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Going Deeper Into the Link Between the Labour Market and Inflation*

Tito Nícias Teixeira da Silva Filho**

Abstract

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The unemployment rate is one of the most closely watched economic indicators. However, it has important limitations and shortcomings as a measure of the state of the labour market. This could help to explain the fact that in traditional Phillips curves unemployment explains but a small part of inflation. This paper tries to mitigate such problems going deeper into labour market indicators. With that aim alternative unemployment rates are built and assessed, along with disaggregated unemployment rates and other labour market indicators. The evidence shows that some of those indicators have considerably greater explanatory power over inflation than the traditional unemployment rate and, therefore, should be followed closely by policymakers.

Keywords: Unemployment, natural rate of unemployment, NAIRU, Phillips Curve, inflation shocks, labour market indicators.
JEL Classification: C22, E24, E31, E52

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> "However, if the unemployment rate rises because of a large inflow of reentrants to the labor market who are optimistic about job prospects, this **might signal very different wage and price pressures** from the case in which the unemployment rate rises because jobs are destroyed, workers are terminated, and the escape rate from unemployment to employment falls dramatically."
>
> (Bleakley *et al*., 1999; emphasis added)

1 – Introduction

The unemployment rate – along with the inflation rate – is probably the most closely watched economic indicator by both the public and policymakers. Its releases usually gain especial attention by the press and deserve careful comments from the Government. Indeed, the unemployment rate is important both as an economic and social welfare indicator. It is pivotal in assessing agents' welfare and, therefore, in designing social policies. Moreover, it is key in the assessment of the state of the labour market and, more broadly, of the cyclical position of the economy. In its turn the degree of tightness in the labour market is considered to be a key factor in explaining inflationary pressures, as highlighted by the Phillips curve.

However, despite its importance and popularity, those economists that delve into the intricacies of the labour market argue that the unemployment rate is a deficient indicator of the state of that market (e.g. Blanchard and Katz, 1997). Thus policymakers face a sizable challenge when measuring the unemployment gap, the most traditional labour market slack indicator. Besides the well-known difficulties involved in the estimation of the natural rate of unemployment, the unemployment rate itself bears important shortcomings as a measure of labour market conditions.

For example, according to the guidelines of the International Labour Organization (ILO) a person can be considered employed even if he has worked only one hour per week. Sometimes even paid work is not required. Similarly, if a person is not working but willing to work and has not searched for a job in the last 4 weeks prior to the survey period because, for example, she was sick or discouraged by unsuccessful searches, she is considered out of the labour force and, therefore, is not counted as unemployed. In both cases the labour market would appear in a much better shape than it really is.

The above examples show unambiguously some of the problems involved in the definition and measurement of the unemployment rate [see also Lucas and Rapping (1969), Clark and Summers (1979), Abowed and Zellner (1985) and Poterba and Summers (1986)] and, consequently, in using it as a gauge of the state of the labour market. Obviously, these shortcomings make it much harder for the central bank to uncover the true link between inflation and labour market conditions. Therefore it is highly desirable to find better indicators of the state of the labour market.

One strategy would be to use the flow approach to the labour market [see Blanchard and Diamond (1990), Davis and Haltiwanger (1992) and Davis *et al*. (1996)]. This approach shows that the labour market is characterized by a high level of flows between those employed, unemployment and out of the labour force (i.e. inactive), and these flows would provide a theoretically more appropriate measure of labour market conditions than the unemployment rate. This approach, however, requires a large amount of good microeconomic data, which is usually available to few countries only.[1]

Hence a different strategy is followed in this paper, namely: to search for readily available or easily built labour market indicators that are either less affected by the problems cited above or that provide better information on the state of the labour market. Ultimately the search is for those indicators that show a more solid link with inflation. Three routes are followed: First, to build alternative unemployment measures, which, in principle, should be less affected by the problems involved in the measurement of the traditional unemployment rate. Second, to use disaggregated unemployment data, which could prove to be more informative about inflationary pressures than the aggregate rate. Third, to search for other labour market indicators that help to explain inflation. The main contender here is the ratio of entrance wages to exit wages in the formal labour market, a variable deemed by many economists as being informative about Brazilian inflation.[2] To my best knowledge such a broad exercise has not yet been carried out in the literature.

[1] Note that, although it focuses on different variables, the flow approach hinges on the same concepts that are behind traditional labour market statistics: employment, unemployment and inactivity. Therefore, despite being theoretically more appealing the indicators highlighted by this approach are also affected by the same measurement issues present in unemployment figures.

[2] One could make the case for using hours worked to gauge the state of the labour market since it measures with greater precision the services of labour. However, hours worked is a very well known

The main findings of the paper are: unemployment measures that take into account those that – although considered inactive – report that are ready and available to start working, as well as those marginally attached to the labour force, have greater explanatory power over inflation than the aggregate rate. The same result follows when one uses some disaggregated measures of unemployment such as the unemployment rate among the head of household, among those older than 49 years old and in commerce. In all the above cases the measures are not only more significant than the aggregate unemployment rate but have a larger coefficient. Moreover, when the traditional unemployment rate is added to those models it usually becomes insignificant. Finally, the ratio of entrance wages to exit wages in the formal labour market does not seem useful to predict inflation in Brazil.

The paper is organised as follows. Section 2 pinpoints the main problems associated with the definition and measurement of the unemployment rate. Section 3 searches for alternative – supposedly better – labour market indicators. Section 4 investigates whether the contenders have greater explanatory power over inflation than the traditional aggregate unemployment rate. Section 5 concludes the paper.

2 – Unemployment Rate: A Poor Gauge of Labour Market Conditions

The limitations and flaws of the unemployment rate as a gauge of labour market conditions are long known in the literature. For example, Lucas and Rapping's (1969) analysis implies that unemployment surveys should also investigate job characteristics to define states more precisely. Hall (1970) and Clark and Summers (1979) show that the difference between the states of unemployment and inactivity is fuzzy, while Abowed and Zellner (1985) and Poterba and Summers (1986) show that agents' labour market state depends on the unemployment surveys' design and how the questions are posed.

Indeed, the very definition of unemployment has always been a controversial issue, mainly because it is based on agents' behaviour rather than on a clear economic concept (see Norwood, 1988). Typically, an agent is considered to be unemployed if he is *actively* searching for work, could start working in the reference week (i.e. the

indicator and the goal here is to seek for non obvious labour market indicators. Moreover, reliable estimates of hours worked are usually available for the industrial sector only.

one-week period prior to the survey week), but has been unable to find a job.[3] By actively it is normally meant that the agent has taken some *effective action* (e.g. sent a CV, talked to a friend who can help, etc, instead of just looking at ads) to find a job in the *recent period*. By recent period it is typically meant the last four weeks before the survey week.

In Economics definitions are usually theoretically based. For example, in the credit constraint literature, the definition of constraint has a clear economic concept behind it: if an agent goes to the bank for a loan and is willing to pay the current rate of interest but the bank is not willing to give him the loan, then credit is considered to be constrained.

Broadly speaking, given how unemployment is defined one can identify four "sources" for poor measurement of labour market conditions. First, the difference between unemployment and inactivity is fragile.[4] This is a long debated issue by labour economists and statisticians. Indeed, the difference is somewhat arbitrary since, for example, the simple act of expanding the considered searching period say, to the last three months, would modify agents' state classification. It is not clear how many of those considered outside the labour force should be counted as unemployed and how many should be counted as inactive. Some "non-searchers" (during the reference period) are closely attached to the labour force, while others are not, and this line is not an easy to draw.

The second source is the so-called underemployment. In this situation, even though agents are actually employed they are not happy with their current labour conditions.[5] This is the case, for example, of those who work on part-time jobs but wanted a full-time job and couldn't find one. As the ILO states "Underemployment reflects the under utilisation of the productive capacity of the employed population." This situation leads to mis-measurements of labour market conditions.

[3] Those that have not searched for work either because they were waiting to start working shortly in a new job or because they were on a temporary layoff (and, therefore, waiting to be recalled to the former job) are not considered unemployed (or inactive).

[4] This fuzziness is what is typically behind official explanations as to why the state of the labour market is not as gloomy as it seems when bad times are over but unemployment keeps stubbornly high in the beginning of the recovery: the participation rate is procyclical. However, interestingly, when the economy is entering a recession and unemployment is increasing more slowly than expected as many people are leaving the labour force the opposite warning is never made.

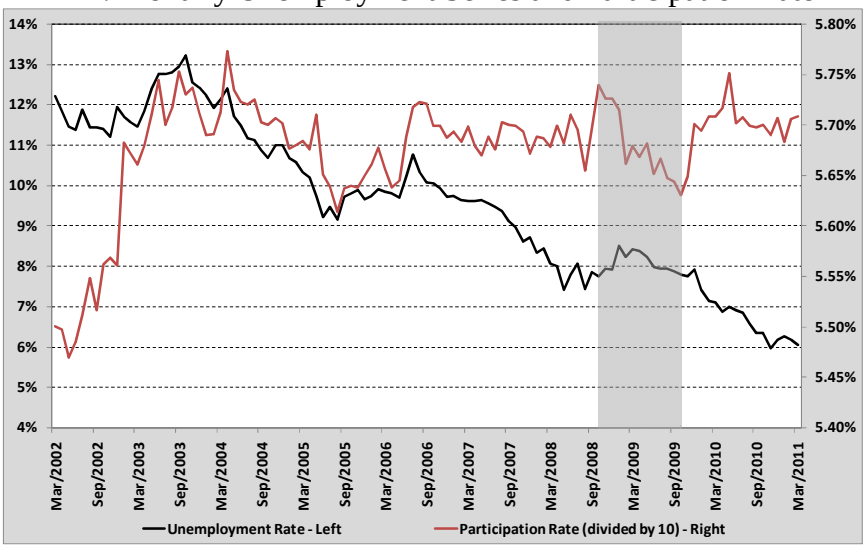
[5] The Brazilian Institute of Geography and Statistics (IBGE), defines underemployment as the situation in which the worker, during the reference week, worked less hours than the legal workweek, even though he wanted to work more hours and was available to do so. In Brazil, this definition, as well as others cited along the paper, follows the guidelines of the ILO.

Third, the very nature of the unemployment indicator, as a three-state variable, does not make it an ideal indicator of labour market tightness. Underemployment itself can be used to illustrate this point. Since the same unemployment rate is consistent with different shares of underemployment, one cannot differentiate between different intensities in the use of the labour input by just looking at the aggregate rate. Hence, even if two problems listed above were handled, the unemployment rate would remain an imprecise indicator of the labour market state, since it does not accurately measure labour services.

Finally, as mentioned, labour economists do not consider the unemployment rate as the best theoreticall indicator of the state of the labour market. For example, Blanchard and Katz (1997) argue that "The right measure of the state of the labor market is the exit rate from unemployment, defined as the number of hires divided by the number unemployed, rather than the unemployment rate itself." Therefore, the latter two points hinge on reasons that go beyond merely measurement issues.

Figure 1

PME: Monthly Unemployment Series and Participation Rate*



(*) Data are seasonally adjusted.

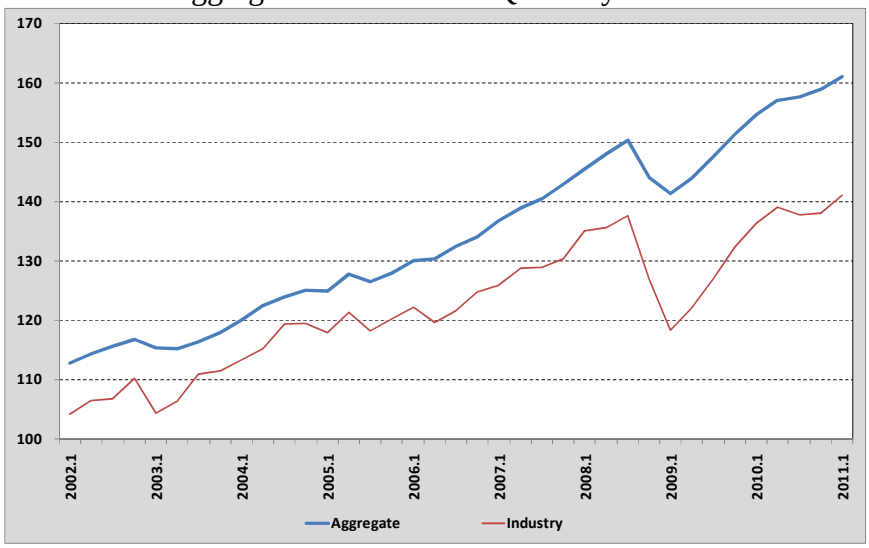
The way employment is typically defined also gives room for pernicious interactions with labour market legislation at certain junctures, worsening measurement problems. One enlightening case is what happened to the Brazilian unemployment statistics during the year that followed the onset of the 2008 world crisis (2008.10–2009.9) – highlighted by the shaded vertical area of Figure 1. When faced with a surge in macroeconomic uncertainty and a sudden fall in credit supply

firms decided to reduce sharply or even halt production, with great impact on economic activity. However, as Figure 1 shows, the unemployment rate faced but a mild increase (0.6 p.p.) from October 2009 to March 2009 and quickly returned to its previous level within a year, a performance much better than originally anticipated.

Indeed, as Figures 2 shows while the unemployment rate rose by less than one percentage point in the six-month period mentioned above, total and industrial GDP tumbled by 6% and 14%, respectively. So what explains such a discrepancy?

Figure 2

Aggregate and Industrial Quarterly GDP*



(*) Data are seasonally adjusted

Part of the answer lies on the behaviour of the participation rate, which fell 0.6 p.p. just from October 2009 to March 2010 (Figure 1). As a consequence, unemployment fell less than it would have had the participation rate remained constant. This evidence portrays clearly the fuzziness mentioned above, as many persons left the labour force during that period. It is very likely that many of those who were having difficulties in finding work at the time certainly thought it would become much harder due to the crisis and stopped searching, although wanting a job.[6]

[6] The fall in the participation rate offset an important part of the effect of the 9.3% increase in the number of unemployed on the unemployment rate. Indeed, had those that left the labour force been considered unemployed instead, the unemployment rate would have been more than one percentage point higher than its actual value in March 2009 (calculations were made using seasonally adjusted data). If calculations are made assuming that the labour force remained on its pre-crises growth *path*, then the increase would have been even greater. Finally, notice that by March 2011 the participation rate had not yet recovered its previous level.

It should be called to attention at this point that it is not possible to learn an important part of the developments above by just analysing labour market indicators. The Brazilian labour market legislation – as should also happen in other countries' legislations – allows firms to resort to some legal possibilities in order to postpone or even avoid firings during difficult times. Indeed, firms in Brazil, under certain conditions, and for limited periods of time, are allowed, for example, to reduce regular working hours and wages (Law N^{o} 4923/1965), to impose compulsory vacations and to turn full-time jobs into part-time jobs (CLT; § 2, article 58-A), among other options.[7]

That is precisely what happened in the wake of the 2008 crisis, as several firms resorted to such options. Such peculiarities added to the measurement problems cited above and prevented a larger increase in the unemployment rate. As a result the rise in unemployment was much lower than expected, worsening the role or the unemployment rate as an indicator of labour market conditions.

3 – Seeking for Better Labour Market Indicators

Although the effects of the 2008 crisis served as the backdrop against which the limitations of the unemployment rate were highlighted, as it should be clear by now it also bears important limitations in normal times. As underlined, one major shortcoming comes from the ambiguity between the states of unemployment and inactivity (i.e. out of the labour force). In principle, some alternatives to mitigate this problem are to consider as unemployed those that although labelled as inactive: a) stated that were ready and willing to start working; b) are marginally attached to the labour force;[8] and c) stopped searching for a job since they assessed that they would not be able to find one (i.e. the so-called discouraged workers).[9]

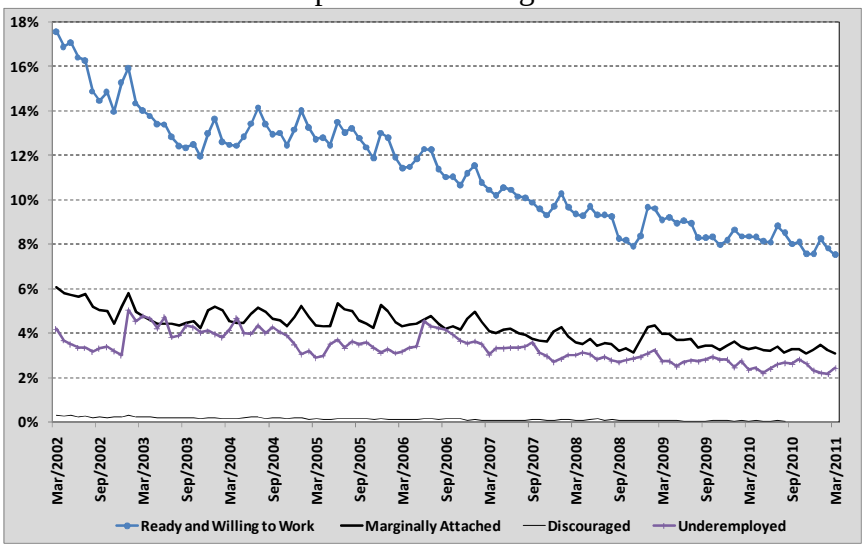
Figure 3 shows the size of those three groups relative to the labour force from March 2002 to March 2011. As can be seen, discouraged workers amount to such a

[7] CLT stands for Labour Laws Consolidation, which is the main labour legislation in Brazil.
[8] The IBGE defines as marginally attached to the labour force those persons considered inactive in the reference week who worked or searched for work during the reference period of 365 days prior to the survey week and were available to start working in the reference week.
[9] Discouraged workers are officially defined by the IBGE as those persons marginally attached to the labour force in the reference week that searched for work on a permanent basis, at least during 6 months, counted up to the date of the last effort made to get work during the reference period of 365 days prior to the survey week, and having quit as they were unable to find any kind of work, work with appropriate earnings or work in accordance with their qualifications.

negligible number that they are almost indistinguishable from the horizontal axis. However, both those ready and willing to work and those marginally attached to the labour force represent an important share of the labour force. In the former case they outnumber the amount of unemployed. Hence, alternative unemployment rates that take into account those two groups could portray a very different picture of labour market conditions and, therefore, could potentially be more informative about inflation developments.

Figure 3

PME: Selected Groups as a Percentage of the Labour Force



It is eye-catching the steep decline in the number of those that, although hadn't searched for work, stated that they wanted and were ready to work. It is also inevitable not to note that this decline coincided with the steep fall in the aggregate unemployment rate displayed in Figure 1. On the other hand it is worth mentioning the much greater stability of the share of those marginally attached to the labour force – especially up to the second quarter of 2007 – although their relative number also declined during the sample.

Another option to "correct" the traditional unemployment rate is to consider those labelled as underemployed as effectively unemployed.[10] Figure 3 shows that this group is also large relatively to the labour force. Finally, one might also think of

[10] Note that, in this case, the size of the labour force remains the same when calculating the corresponding alternative unemployment rate, in contrast to the former cases.

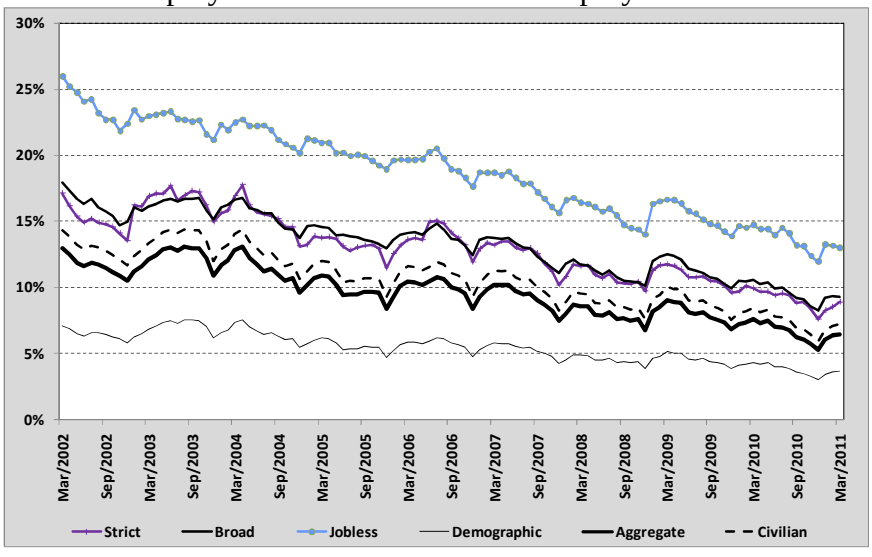
calculating the unemployment rate in relation to the working age population rather than to the labour force.[11]

Therefore, four alternative "unemployment" rates are built according to the adjustments above. The first one – named jobless rate (U^j) – defines the rate that takes into account not only the unemployed but also those (inactive) that said they were ready and willing to work. The second – named broad unemployment rate (U^b) – takes into account, besides the unemployed, the so-called marginally attached to the labour force, which are a subgroup of the jobless. The third one – named strict unemployment rate (U^s) – also considers as unemployed those underemployed.[12] The last one – named demographic unemployment rate (U^d) measures unemployment relatively to the working age population. Moreover, since the private and public sector labour market functions very differently from one another, the civilian unemployment rate (U^c) is also calculated. Although this rate is quite common in other countries, such as the U.S., it is not calculated in Brazil.

Figure 4 shows how the above rates would behave. Since the number of discouraged workers is very small the associated alternative unemployment rate is not shown, as it is virtually identical to the traditional rate.

Figure 4

Unemployment and Alternative Unemployment Rates



[11] The working age population is given by those persons that, in the last day of the reference week, are 10 years or older.

[12] This name is not very accurate, but I could not find a better one.

At this point it should be said that the adjustments proposed above do not actually solve the measurement problems listed before, since it is a very difficult task – probably impossible – to draw a precise line, for those pertaining to the inactive population, as to who should be considered unemployed and who don't. Indeed, many papers in the literature aim at testing hypotheses such as whether discouraged workers or those marginally attached to the labour force can be regarded as behaviourally equal to the unemployed [see Clark and Summers (1979), OECD (1995) and Jones and Riddell (1999)]. Even so, one hopes that those adjustments can improve the role of the unemployment rate as an indicator of labour market conditions.

The suggested adjustments hinged on the understanding that the way the unemployment rate is defined and measured leads to some problems. However, although a theoretically stronger measure is certainly most welcome, the main goal of the paper is to come up with alternatives labour market indicators that have a more solid link with inflation. This pragmatic requirement is crucial in policymaking. Indeed, it would be of little use for a central bank to use theoretically sounder unemployment measures if they do not add additional explanatory power over inflation developments.

Therefore, this paper also follows another route: besides building alternative unemployment rates, several disaggregated unemployment rates will be put under scrutiny to assess if they can explain inflation better than the aggregate rate. It is not only certainly possible but also theoretically plausible that the unemployment rate of some labour force groups is more informative about inflationary developments than the aggregate rate.

That could happen, for instance, if a given group is more tightly linked to the labour force (i.e. less frequent transitions to and from inactivity). Also, some groups could be less (more) relevant in wage setting decisions and, therefore, to inflation. For example, it has been argued that the long term unemployed are less relevant to wage formation than the recently unemployed (e.g. Blanchard and Wolfers, 2000). Similar logic could be applied to other disaggregated groups. For example, the level of extra hours worked are usually seen as one important indication of whether the labour market is too tight. Likewise, unemployment among certain groups could give early signals regarding emerging inflationary pressures.

Finally, other labour market indicators, such as the ratio between entrance wages and exit wages in the formal labour market, are also investigated. This ratio is taken by some Brazilian economists as being informative about inflationary pressures.

4 – Labour Market Indicators and Inflation

The main goal of the paper is to come up with better indicators of the state of the labour market than the traditional unemployment rate, which is known to have important shortcomings. Since the state of the labour market is widely recognized as being a key driver of inflation, it becomes clear that the contenders should be assessed by their capacity to explain inflation. Therefore, a natural theoretical framework to assess this link is the well-known Phillips curve.[13]

Before proceeding, however, it is needed to be said that although inflation is driven by fundamentals in the long run, it is affected by a myriad of factors in the short run. Among those, lie prominently supply and relative price shocks. The importance of shocks has been widely recognized in the literature (see Gordon, 1997).[14]

The relevance of such shocks has been paramount not only for explaining inflation dynamics in Brazil but also the persistence of high real interest rates. Indeed, the "wrong" slope that emerges for the inflation–unemployment link in the 1996–2006 period is a key evidence on the pervasiveness and importance of price shocks in Brazilian inflation (see da Silva Filho, 2008). Therefore, a failure in taking them appropriately into account not only will hinder the ability to explain inflation dynamics but mainly to uncover the true relation between inflation and labour market conditions. However, shocks are not directly observed and proxies should be used instead. Therefore, it is crucial to find good proxies.

Broadly speaking, three types of proxies are built. The first aims at capturing the *direct* effects of exchange rate shocks on inflation, either on nominal or real grounds. Within this group lie changes in the nominal and real exchange rate and the difference between those changes and inflation. The second type aims at measuring the *indirect* effects of changes in exchange rates on prices as well as the effects of

[13] Moreover, the Phillips curve is a reduced form relationship consistent with several economic theories.
[14] Indeed, this is the main rationale behind the construction of core inflation measures.

changes in relative prices between groups of goods. Some examples are the difference between tradable goods inflation and overall inflation and between tradable goods and non-tradable goods inflation. The third type of proxies tries to capture the most traditional supply shocks, such as food shocks and commodity prices shocks. Two examples are the difference between food inflation and aggregate inflation and between changes in the terms of trade and overall inflation.

Since the central bank's major interest lies on annual inflation rates, rather than on quarterly or monthly rates, the Phillips curve is defined in terms of annual inflation (see Gruen *et al.*, 1999). The general specification (assuming that the curve is vertical in the long run) can be stated as

$$\Delta\pi_t = \alpha(L)\Delta\pi_{t-1} + \beta(L)\left(u_t^k - u_t^{n(k)}\right) + \gamma(L)\boldsymbol{x}_t + \varepsilon_t, \quad \varepsilon_t \sim NID(0, \sigma_\varepsilon^2) \quad (1)$$

where: $\pi_t = \Delta_4 lnP_t \equiv lnP_t - lnP_{t-4}$ is annual IPCA inflation, u_t^k is the seasonally adjusted unemployment rates, $u_t^{n(k)}$ is the corresponding unobservable (and possibly time-varying) natural rate, while $\boldsymbol{x}_t \subset \{S_t^l\}$ is a vector of inflation shocks proxies (which have been normalised so that they have a zero net effect on the natural rate measurement). Finally, $\alpha(L)$, $\beta(L)$ and $\gamma(L)$ are lag polynomials, while $k \in$ {jobless rate, broad, unemployment rate, etc ...} indexes the labour market indicators and $l \in$ {exchange rate, terms of trade, food, etc ... } indexes the inflation shocks. Tables 3 and 4 in the Appendix 1 give a detailed account of the variables used. The data are measured on a quarterly basis and the estimation sample goes from 2002.3 to 2010.3.[15]

Note that if the natural rate of unemployment is constant then (1) can be expressed as follows

$$\Delta\pi_t = c + \alpha(L)\Delta\pi_{t-1} - \beta(L)u_t^k + \gamma(L)\boldsymbol{x}_t + \varepsilon_t, \quad \varepsilon_t \sim NID(0, \sigma_\varepsilon^2) \quad (2)$$

In this case equation (2) can be estimated by OLS and the natural rate can be easily calculated as $u_t^{n(k)} = -c/\beta(1)$.

[15] The sample begins in 2002 since it is the year when the new unemployment survey began to be carried out.

However, if the evidence suggests that the natural rate changed during the period analysed one can allow for that change by using the unobserved components (UC) framework and estimate the model using the Kalman filter. In this case a statistical model for the natural rate must be specified firstly. One popular statistical assumption is that it evolves according to a random walk. In this case the model is

$$\Delta\pi_t = \alpha(L)\Delta\pi_{t-1} + \beta(L)\left(u_t^k - u_t^{n(k)}\right) + \gamma(L)\boldsymbol{x}_t + \varepsilon_t \quad (3)$$

$$u_t^{n(k)} = u_{t-1}^{n(k)} + \xi_t \quad (4)$$

$$\varepsilon_t \sim NID(0, \sigma_\varepsilon^2),\ \xi_t \sim NID\left(0, \sigma_\xi^2\right) \text{ and } E(\varepsilon_t, \xi_t) = 0$$

Note that if $var(\xi_t) = 0$ then the model (3)–(4) reduces to model (2). One advantage of this framework is that the NAIRU can be allowed to vary without having to specify its determinants. However, this is also its main weakness, since if one cannot reliably identify the causes for the changes, they might just be reflecting other factors, such as model inadequacy.

4.1 – Empirical Results

A general-to-specific modelling strategy was used when searching for congruent parsimonious encompassing models (see Hendry, 1995). Five lags of each regressor were usually included in the general unrestricted model (GUM).

A large numbers of models were estimated and in most cases alternative labour market indicators were either insignificant or became insignificant when added to specifications that already contained the total unemployment rate. However, some alternative indicators not only did prove to be relevant in explaining inflation but dominated the traditional unemployment rate to the point that the latter became insignificant when added to models that already contained the former.

Table 1 lists the preferred specifications for those indicators that seem to be relevant in explaining inflation in Brazil, as well as one specification for the traditional Phillips curve (i.e. using the aggregate unemployment rate). It uncovers some interesting evidence.

First, the following alternative labour market indicators seem to provide relevant information about inflation: the jobless rate, the broad unemployment rate,

the unemployment rate among head of households, the unemployment rate among those with 50 years or older and the unemployment rate in commerce (columns 2 to 6).

Table 1
Phillips Curves Estimates Using Alternative Labour Market Indicators

Unemp. Measure	(1) **Aggregate**	(2) **Jobless**	(3) **Broad**	(4) **Head of Household**	(5) **50 Years or More**	(6) **Commerce**
$\sum_{i=i}^{5} \Delta\pi_{t-i}$		-0.52 *** [2, 4]	-0.74 *** [2, 3, 4]	-0.28 *** [3, 4, 5]	-0.15 *** [3]	-0.65 *** [2, 4]
$\sum_{i=0}^{5} S_{t-i}^{rel1}$	-0.12 *** [4]		-0.36 *** [0, 4, 5]	-0.44 *** [3]	0.50 *** [0.3]	-0.04 *** [0, 4]
$\sum_{i=0}^{5} \lvert S_{t-i}^{rel1} \rvert$	0.19 *** [4]				-0.51 *** [0, 4, 5]	-0.15 *** [4]
$\sum_{i=0}^{5} S_{t-i}^{trad2}$	0.05 *** [2]	0.10 *** [3, 4]	0.26 *** [5]		0.04 *** [2, 5]	-0.25 *** [1]
$\sum_{i=0}^{5} \lvert S_{t-i}^{trad2} \rvert$		-0.29 *** [4, 5]				
$\sum_{i=0}^{5} S_{t-i}^{food1}$	-0.03 *** [4]	-0.29 *** [4, 5]	0.05 *** [1, 3, 5]	0.08 *** [3]		0.24 *** [1, 3]
$\sum_{i=0}^{5} U_{t-i}^{k}$	-0.11 *** (-3.1) [0]	-0.15 *** (-7.6) [0]	-0.25*** (-7.9) [0]	-0.37 *** (-5.8) [0]	-0.49 *** (-7.0) [0]	-0.72 *** (-8.0) [0]
$\sum_{i=0}^{5} \Delta U_{t-i}^{k}$	-0.35 *** [3]	-1.71 *** [0, 2, 5]	-0.55 *** [2]	-2.60 *** [0, 2, 5]	0.08 *** [3, 4]	-0.44 *** [0, 2]
C	1.06	1.92	1.35	1.38	1.65	3.09
NAIRU	9.6%	12.5%	11.6%	3.8%	3.4%	4.3%
Sigma	0.19	0.23	0.24	0.25	0.20	0.22
AR 1-3	1.67 (0.21)	1.15 (0.36)	0.25 (0.86)	0.10 (0.96)	2.06 (0.15)	0.48 (0.70)
ARCH 1-3	0.12 (0.95)	0.66 (0.59)	1.37 (0.28)	1.75 (0.18)	0.56 (0.65)	1.82 (0.17)
Normality	2.32 (0.32)	0.67 (0.71)	0.89 (0.64)	1.26 (0.53)	0.49 (0.78)	0.00 (0.99)
Hetero	0.49 (0.89)	2.03 (0.13)	3.14 (0.10)	0.54 (0.88)	2.87 (0.06)	0.57 (0.86)
RESET	2.55 (0.10)	1.91 (0.18)	1.28 (0.31)	1.16 (0.34)	1.69 (0.22)	1.80 (0.20)

(*) Numbers in brackets below coefficients shows which lags enter the model, while those in parentheses below test statistics values give the associated p-value. Values in parentheses below alternative indicators' level estimates give the associated t-statistics. (*), (**) and (***) indicate significance at 10%, 5% and 1%, respectively.

The importance of the jobless and broad rates supports the assessment on the relevance of the fuzziness between the states of unemployment and inactivity. The significance of the unemployment rate among head of households – which is the group expected to be more tightly linked to the labour force – also confirms previous assessment on the likely superior informational content of certain disaggregated rates.

Note that this group is precisely the one cited by Blanchard and Diamond (1990) as an example of primary workers in their model. As to the unemployment rate among those aged 50 or more and the unemployment rate in commerce, they also seem to convey relevant information on inflation, although the reason for that is not immediately obvious.

One hypothesis could be that the former acts like a gauge of the intensity of labour demand, in the same way that extra hours do, since an important share of workers at that group are retired and may decide to go back to the labour force when labour market conditions are tight. As to the latter, commerce is the largest sector in the unemployment survey, and its dynamics could be more informative on inflation than other sectors. Moreover, in contrast to the industrial sector and similarly to the service sector, commerce was not so affect by the 2008 crisis, a fact that might help to explain why inflation did not fell much following the crisis. Also, the coefficient of variation of unemployment in commerce (along with in the service sector) is much smaller than in other sectors, which might reduce the noise of the indicator. Anyway, extra work is needed to investigate further those two results.

Second, and perhaps most importantly, in models 2 to 6 not only the non traditional rates are more significant than the aggregate unemployment rate (see t-values in parentheses below level coefficients estimates) but the magnitude of their effects on inflation is much larger. Indeed, in specifications 3 to 5 those effects are from two to six times larger than the effect of total employment, as shown in (1).

In this regard it is also worth noticing that the ratio of entrance wages to exit wages in the formal labour market, whether in the aggregate or in specific sectors, does not seem to be helpful in explaining inflation. This variable is pointed by many economists as being useful to predict inflation in Brazil.

Third, shocks are very important to explain inflation dynamics in Brazil. Among the several proxies tested three were consistently significant across models: tradable shocks, relative price shocks and food shocks. The former seems to be capturing the *final* effects of changes in the exchange rate on domestic CPI inflation, while the second reflects the inflationary effects of changes in relative prices between tradable and nontradable goods, a wedge that cannot be attributed only to movements in the former group. For both kinds of shocks the significance of their absolute values provide evidence suggesting that their effects on inflation are asymmetric, that is, a

positive shock does not have the same effect on inflation as a negative shock. Finally, food shocks also seem to be important in explaining inflation dynamics in Brazil.

Notice that exchange rate and terms of trade shocks were not found to be relevant. This absence can be explained by the fact that exchange rate effects are already being captured by their effects on the price of tradable goods. Indeed, shocks to the exchange rate are relevant only up to the point that they are transmitted all the way in the price chain. Of course, the exception concerns imported final goods. Since the Brazilian economy is relatively closed, this effect does not seem to be very relevant. The "non-relevance" of shocks to the terms of trade should also be put into perspective, since some of their effects are also captured by changes in the price of tradable goods.

Finally, the models pass in all diagnostic tests, including parameter constancy and the structural breaks test, as recursive graphs indicate (see Appendix 2). Therefore the evidence suggests that natural rates have remained reasonably constant during the period investigated and, therefore, there is no need to estimate model (3)–(4).[16]

6 – Conclusion

Despite its great popularity among the public and economists the aggregate unemployment rate has important shortcomings and, therefore, is not considered by labour economists as the best measure of the state of the labour market. As a consequence, the link between labour market conditions and inflation becomes blurred. This fact might help to explain the often found small role played by the total unemployment rate in traditional Phillips curves.

Given that diagnostic, the paper went deeper into labour market indicators, searching for indicators that better reflect labour market conditions. Three strategies were followed. First, to build alternative unemployment rates, trying to mitigate the problems listed above. Second, to assess the explanatory power of disaggregated unemployment rates over inflation. There are theoretical reasons to expect that some

[16] The estimate for the (aggregate) natural rate is greater than the ones found in Da Silva Filho (2008). Some factors have certainly contributed to that. First, the sample used here not only is different from the one used in the previous estimate, but uses only data from the new PME. Second, this sample includes the turbulent post-2007 period, since when measurement problems have been exacerbated, as argued in this paper. Therefore, the focus should be on the differences between the six specifications in Table 1 and, more specifically, on the evidence that the non traditional indicators listed there seem to be more informative about the inflation dynamics than the traditional aggregate unemployment rate.

of those rates might convey better information on labour market conditions and, therefore, on inflation, than the traditional unemployment rate. Third, to search for other labour market indicators that might also be useful in explaining inflation. This requirement is crucial, since the state of the labour market is widely recognized as being a key driver of inflation. Therefore, the contenders should be assessed by their capacity to explain inflation.

The evidence shows that some alternative unemployment rates such as the jobless rate and the broad unemployment rate – along with some disaggregated unemployment rates – seem to explain inflation better than the traditional unemployment rate. Also, the disaggregated rates that seem to be most robustly correlated to inflation are: the unemployment rate among head of households, the unemployment rate among those with 50 years or older and the unemployment rate in commerce.

The improvements compared to traditional Phillips curves are substantial, since not only the above rates are more significant than the traditional unemployment rate but their effects on inflation are much larger. Indeed, in some cases the coefficients are up to six times larger than the traditional effect.

Therefore, policymakers should not see the aggregate unemployment rate as the best (or only) indicator of labour market tightness. They should recognize its limitations and seek for alternative labour market indicators that could provide a better assessment on the inflation outlook, especially in turbulent times. This paper has uncovered some promising candidates.

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Appendix 1

Table 3: List of Labour Market Variables

Variable	*Definition*
U	*Total unemployment rate*: unemployed to labour force ratio
U^j	*Jobless rate*: rate that takes into account not only the unemployed but also those that said they were ready and willing to work.
U^b	*Broad unemployment rate*: rate takes into account the so-called marginally attached to the labour force.
U^s	*Strict unemployment* rate: underemployed are considered unemployed.
U^d	*Demographic unemployment rate*: unemployed to working age population.
U^c	*Civilian unemployment rate*: unemployment rate in the civil population.
U^m	Unemployment rate among men
U^w	Unemployment rate among women
U^h	Unemployment rate among head of household
U^o	Unemployment rate among other members of the household
U^{14}	Unemployment rate among men aged 10-14
U^{17}	Unemployment rate among men aged 15-17
U^{24}	Unemployment rate among men aged 18-24
U^{49}	Unemployment rate among men aged 25-49
U^{50}	Unemployment rate among men aged 50 or more
U^{8S}	Unemployment rate among men with 8 years or less of schooling
U^{10S}	Unemployment rate among men with 8-10 years of schooling
U^{11S}	Unemployment rate among men with 11 years or more of schooling
U^{30D}	Percentage of those unemployed for 30 days or less in total unemployment.
U^{180D}	Percentage of those unemployed for 31-180 days in total unemployment.
U^{360D}	Percentage of those unemployed for 181-360 days in total unemployment.
U^{361D}	Percentage of those unemployed for more than 360 days in total unemployment.
U^{30p}	Percentage of those unemployed for 30 days or less in the labour force.
U^{180p}	Percentage of those unemployed for 31-180 days in the labour force.
U^{360p}	Percentage of those unemployed for 181-360 days in the labour force.
U^{361p}	Percentage of those unemployed for more than 360 days in the labour force.
U^M	Unemployment rate in the manufacturing sector
U^C	Unemployment rate in the construction sector
U^{Co}	Unemployment rate in the commerce sector
U^S	Unemployment rate in the service sector
U^{OS}	Unemployment rate in other services sector
U^D	Unemployment rate among maids
H^{14}	Percentage of employed working less than 14 hours per week.
H^{39}	Percentage of employed working 15-39 hours per week.
H^{44}	Percentage of employed working 40-44 hours per week.
H^{45}	Percentage of employed working more than 45 hours per week.
R	Entrance to exit wages ratio in the economy (formal labour market)
R^P	Entrance to exit wages ratio in the private sector (formal labour market)
R^M	Entrance to exit wages ratio in manufacturing (formal labour market)
R^E	Entrance to exit wages ratio in mineral extraction (formal labour market)
R^C	Entrance to exit wages ratio in construction (formal labour market)
R^{Co}	Entrance to exit wages ratio in commerce (formal labour market)
R^S	Entrance to exit wages ratio in services (formal labour market)

Table 4: Selected Proxies for Supply and Relative Price Shocks*

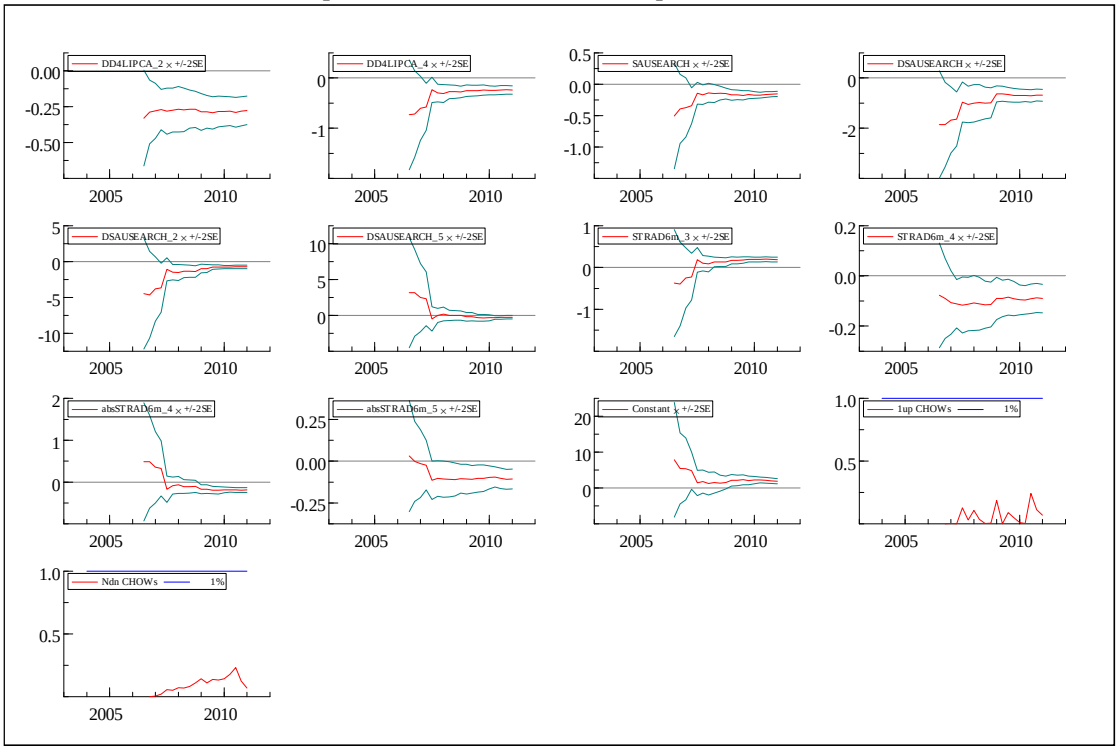
Shock	*Definition*
S_t^{ner}	$\Delta ln(NER_t) - \Delta ln(IPCA_t)$
S_t^{reer}	$\Delta ln(RER_t) - \Delta ln(IPCA_t)$
S_t^{tt}	$\Delta ln(TT_t) - \Delta ln(IGPDI_t)$
S_t^{trad1}	$\Delta ln(IPCA_t^{trad}) - \Delta ln(IPCA_t)$
S_t^{trad2}	$\Delta ln(IPA_t) - \Delta ln(IGPDI_t)$
S_t^{ntrad}	$\Delta ln(IPCA_t^{ntrad}) - \Delta ln(IPCA_t)$
S_t^{adm1}	$\Delta ln(IPCA_t^{adm}) - \Delta ln(IPCA_t^{ntrad})$
S_t^{rel1}	$\Delta ln(IPCA_t^{trad}) - \Delta ln(IPCA_t^{ntrad})$
S_t^{rel2}	$\Delta ln(IPCA_t^{adm}) - \Delta ln(IPCA_t^{free})$
S_t^{food1}	$\Delta ln(IPA_t^{agr}) - \Delta ln(IPCA_t)$
S_t^{food2}	$\Delta ln(IPA_t^{agr}) - \Delta ln(IGPDI_t)$
S_t^{ind}	$\Delta ln(IPA_t^{ind}) - \Delta ln(IGPDI_t)$

(*) IPCA, IGPDI and IPA are acronyms for the Broad Consumer Price Index, General Price Index and Wholesale Price Index, respectively. $IPCA_t^{trad}$. $IPCA_t^{ntrad}$. $IPCA_t^{free}$ and $IPCA_t^{adm}$ are acronyms for tradable, non-tradable, free-prices and administered prices inflation in the IPCA, respectively. IPA_t^{agr} and IPA_t^{ind} measures agriculture and industrial inflation in the IPA. The IGPDI is a weighted average of the IPA (60%), IPC (Consumer Price Index) (30%) and INCC (Civil Construction National Index) (10%). The IPCA is calculated by the Brazilian Institute of Geography and Statistics (IBGE), while the IGPDI is calculated by the Getulio Vargas Foundation (FGV). NER and RER indicate nominal exchange rate and real exchange rate, respectively. TT stands for terms of trade. Other proxies, not listed here, were also used in estimations. All proxies are expressed as deviations from their means.

Appendix 2

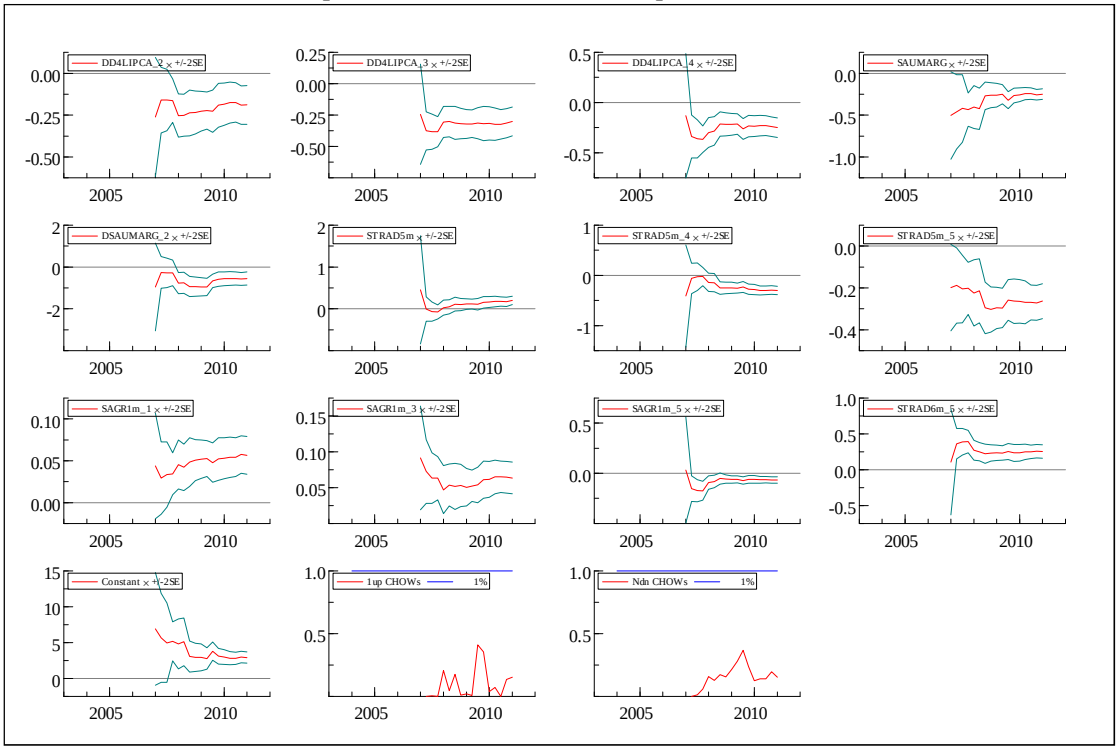
Model 2

Recursive estimates, 1-Step Residuals +/- 2 S.E., 1-Step Chow Test, Break-Point Chow Test



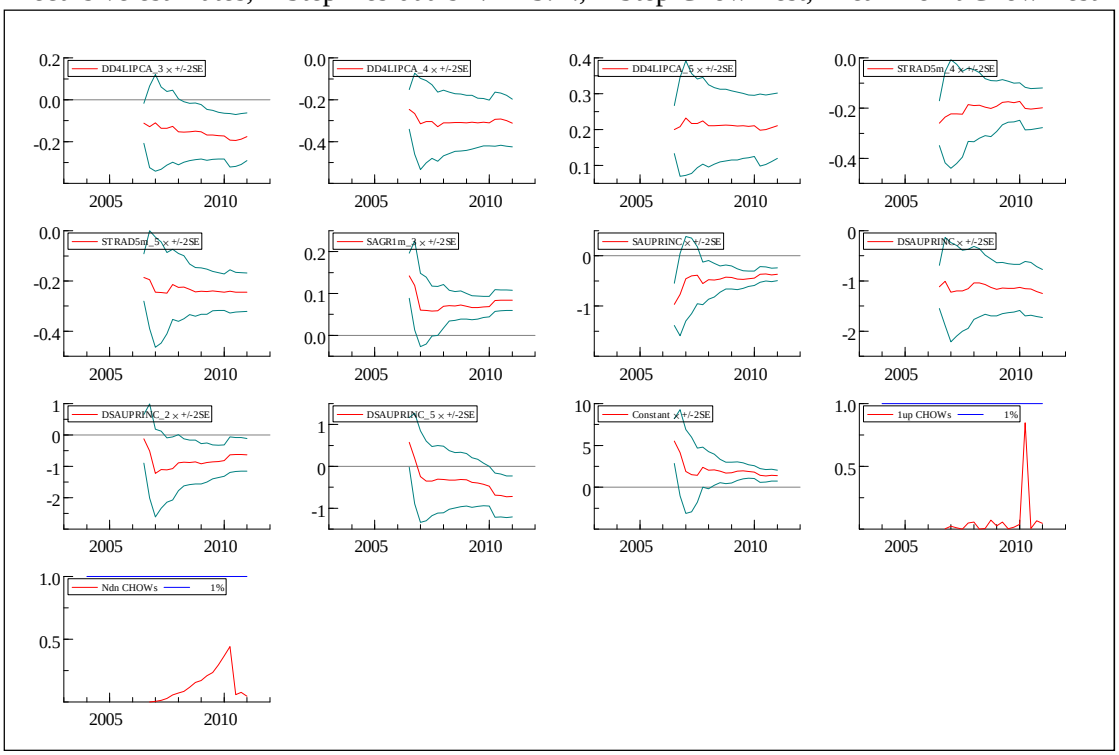
Model 3

Recursive estimates, 1-Step Residuals +/- 2 S.E., 1-Step Chow Test, Break-Point Chow Test



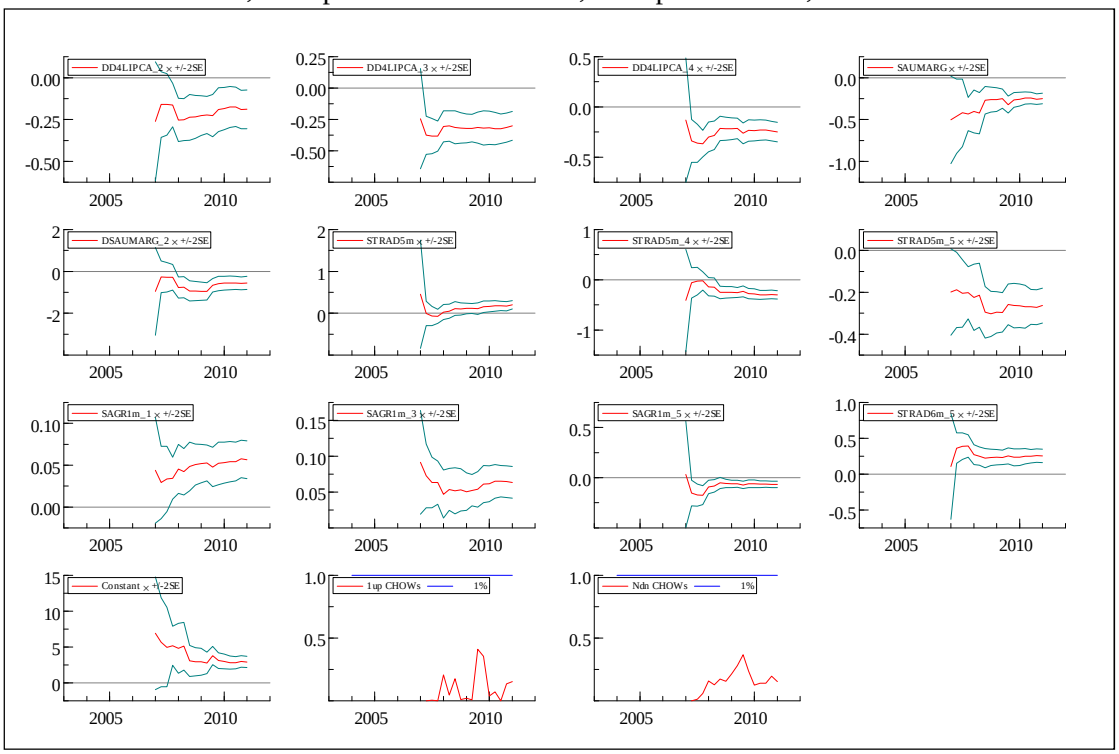
Model 4

Recursive estimates, 1-Step Residuals +/- 2 S.E., 1-Step Chow Test, Break-Point Chow Test



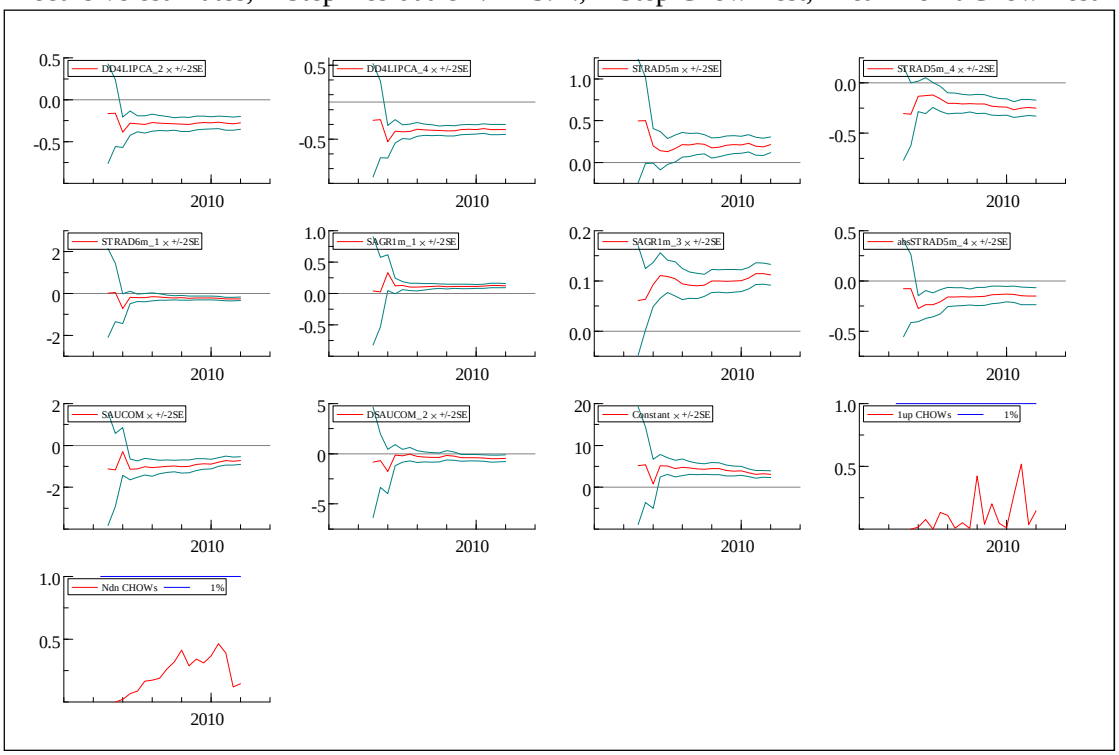
Model 5

Recursive estimates, 1-Step Residuals +/- 2 S.E., 1-Step Chow Test, Break-Point Chow Test



Model 6

Recursive estimates, 1-Step Residuals +/- 2 S.E., 1-Step Chow Test, Break-Point Chow Test



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