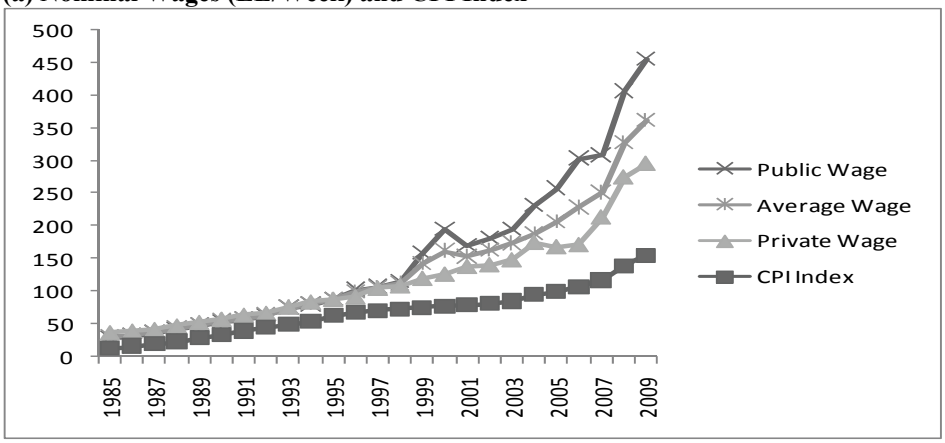
Nominal wages in the private and public sectors in Egypt have generally been on a rising trend. The nominal wage level in the private sector was higher than that in the public sector up until 1995; both standing at LE 88 per week, but after that the public sector wage took on a higher trend reaching LE 455 per week in 2009, compared to a private sector wage of LE 297 per week. Increases in nominal wages have been often described as "inflation allowances" (Fares and Ibrahim 2009; Metwally and Al-Sowaidi 2004). That is, nominal wage growth generally comes after price inflation. But, it is also plausible to consider that nominal wage increases exert an upward pressure on prices. Thus, several crucial questions emerge here: Do changes in aggregate demand policies (fiscal, monetary and exchange rate policies) affect nominal wages? In other words, what are the common macro drivers of price- and wage-inflation? And do these macro drivers of wage and price inflation affect the private and public sectors in the same way?

A first cut at answering the above questions would be to trace the evolution of the private and public nominal wages against that of the consumer price index. The purpose of this would be to see whether price inflation is associated with nominal wage inflation. Afterwards, our analysis would move to the examination of the variables of interest (discussed later) that are likely to affect price- and wage- inflation to give us a first feeler of their relevance to the developments of nominal wages in both private and public sectors, before proceeding to the empirical analysis.

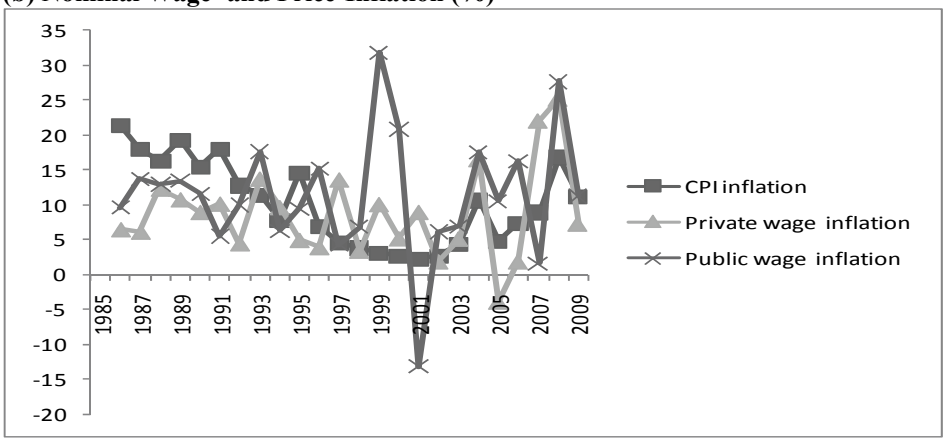
[5] Fares and Ibrahim's model has been the first to explore the direction of causality between price and wage inflation in Egypt using the Granger-causality technique, but several limitations that were discussed in their paper leave room for enhancing the accuracy of their results. First, data used for the empirical analysis were actually generated using a partitioning technique to convert the series from annual to quarterly frequency. Second, the specification of the Granger-causality equations lends itself to the risk of serious misspecification, as it accounted for wage- and price- growth rates only, thus omitting important determinants of price-inflation.

Figure 1. Nominal Wages in the Private and Public Sectors and the Consumer Price Index

(a) Nominal Wages (LE/Week) and CPI Index



(b) Nominal Wage- and Price-Inflation (%)



Source: Data on nominal wages are obtained from the CAPMAS, Employment, Wages and Labor Hours, various issues. CPI index data are obtained from the IMF's International Financial Statistics online database. CPI data are annual averages of fiscal years. So the year 1985 means fiscal 1984/85, which starts on July 1st 1984 and ends June 30th 1985. Nominal wages data represent the average weekly wage in the first week of October of the respective year.

The above graphs show that the nominal wage in the private sector has been drifting in parallel to the domestic price level throughout most of the period under study (1985–2009). Figure 1b shows this more clearly as private sector nominal wage inflation seems to correspond with CPI inflation, albeit with larger fluctuations in the private sector wage since the step devaluations of the Egyptian pound vis-à-vis the US dollar that started in 1999, and the depreciation that followed the floatation of the Egyptian pound in 2003.

The public sector nominal wage was moving together with the private sector wage, and drifted parallel to the consumer price index up until 1999.[6] After that, the nominal wage in

[6] The above display of the evolution in public and private wages establishes the importance of analyzing each sector independently, especially that most of the fluctuations in the private or public wage series are ironed out in the "Average Wage" series as depicted in Figure 1a above.

the public sector started to move independently, evidently out-pacing the consumer price index. This is clearer in Figure 1b, which shows that nominal wage inflation in the public sector exhibits sharper fluctuations; irrelevant of price inflation especially since 1999. It is worth noting that the largest increases in the public sector wage coincided with major political events in Egypt.[7] In 1999, after a public referendum, former President Mubarak was elected to his fourth term, making him Egypt's longest-serving President in history. The next major increase in the public sector wage was in 2004, also the year that preceded Egypt's first multi-candidate Presidential election which Mubarak also won overwhelmingly. The public sector wage increases in 2006 preceded the major constitutional amendments which were introduced in 2007 following the notorious referendum that aimed to change the constitution to grant more power to the President. The year 2008 witnessed the eruption of the riots in the Delta Town of Mahalla which was the first riot among many other episodes of civil unrest to which the government seemed to respond by stepping up wages of public sector workers and civil servants. Besides the political developments that are likely to have contributed to public sector wage raises, the higher trend that public sector wages took on since 1999 followed the beginning of a period of loose fiscal conditions, contrary to the first half of the 1990s, which was characterized by fiscal consolidation under the stabilization phase of the Economic Reform and Structural Adjustment Program that Egypt adopted since 1991.[8] Therefore, we have reason to suspect that public sector wage growth has been associated with worsening fiscal conditions.

In light of the above, the next section discusses the relevance of each of domestic credit, the nominal exchange rate (LE/US dollar) and real GDP for the analysis of nominal wage and price dynamics before proceeding to the empirical analysis.

[7] See the website of Carnegie Endowment for International Peace for a comprehensive coverage of major political milestones in Egypt: http://egyptelections.carnegieendowment.org/timeline

[8] Egypt adopted the Economic Reform and Structural Adjustment Program (ERSAP) in 1991 following a stand-by agreement signed between Egypt and the IMF. Fiscal consolidation has been the cornerstone of the stabilization phase of ERSAP which started 1991 and ended 1996 (Abdel-Khalek 2001; Subramanian 1997). The overall budget deficit started rising after the completion of the stabilization phase of ERSAP. According to the old budget classification, the overall budget deficit increased from 2.9 percent of GDP in 1998/99 to almost 9 percent of GDP in 2004/05 (Central Bank of Egypt website, time series). See footnote 11 for information about the reclassification of the government budget.

Choice of the Variables for Empirical Analysis of Price and Wage Dynamics: Domestic Credit, Nominal Exchange Rate and Real GDP

We rely here mainly on the "fiscal" view and the "balance of payments" view of inflation. The "fiscal" view postulates that the root cause of monetary growth in developing countries is found in fiscal imbalances (Agénor and Hoffmaister 1997). Proponents of the fiscal view of inflation "point to the exogenous component of the fiscal deficit as the fundamental source of monetary emission that moves the economy to a high-inflation equilibrium" (Montiel 1989). On the other hand, advocates of the "balance of payments" view consider inflation to be mainly driven by exchange rate movements in the presence of accommodative monetary policy. That is to say that nominal exchange rate shocks that arise from adverse external conditions cause inflation, when monetary policy is passive (Agénor and Hoffmaister 1997; Montiel 1989). Exchange rate depreciation leads to a higher inflation rate either due to raising inflationary expectations (due to expectations of higher import prices), or through some form of wage indexation that would compensate employees for the deteriorating value of the domestic currency vis-à-vis the main trading partners' currencies.[9]

In addition, we also consider real GDP in order to account for the prominent role that real output (and more generally supply shocks) plays in domestic price dynamics. We discuss next developments in domestic credit, the nominal exchange rate, as well as real GDP and their links with price and wage inflation in Egypt.

Domestic credit and links with price and wage inflation in Egypt

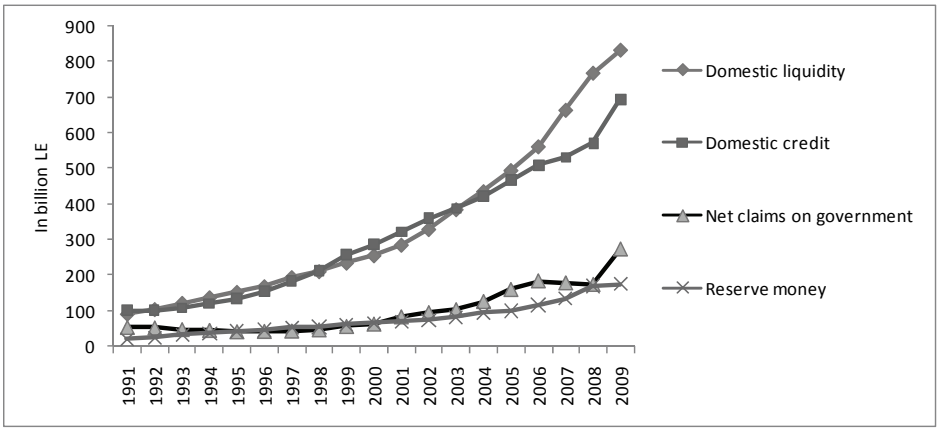
As mentioned above, those that adhere to the "fiscal" view of inflation focus on the source of monetary growth as the overriding cause of inflation. And in Egypt, inflation has been attributed to fiscal determinants, among other factors (see Helmy 2009). As displayed in Figure 2, the evolution of reserve money (M0)[10] along with that of net claims on the government helps establish the link between monetary growth and the persistent need to

[9] See Montiel (1989) and Agénor and Hoffmaister (1997) for more extensive analysis of the "fiscal" view and "balance of payments" view of inflation, and the difficulty of drawing analytical distinctions between the two views.

[10] Reserve money (M0) is composed of money in circulation outside the Central Bank of Egypt (CBE) and local currency deposits of banks at the CBE. It is considered the base of money in its broader definition, and is also known as the monetary base or high-powered money. It is used as an intermediate operational target of the monetary policy in the management of domestic liquidity (M2) (Central Bank of Egypt, Monthly Statistical Bulletin, January 2011). See Al-Mashat (2008) for a comparison of the various definitions of money (M0 & M2) and their links with the domestic price level. M0 growth was found to be the most tightly linked to consumer price inflation.

finance the budget deficit through extending credit to the government. This intuition comes from the fact that the budget deficit in Egypt is mainly financed from domestic sources. In 2001/02, 97 percent of the overall budget deficit was financed by domestic borrowing and issuing of securities (as opposed to foreign borrowing and issuing of foreign securities). This ratio went up to 98.6 percent in 2008/09 (People's Assembly, Plan and Budget Committee, Final Accounts).[11] And as mentioned in the literature review in Section II, according to Helmy (2009), inflation in Egypt is not only related in the long run to fiscal imbalances, but also to the sources of financing the budget deficit; particularly financing from the central bank. Helmy's major empirical finding was that Egypt's budget deficit as well as the credit that is extended to the government remain important drivers of inflationary pressures. This finding is supported by Figure 2 below which shows how the time paths of the "net claims on government" and "reserve money" series seem to drift closely together.

Figure 2. Domestic Liquidity (M2), Reserve Money (M0), Domestic Credit, and Net Claims on Government (in Billion LE)



Source: Central Bank of Egypt website, time series.
Notes: Years in this figure are all fiscal years (1991 = 1990/91).

[11] The government budget in Egypt was reclassified in 2005 to accord with the IMF's Government Finance Statistics Manual 2001 that adopts "cash-basis" accounting principles. Data according to the new budget classification are available starting from fiscal year 2001/02. Therefore, the reclassification of the government budget makes it difficult to trace the evolution of sources of financing the budget deficit for the whole period (1985-2009) that is later considered in the empirical analysis. It is worth noting that the government budget prior to 2001/02 is available according to the old budget classification that was reported on both cash and accrual bases.

Figure 2 also shows that domestic credit[12] is tightly linked to domestic liquidity (M2).[13] Therefore, "domestic credit" is introduced in our empirical analysis as it is the domestic counterpart of M2 (on the assets side) and so, net domestic credit may proxy the impact of monetary growth on inflation while explicitly accounting for the portion of the monetary base expansion that is due to fiscal imbalances. More precisely, the part of domestic credit that is extended to the government approximates the portion of monetary base expansion due to the rising budget deficit (Helmy 2009). According to the Central Bank of Egypt data, domestic credit directed to the government constituted more than 50 percent of total domestic credit during the early 1990s. This ratio went down to an average of 27 percent after the fiscal consolidation that characterized the stabilization phase of ERSAP (1991–1996), and then started trending up again to form about 40 percent of total domestic credit in 2008/09.[14]

And as mentioned earlier in this section, the average public sector wage has started on a higher upward trend at a time that coincided with the lax fiscal conditions and major political milestones.

We present in Figure 3 the growth rates of domestic credit, net claims on government along with that of nominal wage in the public sector.

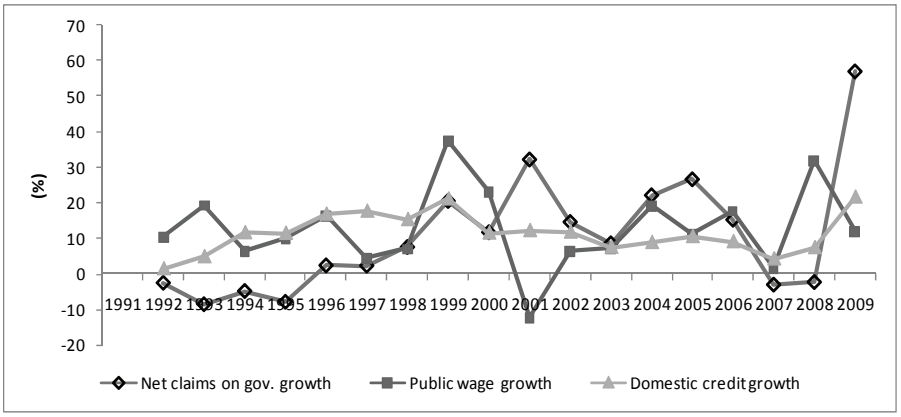
Indeed there seems to be an association between the three series, but growth in credit extended to the government corresponds more readily with the growth rate of the public sector wage, particularly since the mid-1990s.

[12] Domestic credit in Egypt consists of net claims on government, claims on the private business sector, claims on the public sector, and claims on households.

[13] M2 is defined from the assets side as "net foreign assets" plus "domestic credit" (Ministry of Finance, Financial Monthly, Oct. 2010; Central Bank of Egypt website, time series). From the liabilities side, M2 includes money (M1) and quasi money (Ministry of Finance, Financial Monthly, Oct. 2010).

[14] Besides the part that is extended to the government, the remainder of net domestic credit is mostly directed to the private sector (including the private business sector and the household sector). Credit extended to the private sector has been increasing persistently (in percent of GDP) since the early 1990s. However, according to Kheir-El-Din and Abou-Ali (2008) and Kheir-El-Din and Moursi (2007), credit extended to the private sector has not been beneficial for the real economy. That is because a large part of "the credit to the private sector has been directed to unnecessary, high-return activities, speculations on land and real estate prices, and the importation of luxury goods." Thus, even the portion of net domestic credit that was directed to the private sector in Egypt is expected to have an inflationary impact.

Figure 3. Public Sector Nominal Wage Inflation and Growth Rates of Domestic Credit and Net Claims on the Government (in percent)



Source: Author's calculations based on Central Bank of Egypt data and CAPMAS data from "Employment, Wages and Labor Hours" annual bulletin.

The exchange rate and links to price and wage inflation in Egypt

The Egyptian exchange rate has been pegged to the US dollar since 1991 up till 1999.[15] The Central Bank of Egypt strictly managed the exchange rate, and resisted IMF's recommendations of a 20-30 percent depreciation of the currency. During the spring and summer of 1999, concerns rose about a possible devaluation, which in turn generated a large demand for dollars. Toward the end of 1999, the market exchange rate (the one used by money changers) was 10 percent above the central bank's official exchange rate. By increasing interest rates and selling reserves (though the central bank lost a substantial amount of reserves), the central bank was able to bring market rates back in line with the official rate. The pressure on the Egyptian pound continued through the beginning of 2000. So, the central bank allowed for a depreciation of the official rate (of approximately 3 percent) in June of 2000 (Panizza 2002). At the end of January 2001, a band was introduced (+/-1 percent around the central rate). Throughout 2001 and 2002, the central rate was devalued on a number of occasions and the band widened to +/-3 percent. Finally, in January 2003, the Egyptian pound was allowed to float.[16] By the end of fiscal year 2002/03, the cumulative depreciation of the

[15] Prior to 1991, Egypt maintained a multiple exchange rate system that consisted of three exchange markets: the central bank pool rate (of the central bank of Egypt), the commercial bank rate, and the rate outside banks (IMF 1990). In February 1991, the multiple exchange rate system was replaced by a temporary dual system, consisting of a primary market and a secondary (free) market. It was subsequently unified in October 1991. After that, the exchange rate was pegged to the US dollar, and was traded in a single market, with the authority intervening to maintain the peg (IMF 1998).

[16] Currently, the Egyptian exchange rate regime was classified by the IMF as "other managed arrangement."

Egyptian pound reached 31 percent compared to its value before announcing the floatation of the Egyptian pound (Helmy 2009).

From the Figure 1b above, we could observe a lagged response in the price level to the step devaluations of the Egyptian pound vis-à-vis the US dollar that were undertaken between January 2000 and December 2001, and that were later amplified by the large depreciation of the Egyptian pound in 2003. Double-digit CPI inflation set in, reaching 10.3 percent in 2003/04 and 11.4 percent in 2004/05, with a peak of 21.7 percent (year-on-year) in April 2004 (Al-Mashat 2008; Helmy 2009).[17]

It is plausible to consider that the depreciation of the Egyptian pound may have posed an upward pressure on the private sector nominal wage, either through the creation of inflationary expectations or through a secondary effect coming from the higher price level (that resulted from the exchange rate depreciation).

Real GDP and nominal wage inflation

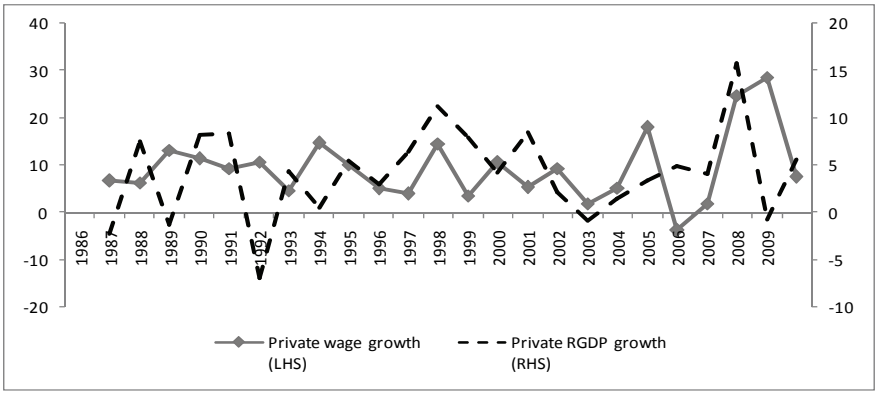
As highlighted in the literature review in Section II of this paper, a change in aggregate demand (or aggregate supply) that results in a change in real output will also have implications for the domestic price level as well as the nominal wage level. Thus, it is imperative to include "real GDP" while studying the dynamics of wages and prices in the Egyptian economy. The following plots depict the growth rates of real GDP in the private and public sectors along with the growth rate of nominal wages in each respective sector.

Fluctuations of the nominal wage in the private sector seem to correspond more tightly with real private sector GDP growth. By contrast, the growth rate of the nominal wage in the public sector is independent of the growth rate of public sector real GDP. This indicates that the private sector nominal wage reflects developments in real economic activity, while the public sector nominal wage does not.

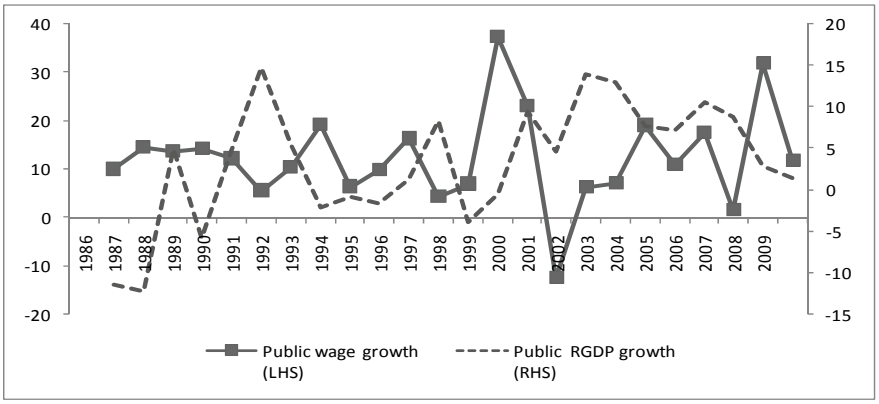
[17] It is worth noting that the upward pressure on the domestic price level due to the developments in the exchange rate was exacerbated by an accommodative (expansionary) monetary policy that was not translated into real GDP growth (Al-Mashat 2008).

Figure 4. Nominal Wage and Real GDP Growth in the Private and Public Sectors (%)

(a) Private Sector



(b) Public Sector



Source: Nominal wage data are obtained from CAPMAS' "Employment, Wages and Labor Hours" annual bulletin. Real GDP growth is calculated by the author based on GDP figures from the Ministry of Planning, deflated by GDP deflator (base year = 1991/92) obtained from the World Development Indicators online database.

The above analysis provides a preliminary indication that developments in the nominal wage level could not be separated from developments in the price level, nor from the underlying drivers thereof. Hence we proceed in the next section to empirically investigate this proposition.

IV. NOMINAL WAGE AND PRICE DYNAMICS: EMPIRICAL ANALYSIS

The empirical investigation is conducted for the period 1985–2009. The methodology used in this study is the vector error correction model (VECM) which allows us to investigate the long-run relationship as well as short-run dynamics among the variables of interest. The VECM is a restricted form of the vector auto-regression (VAR) technique and is designed for the case where variables are non-stationary and are co-integrated. Therefore, the short-run dynamics among the differenced (stationary) form of the variables of interest must include an

error-correction term which "corrects for" the short-run deviations from the long-run equilibrium.[18]

In the next part, we first present the result of the co-integration test and then proceed to the estimation of the VECM.

The VECM consists of a system of equations allowing for the endogeneity of all the included variables. The dependent variable in each equation is the current change in the log of a variable (i.e., the variable's growth rate) and is regressed on its own lagged growth rates as well as lagged growth rates of the other endogenous variables included in the system, plus the dependent variable's own current error (innovation/shock). Each individual equation also includes an error correction term, which is the lagged error obtained from the estimated co-integration equation, and allows for an adjustment process in the short-run to "correct for" deviations from the long-run equilibrium relationship.

The system of equations obtained from the estimated VECM serves two purposes: (1) To find out which variables undergo the short-run adjustment to the long-run equilibrium. This is identified from the coefficient on the error correction term which reflects the speed of adjustment to the long-run equilibrium. Only the statistically significant coefficients will be those that undergo the short-run adjustment. Larger absolute values on these coefficients reflect a higher speed of adjustment towards full long-run equilibrium. (2) To generate impulse response functions and forecast error variance decomposition. Impulse response functions would allow us to draw conclusions on how the endogenous variables in the system react to their own shocks as well as the shocks of the other variables. And the forecast error variance decomposition would identify to what extent the variation in each variable is attributed to its own shock and the shocks to the other variables in the system (i.e., it highlights the relative importance of each variable's shock in explaining its own variation as well as the variation in other variables in the system).

Model Specification

Our primary goal is to investigate how wages and prices interact together, but studying these two variables alone would be omitting important factors that should be accounted for when studying inflation dynamics. Even though determinants of inflation in Egypt have been

[18] See Appendix VI for limitations of the empirical methodology adopted in this paper.

empirically researched before, there is no consensus on the appropriate specification that would best describe the inflationary process. And so, for deciding on the choice of variables to be included in this study's empirical investigation, we resorted to both theory as well as previous empirical studies, as outlined in the previous two sections.

This study concentrates on price and wage dynamics while accounting for the most prominent macro sources of inflation in Egypt. The VECM thus consists of the following endogenous variables: The urban consumer price index (CPI), nominal wages in the private sector (Wpr), nominal wages in the public sector (Wpub), the nominal exchange rate (bilateral exchange rate; Egyptian pound per US dollar) (EXRATE), real GDP (RGDP), and domestic credit (Dcredit).

Data Sources

Data on Nominal Wages in the private sector and the public sector are obtained from the Central Agency for Public Mobilization and Statistics' annual publication entitled: Employment, Wages and Labor Hours. The nominal wage is given by the average weekly wage in the first of October of each year as this timing has proved to be the most stable in terms of employment, and so the weekly wage in October would be a good representative of the average annual weekly wage. Nominal wages in this CAPMAS publication cover "formal" employment in the private and public sectors only. "Formal" employment here refers to workers with a contract in private sector enterprises that consist of 10 or more employees (with the exception of agricultural workers that do not work inside enterprises, but are still considered in this category). That, in addition to all public and public business sector workers. Wages in the government sector (civil servants' wages) are not included in this CAPMAS publication.

The urban consumer price index (CPI), nominal exchange rate (Egyptian pound/US dollar), domestic credit, and real gross domestic product are obtained from the International Financial Statistics (IFS) and the World Development Indicators (WDI) online databases.

Co-integration Analysis

First, the time series properties of the variables of interest were investigated. All variables were found to be I(1). The details of the appropriate unit root test are available in Appendix I.

The Johansen test for co-integration is used to determine whether a long-run relationship exists among the non-stationary variables, namely the consumer price index (CPI), nominal wages in the private sector (Wpr), nominal wages in the public sector (Wpub), the nominal exchange rate (EXRATE), real GDP (RGDP), and domestic credit (Dcredit). The Johansen test for co-integration is conducted with one lag only for the period (1985–2009). The lag length was selected using the Schwarz-Bayesian Information Criterion.[19] Two exogenous variables are included: 1) A dummy to account for Egypt's Economic Reform and Structural Adjustment Program (ERSAP). So, the dummy takes on a value of one starting 1990/91 which was the year that marked the initiation of ERSAP. 2) The US consumer price index to account for the potential impact on domestic prices of inflation in the US (i.e., imported inflation), especially that the Egyptian pound was pegged to the US dollar for the bigger part of the period under study.

The results of the Johansen Co-integration Test are detailed in Appendix II. But for convenience, we present here the estimated co-integrating vector, normalized on log CPI. The standard errors are in ( ) and t-statistics in [ ].

$$\text{Log CPI} = -3.63 + 0.19\ \text{Log EX.RATE} + 0.59\ \text{Log DCredit} - 2.95\ \text{Log RGDP} + 1.95\ \text{Log Wpub} + 1.22\ \text{LogWpr} \qquad (1)$$

(0.07)	(0.18)	(0.53)	(0.17)	(0.2)
[2.7]	[3.34]	[-5.6]	[11.7]	[6.04]

From the co-integrating vector presented above, it seems that in the long-run, an increase in real GDP is associated with a decreasing consumer price index, whereas a rise in private- and public-sector wages is associated with an increase in the consumer price index. Similarly, the depreciation of the Egyptian pound against the US dollar,[20] and/or a rise in domestic credit are also associated with an increasing consumer price index.

While causality is not established from this empirical test, it could be said that the main drivers of inflation, namely the exchange rate depreciation and domestic credit expansion (which in turn translates into monetary growth), enter the equation with the correct expected

[19] The Schwarz-Bayesian Information Criterion (SBIC) is less conservative than the Akaike Information Criteria in the sense that the SBIC penalizes the number of parameters in the system and so inhibits the selection of too many unnecessary lags (Pedroni 2010). Thus we find the SBIC more suitable for the small sample size used in our empirical tests.

[20] The bilateral exchange rate that is used in the empirical tests is the LE/US dollar, so an increase means depreciation of the Egyptian pound versus the US dollar. Thus the positive coefficient on the exchange rate variable is expected, and points to the impact of depreciation in fueling inflationary expectations and raising the cost of imports which feeds through to consumption prices and the cost of production.

signs (i.e., as theory predicts). Also, the positive association between nominal wages and prices accords with the expected relationship that demand-pull (and/or cost-push) inflation hypotheses predict.[21] Finally, the negative association that is found between the domestic price level and real GDP accords with previous empirical studies on Egypt that have attempted to explore the nature and direction of this relationship. The economic intuition behind this negative relationship rests in the adverse effect on investment and productivity that inflation causes (see Helmy (2009); Kheir-El-Din and Abou-Ali (2008)).[22] Inflation is one of the most important indicators of macroeconomic stability (Al-Shawarby 2009), and so higher inflation rates would mean an uncertain/non-conducive environment for real economic growth. On the other hand, a higher level of real GDP (that would relax constraints on the supply side, relative to aggregate demand) would moderate upward pressures on the domestic price level.

Moving to the short-run dynamics: Having established co-integration between the variables of interest, a vector error correction model is estimated. The endogenous variables in the VECM system were introduced in the following order: domestic credit, nominal exchange rate, CPI, real GDP, nominal wage in the private sector, nominal wage in the public sector. The ordering of the variables included in the estimation of the VECM bears assumptions for how variables affect each other.[23] The assumption is that shocks to the first variable affect the innovations in all variables; shocks to the second variable affect all variables but the first; and

[21] When nominal wages increase without a parallel increase in labor productivity (output per worker), this results in inflation. Even though this study did not tackle the issue of labor productivity explicitly, previous studies have established evidence that labor productivity growth in Egypt has been fairly small. According to Kheir-El-Din and El-Leithy (2006), "during the period 1990/91– 2004/05, real output per worker increased at a modest annual rate of 1.51 percent." Therefore, our paper's empirical finding with regards to the positive relationship between nominal wages and the price level not only accords with theoretical hypotheses (as outlined in the literature review section), but also with the specifics of the Egyptian economy that point to the inflationary impact that comes from rising nominal wages in the absence of a corresponding increase in real labor productivity.

[22] In an OLS regression analysis for the period 1981/82 -2005/06, Kheir-El-Din and Abou-Ali (2008) found that inflation has a significant negative impact on real GDP growth. But their paper also found the relationship between inflation and real growth to be actually non-linear; and detected the presence of a threshold. Meaning that there exists a threshold level below which inflation is considered a desired phenomenon, but above that threshold level, inflation becomes detrimental to growth. Below the threshold, inflation is compatible with a growing economy and resilient demand. Above the threshold, higher inflation increases inflationary expectations and erodes the real value of returns on investment.

[23] The Cholesky factorization option is chosen to generate the impulse response functions. This option imposes an ordering of the variables in the VAR in a way that attributes all of the effect of any common component to the variable that comes first in the VAR system. Responses can change dramatically if we change the ordering of the variables.

In order to address the problem of the small sample size, the "degrees of freedom adjustment" option is also chosen to make small sample degrees of freedom correction when estimating the residual covariance matrix used to derive the Cholesky factor.

so on. This assumption is essentially arbitrary, in the sense that the ranking/ordering of the variables in the system must be imposed a priori. We present next the short-run adjustment process towards the long-run equilibrium, and then the impulse response functions and the forecast error variance decomposition that are generated from the estimated VECM.[24]

Short-Run Adjustment to Long-Run Equilibrium

As mentioned above, a principal feature of co-integrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. Thus the short-run dynamics must be influenced by the extent of any deviation from the long-run relationship. In order to assess the process with which the co-integrated variables undergo the short-run adjustment towards the long-run equilibrium, we present in the table below the coefficients on the error correction term. These are called "adjustment coefficients," and they appear in each of the six equations that constitute the short-run dynamics of the VECM system. The error correction term—as mentioned earlier—is essentially the lagged value of the residual obtained from the co-integration equation, and is included in the short-run equations in order to capture the extent of short-run deviation from the long-run equilibrium.

Table 1. Adjustment Coefficients

Error correction	**Log domestic credit**	**Log EX.RATE**	**Log CPI**	**Log real GDP**	**Log private wage**	**Log public wage**
Adjustment Coeff.	-0.062	-0.19	-0.07	-0.03	-0.173	-0.227
St. Errors	(0.04)	(0.159)	(0.04)	(0.01)	(0.05)	(0.09)
T-Statistics	[-1.67]	[-1.197]	[-1.64]	[-2.35]	[-3.33]	[-2.503]

From the table above, we see that the t-statistics of net domestic credit, CPI, real GDP, and the nominal wages in the private and public sectors indicate that the adjustment coefficients are all statistically significant at least at the 10 percent level. Therefore, we could

[24] This particular ordering was chosen in light of the "fiscal" and "balance of payments" views of inflation which dictated that net domestic credit and the nominal exchange rate must come before CPI (that is to say that CPI is mainly explained by these two variables that come first in the ordering). Real GDP is introduced after CPI based on Kheir-El-Din and Abou-Ali's Granger-causality tests that found that the direction of causality goes from CPI inflation to the real growth rate. Finally, nominal wages in both the private and public sectors were introduced last in the ordering of the endogenous variables based on previous studies (Metwally and Al-Sowaidi 2004; Fares and Ibrahim 2008) that described wage raises as "inflation allowances".

conclude that—with the exception of Log Exchange Rate[25]—all of the variables adjust towards the long run equilibrium.

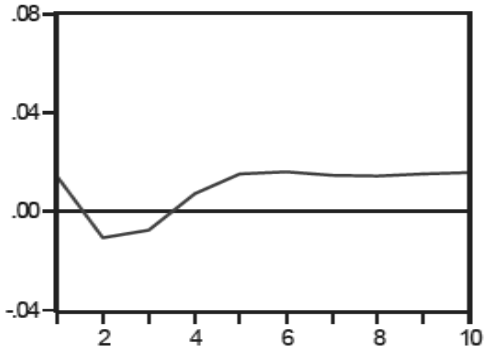
That is, the equilibrium that unifies variables along the co-integrating vector appears to be stable over time.

Impulse Response Functions and Forecast Error Variance Decomposition

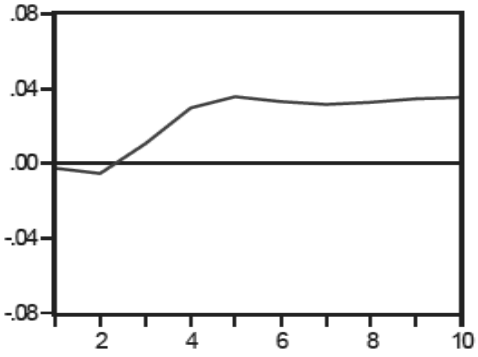
The purpose of this section is to analyze the joint behavior of the endogenous variables that were included in the VECM in response to their own shocks as well as the shocks of the other variables. The whole set of impulse responses is presented in Appendix IV, but we single out the ones that are most crucial for our analysis and present them below for convenience.

Figure 5. IRFs of Nominal Wages to a One Standard Deviation Shock in Log CPI

(a) Response of Log Private Wage



(b) Response of Log Public Wage



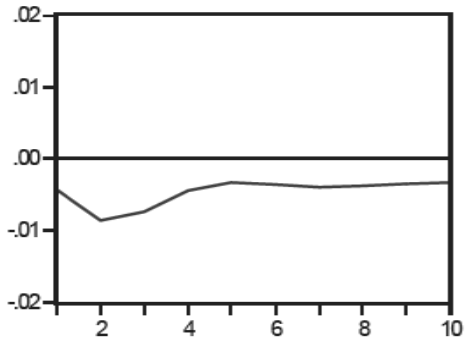
The above graphs are plots of the impulse response functions (IRF's) across time. Both the responses of the private sector and public sector nominal wages display some stickiness on impact (i.e., upon a one standard deviation shock to CPI,) indicating that real wages in both the private and public sectors are eroded in the short-run, before it adjusts to the rise in CPI.

While the IRFs show that the nominal wage in both private and public sectors start to adjust in the second period (after the CPI shock), it is noteworthy that the adjustment in the nominal wage in the private sector is smaller in magnitude compared to that of the public sector. The IRF of the nominal wage in the public sector flattens out at a level that is much higher than before the CPI shock. On the other hand, the nominal wage in the private sector

[25] The reason why the bilateral nominal exchange rate (LE/US dollar) is not adjusting towards the long-run equilibrium may be attributed to the fact that it was pegged (and then closely managed by the monetary authority) throughout the period under study. Also due to the peg to the US dollar, external factors may be causing it to divert from the long-run equilibrium.

seems to flatten out at a level that is slightly above the level before the CPI shock. The slight decrease in the nominal wage in the private sector may be associated with the negative impact that the CPI shock exerts on real GDP as demonstrated by the following IRF, which depicts the time path of real GDP in response to a one standard deviation shock in CPI:

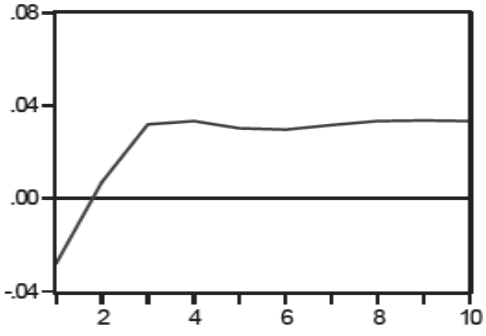
Figure 6. IRF of Log RGDP to a One Standard Deviation Shock to Log CPI



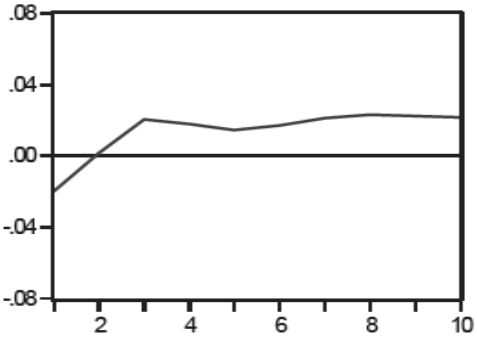
That is to say, the adverse impact on real output due to the shock in the price level may be transmitted to nominal wages, especially in the private sector as it is more tightly linked to economic activity. In other words, nominal wage adjustment in the private sector is more responsive to real economic activity. This is also demonstrated by the following IRFs that depict the responses of the nominal wages in the private and public sectors to a real output shock. The response of the private sector wage shows a larger increase (compared to that of the public sector) in response to a real output shock, rendering a steeper IRF for the nominal wage in the private sector.

Figure 7. IRFs of Nominal Wages to a One Standard Deviation Shock in Log RGDP

(a) Response of Log Private Wage



(b) Response of Log Public Wage



Examining the forecast error variance decomposition, we find that throughout the 10-period forecast horizon, on average, 60 percent of the variation in the nominal wage in the

private sector is explained by its own innovations, while 20 percent is attributed to real output innovations, 13 percent to public sector wage innovations, and 5 percent to CPI innovations.

The variation in the public sector wage over the 10-period forecast horizon is mostly attributed to its own innovations and the private sector wage innovations, accounting for about 15 percent and 31 percent, respectively. Domestic credit innovations explain on average 20 percent of the variation in the public sector wage. This may indicate the association between the rising public sector wage bill and the government need to issue debt, thus increasing domestic credit, in order to meet the budget obligations. CPI innovations explain on average 11 percent of the variation in the public sector wage over the forecast period, but it is worth noting that the relative importance of CPI innovations increases only towards the end of the forecast horizon, implying a delayed adjustment as depicted above. Real output innovations account for no more than 7 percent on average of the variation in the public sector wage. This means that variation in the public sector wage is weakly linked to real economic activity. This is in contrast to the relative importance of real output innovations in explaining the variation in the private sector nominal wage.

Finally, regarding the response of CPI to the various shocks in the system, we find that little of the variation in CPI is explained by innovations in private and public wages, each accounting for around 7 percent on average over the forecast horizon. Innovations in CPI itself (which accounts for an average of 67 percent of its own variation), as well as in the exchange rate (16 percent) seem to be relatively the most important sources of variation in CPI over the forecast horizon.

The implication is that inflation in Egypt is a long-run phenomenon that has been influenced by a series of depreciations of the exchange rate, and accommodating monetary growth that was brought about (mostly) by credit expansion. Nominal wages in the private and public sector have been an integral part of this long-run dynamic relationship. The findings of this empirical investigation suggest that nominal wages (notably that of the public sector) adjust to price level shocks, and that there is a feedback effect (albeit small) from the nominal wages to the price level also.

V. CONCLUSION

This study has aimed at assessing how wages and prices interact with /and affect each other. But price and wage dynamics are at the heart of macroeconomic developments induced by changes in aggregate demand and/or aggregate supply. And so, examining price and wage inflation cannot be separated from the developments that take place in the various macro indicators. Therefore, the study has tested empirically the relationship between prices and wages, while accounting for the most important macro variables that contribute to price inflation dynamics in Egypt.

First, the Johansen test for co-integration was conducted for the following variables: The urban consumer price index, nominal wage in the private sector, nominal wage in the public sector, domestic credit, nominal exchange rate (LE/US dollar), and real gross domestic product. The Johansen test detected the presence of a long-run equilibrium relationship between these variables. From the estimated co-integrating vector, we conclude that in the long-run, a rise in the nominal wage in both private and public sectors, as well as a depreciation of the Egyptian pound (vis-à-vis the US dollar), and an increase in net domestic credit are all associated with a higher level of consumer price index. On the other hand, a higher real GDP level is associated with a lower consumer price index; indicating the favorable effect of easing capacity constraints towards curbing upward pressures on the domestic price level.

Having detected co-integration between the variables of interest, the study then moved to the estimation of a vector error correction model (VECM) assuming that the six variables for which co-integration was established are endogenous. The VECM has the virtue of examining short-run dynamics between the differenced series (the growth rates of the variables of interest) while taking into consideration the process of short-run adjustment towards the long-run equilibrium relationship that is present amongst the levels of the variables of interest. The adjustment coefficients obtained from the estimated VECM (which are actually the coefficients on the error-correction term that is included in each one of the system of equations that characterize the short-run dynamics of the VECM) show that all variables included in the model undergo the short-run adjustment towards the long-run equilibrium relationship, with the exception of the "exchange rate."

Next, impulse response functions (IRFs) and forecast error variance decomposition (FEVD) were obtained from the estimated VECM. The following notes could be drawn:

- Nominal wages in the private and public sectors demonstrate some "stickiness" upon a CPI shock. This indicates that nominal wages do not adjust immediately to a domestic price level increase, which implies an erosion of the real wage in the short-run, before the nominal wage later starts to adjust to the price shock.
- The IRFs show that the nominal wages in both private and public sectors start to adjust to a price shock starting from the second forecast period (the second year). It is noteworthy, however, that the nominal wage in the public sector seems to make a larger adjustment, compared to that of the private sector wage.
- On the other hand, the IRFs that depict the time path of nominal wages to real GDP show that the private sector wage is more responsive, and more tightly linked to real output shocks, as compared to the public sector wage, which may indicate that the private sector has more incentives to adjust wages in line with real economic activity.
- The FEVD also shows that real GDP innovations are relatively important in explaining variation in the nominal wage in the private sector.
- By contrast, the FEVD shows that the variation in the nominal wage in the public sector is not explained by real output innovations. Instead, innovations in domestic credit, and in CPI, and in the private sector wage are the most important sources of variation in the public sector nominal wage. In fact, towards the end of the forecast horizon, innovations in domestic credit become the most important source of variation in the nominal wage in the public sector. This points to the association between the rising public sector wage along with rising domestic credit expansion and the continuous need of the government to finance higher wages by issuing domestic government debt.
- FEVD shows that the variation in CPI remains largely explained by its own innovations as well as those of the nominal exchange rate and real GDP. Innovations in the private and public nominal wages are relatively less important sources of variation in CPI, but are certainly non-negligible.

Overall, the evidence that this study has provided demonstrates a sharp contrast between wage adjustments in the public sector versus the private sector: The public sector wage policy has been seeking higher adjustments to keep up with price inflation, and has not been responsive to real GDP developments. On the other hand, private sector wages appear less flexible to insulate workers from inflationary shocks and seem more responsive to real economic activity. The distinction between nominal wage adjustment in the private and public sectors points to a more methodical/deliberate wage policy in the private sector that aligns wage compensations with the state of economic activity.

The dynamics of wage adjustment in the public and private sectors should be carefully evaluated in the design of wage policies. Adjustment of nominal wages to inflation (regardless of real GDP growth) is bound to create further inflation in the long-run, particularly if the increase in public wages is financed by a higher budget deficit and more domestic borrowing by the government. In contrast, growing wages in line with real economic activity is bound to mitigate inflationary pressures, which would ultimately lead to preserving the real value of wages and salaries towards achieving a higher standard of living in a growing economy.

APPENDIX 1. STATIONARITY OF VARIABLES

Before proceeding to the co-integration test, we needed to ensure that all variables are non-stationary and integrated of the same order. Therefore, we conducted the Augmented Dickey-Fuller Test (ADF) test. All variables included in the empirical tests were found to be non-stationary and integrated of the first order [I(1)].

Table A1. Results of the ADF Unit Root Test for Variables Included in the Empirical Analysis

Series tested for stationarity	ADF test details for log level	T-statistic of ρ p-value in [ ]	ADF test details for first difference	T-statistic of ρ p-value in [ ]	Conclusion about stationarity of the series
Consumer price index	Constant, 1 lag	-1.732 [0.4]	Constant, 9 lags	-3.428 [0.02]	I(1)
Nominal exchange rate	Constant, 1 lag	-1.83 [0.35]	Constant, 0 lags	-2.66 [0.095]	I(1)
Net domestic credit	Constant, 2 lags	-2.19 [0.21]	Constant, 5 lags	-2.75 [0.08]	I(1)
Nominal wage in private sector	Constant, 0 lags	0.05 [0.95]	Constant, 1 lag	-4.79 [0.001]	I(1)
Nominal wage in public sector	Constant, 0 lags	0.23 [0.96]	Constant, 10 lags	-3.53 [0.02]	I(1)
Real GDP	Constant, 0 lags	1.07 [0.99]	Constant, 0 lags	-4.17 [0.004]	I(1)

The ADF test consists of estimating the following equation:

$$\Delta y_t = c + \rho y_{t-1} + \sum_{j=1}^{p} R_j \Delta y_{t-j} + \mu_t$$

where y is the series that is being tested for stationarity; Δy is the differenced series. The Schwarz Information Criterion (SIC) is used to select an appropriate number of lagged differences (p) to be included in the ADF test to render the error (μ) white-noise. The presence of a unit root is rejected (i.e., the series y_t is said to be stationary) if the t-statistic of ρ (the coefficient on the lagged value of y) is large and negative. It is a one-sided test. So, values that are more negative than the critical values (given by the test depending on number of parameters and observations) imply rejection of the presence of a unit root. Alternatively, we could look at the p-value, which should be less than 0.05 for rejecting the presence of a unit root at the 5 percent significance level, or less than 0.10 for the 10 percent significance level.

APPENDIX II. CO-INTEGRATION TEST

The **Johansen Test** is used to estimate and test for the presence of one (or more) co-integrating vectors. The test basically tries to detect if there is one (or more) linear combination(s) of the variables that is (are) stationary.

Sample: 1985 2009

Included observations: 25

Trend assumption: Linear deterministic trend

Series: LCPI LDCREDIT LEXCHANGE LRGDP
LPRWAGE LPUBWAGE

Exogenous series: ERSAP USCPI

Warning: Critical values assume no exogenous series

Lags interval (in first differences): 1 to 1

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.960044	208.1976	95.75366	0.0000
At most 1 *	0.852276	127.6981	69.81889	0.0000
At most 2 *	0.724605	79.88779	47.85613	0.0000
At most 3 *	0.605390	47.64903	29.79707	0.0002
At most 4 *	0.559751	24.40258	15.49471	0.0018
At most 5 *	0.144173	3.892184	3.841466	0.0485

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values.

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.960044	80.49951	40.07757	0.0000
At most 1 *	0.852276	47.81030	33.87687	0.0006
At most 2 *	0.724605	32.23876	27.58434	0.0117
At most 3 *	0.605390	23.24645	21.13162	0.0248
At most 4 *	0.559751	20.51039	14.26460	0.0045
At most 5 *	0.144173	3.892184	3.841466	0.0485

Max-eigenvalue test indicates 6 co-integrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values.

Unrestricted Co-integrating Coefficients (Normalized by b'*S11*b=I):

LCPI	LDCREDIT	LEXCHANGE	LRGDP	LPRWAGE	LPUBWAGE
8.762781	-5.230628	-1.684693	25.88242	-10.69240	-17.06186
-6.846893	7.667785	-5.003662	-74.62133	44.03143	-6.776099
11.02292	-14.93607	4.598685	25.35468	-14.78927	13.45517
6.716190	2.765008	7.016793	65.01163	-14.46028	-7.723736
2.608199	-29.52271	3.929805	75.25387	5.310320	-13.31166
-2.206378	-4.178518	8.011911	-5.539419	2.814792	-2.139203

Unrestricted Adjustment Coefficients (alpha):

D(LCPI)	0.013610	-0.000757	-0.012415	-0.014386	0.015354	-0.002499
D(LDCREDIT)	0.011870	0.010323	0.019887	-0.000283	0.005963	-0.001728
D(LEXCHANGE)	0.036374	0.008601	0.011350	-0.016836	-0.021254	-0.042051
D(LRGDP)	0.005759	0.003344	0.001696	-0.001331	-0.003229	0.002685
D(LPRWAGE)	0.033060	-0.027166	0.010762	-0.000695	0.015027	9.59E-05
D(LPUBWAGE)	0.043411	0.026085	-0.032962	0.034007	0.009458	0.003047

1 Co-integrating Equation(s): Log likelihood 312.4262

Normalized co-integrating coefficients (standard error in parentheses)

LCPI	LDCREDIT	LEXCHANGE	LRGDP	LPRWAGE	LPUBWAGE
1.000000	-0.596914	-0.192255	2.953676	-1.220206	-1.947082
	(0.17864)	(0.07059)	(0.52575)	(0.20187)	(0.16517)

As the Eigenvalue and Trace tests above show, six co-integration vectors are detected. A more rigorous empirical approach would attempt the analysis using all possible co-integration relationships among the variables. See Dibooglu and Enders (1995) for an argument on how the presence of multiple co-integrating vectors "conveys valuable information that should not be wasted". However, our analysis will suffice with the co-integration equation (normalized on Log CPI) presented above as it backed by our predictions based on theoretical hypotheses as well as the specifics of the Egyptian economy as highlighted in the empirical part of this paper, and allows us to proceed to the vector error correction analysis.

APPENDIX III. VECTOR ERROR CORRECTION MODEL

As explained in Section IV of this paper, a principal feature of co-integrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. Thus the short-run dynamics (presented below) must be influenced by the deviation from the long-run relationship (Enders 1996).

The VECM was estimated using the following Cholesky ordering: Net domestic credit, exchange rate, CPI, RGDP, private wage, public wage.

Vector Error Correction Estimates

Sample: 1985 2009

Included observations: 25

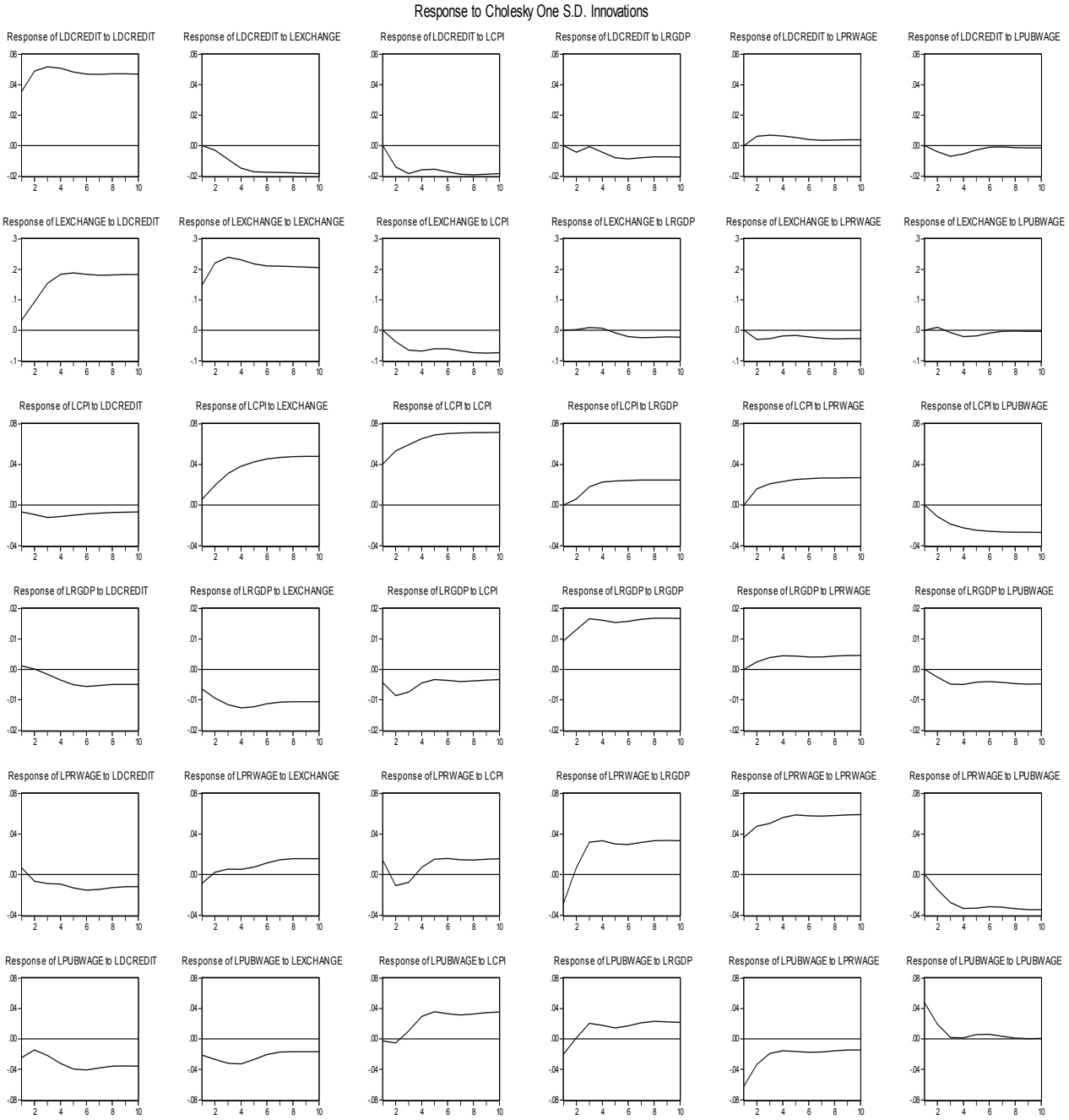
Standard errors in ( ) & t-statistics in [ ]

Error Correction:	D(LDCREDIT)	D(LEXCHANGE)	D(LCPI)	D(LRGDP)	D(LPRWAGE)	D(LPUBWAGE)
CointEq1	-0.062085	-0.190261	-0.071188	-0.030121	-0.172926	-0.227067
	(0.03726)	(0.15900)	(0.04329)	(0.01281)	(0.05188)	(0.09070)
	[-1.66635]	[-1.19663]	[-1.64442]	[-2.35079]	[-3.33337]	[-2.50336]
D(LDCREDIT(-1))	0.350435	1.494961	-0.176605	-0.036159	-0.623953	0.249115
	(0.22215)	(0.94802)	(0.25812)	(0.07640)	(0.30932)	(0.54082)
	[1.57747]	[1.57693]	[-0.68420]	[-0.47330]	[-2.01720]	[0.46062]
D(LEXCHANGE(-1))	-0.019755	0.549419	0.081613	-0.007253	0.187610	-0.047029
	(0.05620)	(0.23985)	(0.06530)	(0.01933)	(0.07826)	(0.13683)
	[-0.35150]	[2.29072]	[1.24976]	[-0.37525]	[2.39738]	[-0.34371]
D(LCPI(-1))	-0.524155	-1.158799	0.198350	-0.128433	-0.583791	-0.366637
	(0.24464)	(1.04398)	(0.28425)	(0.08413)	(0.34063)	(0.59557)
	[-2.14257]	[-1.10998]	[0.69781]	[-1.52657]	[-1.71387]	[-0.61561]
D(LRGDP(-1))	-0.870193	-1.747869	-0.119223	0.055670	1.539743	-0.756863
	(0.62397)	(2.66276)	(0.72499)	(0.21458)	(0.86880)	(1.51905)
	[-1.39461]	[-0.65641]	[-0.16445]	[0.25943]	[1.77227]	[-0.49825]
D(LPRWAGE(-1))	0.153172	-0.098986	0.176264	0.036783	0.119578	0.244837
	(0.14202)	(0.60607)	(0.16501)	(0.04884)	(0.19775)	(0.34575)
	[1.07852]	[-0.16332]	[1.06817]	[0.75310]	[0.60470]	[0.70814]

D(LPUBWAGE(-1))	0.117942	0.819561	-0.005702	0.043838	0.251529	0.152691
	(0.11691)	(0.49891)	(0.13584)	(0.04021)	(0.16278)	(0.28462)
	[1.00883]	[1.64271]	[-0.04197]	[1.09034]	[1.54518]	[0.53648]
C	-0.422028	-2.051968	-0.608956	-0.271206	-1.676315	-2.329882
	(0.37665)	(1.60732)	(0.43763)	(0.12953)	(0.52443)	(0.91694)
	[-1.12049]	[-1.27664]	[-1.39149]	[-2.09378]	[-3.19643]	[-2.54092]
USCPI	0.007975	0.026278	0.009222	0.004177	0.022443	0.030041
	(0.00477)	(0.02037)	(0.00555)	(0.00164)	(0.00665)	(0.01162)
	[1.67057]	[1.28998]	[1.66269]	[2.54425]	[3.37661]	[2.58497]
ERSAP	-0.102330	-0.187667	-0.078405	-0.022022	-0.084368	-0.024919
	(0.03298)	(0.14074)	(0.03832)	(0.01134)	(0.04592)	(0.08029)
	[-3.10290]	[-1.33348]	[-2.04615]	[-1.94170]	[-1.83734]	[-0.31038]
R-squared	0.680432	0.567931	0.700820	0.540170	0.622241	0.384940
Adj. R-squared	0.488691	0.308690	0.521311	0.264272	0.395586	0.015903
Sum sq. resids	0.019027	0.346502	0.025687	0.002250	0.036888	0.112768
S.E. equation	0.035615	0.151987	0.041382	0.012248	0.049590	0.086706
F-statistic	3.548702	2.190744	3.904108	1.957863	2.745319	1.043095
Log likelihood	54.28625	18.01082	50.53474	80.97125	46.01099	32.04277
Akaike AIC	-3.542900	-0.640865	-3.242779	-5.677700	-2.880880	-1.763422
Schwarz SC	-3.055350	-0.153315	-2.755228	-5.190150	-2.393329	-1.275871
Mean dependent	0.129813	0.082278	0.102588	0.047262	0.089028	0.111217
S.D. dependent	0.049808	0.182798	0.059811	0.014280	0.063786	0.087403

Determinant resid covariance (dof adj.)	1.21E-17
Determinant resid covariance	5.63E-19
Log likelihood	312.4262
Akaike information criterion	-19.71410
Schwarz criterion	-16.49627

APPENDIX IV. IMPULSE RESPONSE FUNCTIONS GENERATED FROM THE VECM



APPENDIX V. FORECAST ERROR VARIANCE DECOMPOSITION GENERATED FROM VECM

Variance Decomposition of Log DOMESTIC CREDIT:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.035615	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.062790	92.96212	0.232530	4.940080	0.480680	0.978701	0.405892
3	0.084519	88.89055	1.297554	7.424522	0.272758	1.211311	0.903310
4	0.101416	86.80196	3.016967	7.648370	0.367157	1.240573	0.924971
5	0.115140	84.96855	4.565070	7.744661	0.768648	1.178197	0.774876
6	0.127104	83.34265	5.643703	8.193679	1.107495	1.069721	0.642747
7	0.138169	82.04025	6.386609	8.782843	1.271480	0.970678	0.548146
8	0.148578	81.05186	6.969400	9.250731	1.345355	0.900400	0.482253
9	0.158313	80.29171	7.468969	9.549125	1.402173	0.853610	0.434413
10	0.167408	79.68019	7.891247	9.752178	1.462206	0.818365	0.395815

Variance Decomposition of Log EXCHANGE RATE:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.151987	4.902388	95.09761	0.000000	0.000000	0.000000	0.000000
2	0.288264	11.81398	85.24892	1.721765	0.006334	1.102445	0.106560
3	0.411786	19.73640	75.77416	3.365429	0.048028	0.991800	0.084182
4	0.512069	25.66172	69.36915	3.928817	0.046895	0.775955	0.217467
5	0.591255	29.39771	65.61804	4.005891	0.054343	0.664553	0.259459
6	0.657794	31.54684	63.34172	4.095123	0.146708	0.640428	0.229184
7	0.717892	32.83820	61.72917	4.327139	0.243211	0.667881	0.194399
8	0.773820	33.77711	60.42340	4.626580	0.299681	0.705017	0.168214
9	0.825899	34.56102	59.33723	4.887958	0.332745	0.731665	0.149385
10	0.874375	35.21290	58.46009	5.081045	0.361146	0.749650	0.135168

Variance Decomposition of Log CPI:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.041382	2.613298	1.841808	95.54489	0.000000	0.000000	0.000000
2	0.073713	2.457463	7.491167	82.41734	0.657012	4.646597	2.330423
3	0.105672	2.514923	12.23830	71.63225	3.202211	6.145250	4.267069
4	0.136266	2.202933	15.19167	66.05229	4.648942	6.590588	5.313580
5	0.164440	1.873616	17.12914	62.97036	5.257031	6.858108	5.911747
6	0.189942	1.620904	18.52343	60.99732	5.560375	7.021532	6.276442
7	0.213031	1.429741	19.55727	59.62728	5.745097	7.120062	6.520556
8	0.234112	1.282497	20.31991	58.64176	5.867526	7.188642	6.699663
9	0.253549	1.168734	20.88243	57.92285	5.949144	7.241409	6.835430
10	0.271625	1.080666	21.30611	57.38953	6.003175	7.282452	6.938063

Variance Decomposition of Log Real GDP:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.012248	0.836586	28.05855	12.68961	58.41526	0.000000	0.000000
2	0.022258	0.255215	26.31543	18.84689	52.01869	1.226710	1.337075
3	0.031639	0.380589	26.37709	14.79505	53.31209	2.089402	3.045768
4	0.038700	1.084648	28.23598	11.19824	53.10657	2.712347	3.662210
5	0.044259	2.141945	29.21611	9.117006	52.77343	3.045955	3.705545
6	0.049117	3.028430	29.05230	7.943025	53.15242	3.169692	3.654133
7	0.053658	3.519679	28.37149	7.199721	53.96823	3.246087	3.694790
8	0.057936	3.759702	27.69722	6.612843	54.76053	3.348693	3.821012
9	0.061916	3.919159	27.20177	6.111711	55.34641	3.465778	3.955170
10	0.065611	4.064379	26.84034	5.701298	55.77189	3.567287	4.054808

Variance Decomposition of Log PRIVATE WAGE:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.049590	1.794164	3.039795	8.043545	32.24478	54.87772	0.000000
2	0.071774	1.705412	1.561035	6.097848	16.33651	70.05700	4.242199
3	0.098233	1.692745	1.142945	3.848150	19.32866	63.74861	10.23889
4	0.123339	1.650139	0.905861	2.772074	19.58037	61.25697	13.83458
5	0.145298	1.996779	0.922790	3.103193	18.40810	60.42777	15.14137
6	0.164260	2.424809	1.215700	3.383336	17.68870	59.73324	15.55422
7	0.181556	2.622654	1.641029	3.411323	17.53438	58.94090	15.84971
8	0.197992	2.625773	2.013268	3.381021	17.60281	58.18150	16.19563
9	0.213575	2.571197	2.277163	3.400790	17.63441	57.59459	16.52185
10	0.228146	2.529739	2.469223	3.462504	17.58726	57.18641	16.76486

Variance Decomposition of Log PUBLIC WAGE:

Period	S.E.	LDCREDIT	LEXCHANGE	LCPI	LRGDP	LPRWAGE	LPUBWAGE
1	0.086706	7.843512	6.012037	0.084447	5.101554	51.19999	29.75846
2	0.099960	7.977074	11.80563	0.330640	3.862079	49.83388	26.19070
3	0.111222	10.18342	17.79514	1.160999	6.539550	43.14126	21.17964
4	0.126213	14.50666	20.47181	6.437778	7.121854	35.00085	16.46105
5	0.141432	19.41387	19.95793	11.47556	6.687861	29.20193	13.26284
6	0.154302	23.23852	18.54737	14.26052	6.831525	25.82140	11.30066
7	0.165179	25.56612	17.26661	16.04821	7.629327	23.58208	9.907652
8	0.175137	26.92214	16.25180	17.72847	8.530441	21.75003	8.817125
9	0.184716	27.88366	15.42893	19.42665	9.165137	20.16860	7.927034
10	0.193935	28.72122	14.72494	20.94084	9.564806	18.85469	7.193513

Cholesky Ordering: LDCREDIT LEXCHANGE LCPI LRGDP LPRWAGE LPUBWAGE

APPENDIX VI. LIMITATIONS OF THE EMPIRICAL METHODOLOGY

Vector error correction models (VECM) (and more generally vector auto-regressions (VAR)) provide a good descriptive tool for multi-variate dynamic data relationships as well as forecasting. However, scholars may regard it as an unreliable tool for "structural inference." This arises from the difficulty of interpreting the residuals in a purely economic sense (Pedroni 2010). The Cholesky factoring which imposes assumptions on how residuals/innovations affect the variables in the system is purely a statistical/mechanical concept, and thus may part from economic intuition. In addition, the residuals in a VECM are not orthogonal (i.e., residuals are correlated). The impulse responses that are generated from the VECM are based on purely statistical concepts and not on economic theory. For this reason, impulse responses represent atheoretic analysis of short run dynamics.

These problems that the VECM/VAR suffer from are solved by structural form VECM/VARs, which use economic "structural" knowledge to transform the residuals/innovations so that they could provide economic interpretations, and render the innovations "orthogonal" such that they could be thought of as economically distinct shocks. The reduced form VECM/VAR (that this study adopted) is the base/cornerstone of the more rigorous structural VECM/VAR.

Another limitation arises from the small number of observations that are available for the empirical investigation which may raise doubts about how robust the results are.

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