Dynamics of Output and Employment in the U.S. Economy

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Abstract
This paper investigates the changing relationship between employment and real output in the U.S. economy from 1948 to 2010 both at the aggregate level and at some major industry-grouping levels of disaggregation. Real output is conventionally measured as value added corrected for price inflation, but there are some industries in which no independent measure of value added is possible and existing statistics depend on imputing value added to equal income. Indexes of output that exclude these imputations are closely correlated with employment over the whole period, and remain more closely correlated during the current business cycle. This analysis offers insights into deeper structural changes that have taken place in the U.S. economy over the past few decades in a context marked by the following three factors: (i) the service (especially the financial) sector has grown in importance, (ii) the economy has become more globalized, and (iii) the policy orientation has increasingly become neoliberal. We demonstrate an economically significant reduction in the coefficient relating employment growth to output growth over the business cycles since 1985. Some of this change is due to sectoral shifts toward services, but an important part of it reflects a reduction in the coefficient for the goods and material value-adding sectors.

JEL Codes: E12, E20.
Keywords: Okun’s Law; Kaldor-Verdoorn Effect; Global restructuring; measurement of real output.

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1 Introduction

One of the many remarkable challenges to received economic ideas posed by the financial and economic crisis that hit the capitalist world in 2007 is the fact that widely accepted models of output-employment dynamics badly missed the mark in predicting the shape of the downturn and recovery in the U.S. and other advanced capitalist economies. The two U.S. business cycles preceding the 2007 crisis exhibited “jobless recoveries”, in which employment rose much more slowly relative to measures of output such as real Gross Domestic Product (GDP) than models predicted. The 2007 – 8 crisis added another dimension to this anomaly, showing that GDP could be disconnected from unemployment in downturns as well as recoveries. In 2009, the official unemployment rate in the U.S. rose about twice what would have been predicted by conventional models of output-employment dynamics, given measured declines in output; another way of stating the same phenomenon is that in the downturn of 2009, the fall in GDP was far lower than what would have been predicted by conventional models given the increase in the aggregate unemployment rate. The pattern of jobless recoveries has also reasserted itself: the increase in real GDP since the official end of the Great Recession in the second quarter of 2009 has had even less impact proportionately on the aggregate unemployment rate than in the previous two jobless recoveries.

As we document in this paper, the close relationship between output growth as measured by real GDP and employment generation that characterized the U.S. economy over the two decades after World War II has been weakening since the mid 1980s. This has led both to jobless recoveries in which aggregate unemployment has decreased less during the upturn phase of business cycles than what would have been predicted on the basis of the past association between output growth and unemployment changes, and also to severe job-loss downturns in which the aggregate unemployment rate has increased by more during the downturn phase of the business cycle than past experience would have predicted. Thus, what seems to be at issue is a changing relationship between aggregate demand as measured by real GDP and employment over the whole business cycle.

The political economic implications of this change are far-reaching in both a short- and long-run perspective. As an immediate political issue, persistently high unemployment rates, in the face of modest real GDP growth and high profits,\textsuperscript{1} had an enormous effect on the 2010 mid-term elections in the U.S.\textsuperscript{2}

From a longer term labor perspective, the weakening of the relationship between measured real GDP growth and employment poses serious questions about the social and political viability of what we will call “neoliberal” globalizing strategies for economic development in the U.S. and other economies. These neoliberal strategies include liberalization of international trade and capital flows, deregulation of financial markets and institutions, reliance on inflation-targeting monetary policy, privatization of traditionally public sector economic functions, weakening of job security and workers’ rights to organize, reduction in job safety

\textsuperscript{1}Even as the 2010 unemployment rate remained stuck above 9%, U.S. corporate profits increased at record rates: http://economix.blogs.nytimes.com/2010/11/12/a-high-water-mark-for-profits/

\textsuperscript{2}http://thecaucus.blogs.nytimes.com/2010/07/19/mystery-for-white-house-where-did-the-jobs-go/?emc=etal
and health protection, and unqualified reliance on markets for the allocation of social resources. Understanding the changing relationship between output conventionally measured as real GDP and job creation and unemployment is a necessary first step in fashioning policies that can simultaneously generate growth in employment and protect labor interests such as the right to collective bargaining, adequate wages and benefits, acceptable working conditions, and adequate and secure pensions, within the framework of democratic political institutions as alternatives to neoliberal economics.

What lies behind the changing relationship between real output and employment in the U.S. and other advanced capitalist economies? This paper investigates this question in several steps. First, we document the relationship between the rapid growth of tertiary “service” industries and changes in employment-output dynamics. We provide evidence that the discrepancy between predictions based on historical experience and actual changes has been growing, not only in the 2007-2009 recession but also over the previous three business cycles. An important feature of this discrepancy is the growing importance of industries, such as Finance, Insurance and Real Estate (FIRE) where, in the absence of a measurable industry output, measures of output are imputed in the NIPA accounts on the basis of incomes. A Measurable Value Added (MVA) index of output that excludes these industries is more closely related to changes in employment over recent business cycles than is real GDP. While MVA has a high overall correlation with real GDP over much of the post-WWII period, there is evidence that this correlation is weaker at business cycle frequencies, and has been falling over recent business cycles. Thus one explanation for jobless recoveries and severe job-loss downturns is that the most widely used index of real output, real GDP, is drifting further and further from reporting changes in aggregate demand that lead to changes in employment.

We also examine the evolution of the relation between employment and output in industries where there are independent measures of value-added output and income, using the broad framework of the “Kaldor-Verdoorn effect”. We find that the elasticity of employment with respect to output in these industries has been falling over recent business cycles. Thus in addition to the fact that real GDP does an increasingly bad job of measuring aggregate demand, there appears to be a weakening link between aggregate demand and employment in the U.S. economy.

We evaluate one theory that has been advanced in the literature to explain the phenomenon of jobless recoveries, increasing “flexibilization” of labor markets, and find it not well-supported by the evidence. Finally, we offer some alternative hypotheses regarding the changing relationship between real output and employment in the U.S. economy as a way of understanding deeper processes of structural change taking place in the U.S. economy and its relation to the world economy under the neoliberal regime of financial globalization.

We find that the service industries tend to have a lower responsiveness of employment to output than non-service industries, in part because output is hard to measure in some service industries and incomes in service industries such as FIRE are weakly related to aggregate demand. As a result we would expect the economy-wide responsiveness of employment to output to fall as services grow as a fraction of GDP. But we also find strong evidence that
there has been a significant decline in the sectoral responsiveness of employment to output
in goods and more generally value-adding sectors of the economy, which points to a change
in the structure of U.S. production. We associate this change with the restructuring of the
U.S. economy due to globalization of production.

The rest of the paper is organized as follows: section 2 presents evidence relating to
structural change in the U.S. economy over the postwar period; section 3 investigates the
changing relationship between output and employment at disaggregated industry levels, in-
troducing our empirical model; section 4 highlights the discrepancy in the current and the
previous two recessions between predicted and actual employment (or output) changes; sec-
tion 5 presents some regression-based evidence about the changing employment-output link-
age over the postwar business cycles; section 6 looks at three different explanations for the
weakening employment-output linkage; the last section concludes the discussion. Appendix A
presents details of the construction of the data used for the analysis and some results related
to endogeneity.

2 Sectoral and Aggregate Growth

We begin our analysis by documenting two key features of the structural changes that have
taken place in the post-War U.S. economy: changing distribution of real output and employ-
ment across broad sectors and industries. To do so we use the Annual Industry Accounts of
the U.S. Bureau of Economic Analysis (BEA) that provides consistent annual data for gross
value added and employment at the industry level harmonized across time according to the
2002 NAICS codes.\textsuperscript{3}

2.1 Sectoral Shares

Figure 1 can be used to understand the changing distribution of output and employment
across the various sectors and industries of the U.S. economy. The first row of Figure 1
provides information about three broad divisions of the U.S. economy: the private goods-
producing industries, the private services-producing industries and the private industries
involved in measurable value-addition.

Private goods-producing industries are composed of the following industries: agriculture,
forestry, fishing, and hunting; mining; construction; and manufacturing. Private services-
producing industries, on the other hand, comprise the following industries: utilities; whole-
sale trade; retail trade; transportation and warehousing; information (publishing, motion
picture and sound recording, broadcasting, information and data processing); finance and
insurance; real estate and rental and leasing; professional, scientific and technical services;
management of companies and enterprises; administrative and waste management services;
educational services; health care and social assistance; arts, entertainment, and recreation;
accommodation and food services; and other services, except government.

\textsuperscript{3}Details about this and other data sets used in the paper are collected together in Appendix A.
The distinction between goods-producing and services-producing industries is useful for certain purposes, but it is conceptually unsatisfactory from a Marxian or classical political economy perspective that distinguishes productive and unproductive labor. Some of the service industries such as wholesale and retail trade, realize the final value of produced commodities, and it is more consistent to regard their value added as part of commodity production. Service industries, such as utilities and transportation and warehousing transform the use-value of inputs and add value like commodity producing industries. Some other service sectors such as information services, administrative and waste management services, and arts, entertainment, accommodation and food services produce a measurable output without imputations. The classification of industries into goods-producing and services-producing sectors does not distinguish between value-adding (or productive) sectors and value-realizing (or unproductive) sectors. Hence we have constructed a category of industries which produce an independently measurable value-added, which we term Measurable Value Added (MVA). This “value-adding sector” is composed of sectors where a tangible output (good or service) is sold in the market for a price and hence the value added figure is measurable without imputations. The MVA category is composed of the following industries from the AIA: agriculture; mining; utilities; construction; manufacturing; wholesale trade; retail trade; transportation and warehousing; information services; administrative and waste management; art, entertainment, accommodation and food services.

The first row of Figure 1 shows the transformation of the U.S. economy into a “service economy”: the share of the goods-producing industries, both in terms of value added and employment, has witnessed a secular decline.

The second row of Figure 1 takes a look at the U.S. economy at a more disaggregated level and comes up with several interesting trends. First, the manufacturing sector has witnessed a spectacular decline in terms of both value added and employment; while the manufacturing sector was the largest component of the U.S. economy in the early 1950s, both in terms of value added and employment, it has been overtaken by key service-producing industries in both respects. By the mid-1980s the finance, insurance and real estate (FIRE) sector had overtaken manufacturing as contributing the largest share of GDP; by the mid-2000s, the professional and business services (PBS) sector had similarly overtaken the manufacturing sector. In terms of the share of total employment, the same process was delayed by about two decades: only in the late 1990s did the PBS sector employ more workers than manufacturing.

Second, the FIRE sector has increased its share of value added much more steadily than its share of total employment. In fact, the share of employment accounted for by the FIRE sector has stagnated since the mid-1980s, but the share of output contributed by this sector has continued increasing right till the mid-2000s. A similar, though less pronounced, trend can be observed in both the PBS and information services (INF) sectors too.

We use the following industry-level abbreviations: ALL: the whole economy; PVT: the private industries; PGD: private goods-producing industries; PSV: private services-producing industries; MVA: the value-adding industries; CNS: construction; MFG: manufacturing; WTD: wholesale trade; RTD: retail trade; TWR: transportation and warehousing; INF: information; FIR: finance, insurance and real estate; PBS: professional and business services; EHS: education and health services; ART: art, entertainment, accommodation and food services; OTH: other services.
Third, among the goods-producing industries, only construction (CNS) industries has managed to retain its share, both in terms of value added and employment; in fact, its share of total employment has witnessed a small increase since the early 1990s.

2.2 Real GDP and Real MVA

MVA is a consistent alternative to GDP for the measurement of the value of gross output. Under this convention the incomes generated in the service sectors excluded from MVA would be treated as transfers, without being added to the product side of the accounts as imputations. The aggregate economy as measured by MVA is smaller than as measured by GDP due to the exclusion of these imputations. In 2009 MVA was 42\% of GDP.

If MVA were a constant proportion of GDP over time, it would not make much difference which measure we used. But over the post-WWII period, MVA deflated by broad indexes of prices such as the GDP deflator has been growing more slowly than real GDP. How does real GDP, compare with real MVA over time? To answer this question, we have tabulated (average annual compound) growth rates for the whole economy (ALL), the private sector (PVT), both using real GDP categories, and the value-adding part of the economy (MVA) for different time periods in Table 1.

Several interesting facts emerge from Table 1. First, the growth rate of real MVA was considerably lower than the growth rate of real GDP either for the whole economy or the private sector: between 1948 and 2008, the real GDP for the whole economy grew at an average rate of 3.34 per cent per annum; the real MVA of the economy grew, for this period, at only 2.62 per cent per annum. The ratio of the two growth rates was about 0.78. Given the growing importance of incomes generated in industries such as FIRE, PBS, and EHS over this period, it is not surprising that the inclusion of these incomes as imputed output raises the measured growth rate.

Second, the growth rate differential widened during the neoliberal period, which we regard as 1980–2008. Between 1948 and 1973, the so-called Golden Age of capitalism, the growth rate of real MVA was about 82.66 per cent of the growth rate of real GDP; between 1980 and 2008, the neoliberal era, the growth rate of real MVA was only 72.91 per cent of the growth rate of real GDP. This implies that the value-transferring (or value-wasting) part of the economy has grown relative to the value-adding part during the neoliberal era. The picture is even more pronounced if we restrict ourselves to the private sector of the economy. If, as we will argue, real MVA is more closely linked both to aggregate demand and output, this growing gap between real MVA and real GDP is an important factor in the failure of historic patterns of employment-output dynamics to appear in recent business cycles when output is measured by real GDP.

2.3 Real NMVA and employment

We would now like to show that real MVA is as closely correlated with employment as real GDP over the whole post-WWII period in the U.S and more closely correlated over the
Figure 1: Changing Sectoral Distribution of Output and Employment, 1948-2009
Table 1: Average Annual Compound Growth Rates

<table>
<thead>
<tr>
<th>Period</th>
<th>ALL</th>
<th>PVT</th>
<th>MVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948-08</td>
<td>3.34</td>
<td>3.31</td>
<td>2.62</td>
</tr>
<tr>
<td>1948-1973</td>
<td>3.98</td>
<td>3.81</td>
<td>3.29</td>
</tr>
<tr>
<td>1980-2008</td>
<td>2.99</td>
<td>3.02</td>
<td>2.18</td>
</tr>
<tr>
<td>1950-59</td>
<td>3.62</td>
<td>3.34</td>
<td>2.66</td>
</tr>
<tr>
<td>1960-69</td>
<td>4.65</td>
<td>4.46</td>
<td>4.12</td>
</tr>
<tr>
<td>1970-79</td>
<td>3.57</td>
<td>3.81</td>
<td>3.59</td>
</tr>
<tr>
<td>1980-89</td>
<td>3.39</td>
<td>3.40</td>
<td>2.27</td>
</tr>
<tr>
<td>1990-99</td>
<td>3.32</td>
<td>3.52</td>
<td>3.06</td>
</tr>
<tr>
<td>2000-08</td>
<td>2.15</td>
<td>2.06</td>
<td>1.29</td>
</tr>
</tbody>
</table>

last three business cycles.\(^5\) Unfortunately consistent estimates of MVA are available only at annual frequency over the whole post-WWII period, due to changes in the industrial classification used by the BEA.

Thus we concentrate in this section on a Narrow Measured Value Added (NMVA) aggregate, which is calculated by removing GOV, FIRE, Other Services and Rest of the World (ROW) from nominal National Income (NI) and adjusting for inflation by dividing the resulting nominal value added by the GDP deflator.\(^6\) NI and NMVA are reported consistently with each other on a quarterly basis by the BEA. Moreover, real NI is a very close proxy to real GDP.

Both NI and NMVA correlate closely with U.S. Nonfarm Employment over the post-WWII period from 1948–2010, as Figure 2 shows.

Figure 2 also shows that the relationship between aggregate demand as measured by either NI or NMVA and employment shifted downward noticeably after 2000 (though on this scale the effect appears rather small).

A closer look at the 2001–2010 quarterly data is provided in Figure 3.

Figure 3 shows that the historical NI-employment relationship is a much poorer guide to aggregate-demand-employment dynamics after 2001 than the historic NMVA-employment relationship. An analyst using NI as a measure of aggregate demand would have seriously overestimated employment, while an analyst using NMVA as a measure of aggregate demand would have estimated employment considerably more accurately. Something like this seems to have happened in the formulation of fiscal and monetary policy in the immediate aftermath of the financial crash in the Fall of 2008.

Both NI and NMVA have strong historical correlations with employment. The correla-

\(^5\)Parts of this section closely parallel the discussion in Foley (2011).

\(^6\)Thus NMVA includes Agriculture, Mining, Manufacturing, Construction, Transportation and public utilities, Wholesale Trade and Retail Trade. The value added realized in Wholesale and Retail Trade can be regarded as part of the value added in productive sectors.
Figure 2: NI (blue) and NMVA (red) are plotted on the horizontal axis, with the corresponding quarter’s U.S. Nonfarm Employment on the vertical axis. The dashed lines show the fits for data up to 2000.

Figure 3: The 1947-2000 fitted relation between NI (blue) and NMVA (red) together with quarterly points from 2001Q1 to 2010Q4.
tion of NMVA with employment continued to hold in the last two business cycles. There is, however, a cyclical component to the deviation of NI from NMVA. NI shows smaller cyclical downturns than NMVA, and more rapid recoveries. This cyclical deviation appears to have increased in magnitude, at least over the last two U.S. recessions. As a result cyclical NI fluctuations have deteriorated as a guide to employment fluctuations in the U.S. economy. If the goal is to understand the severity of business cycles as fluctuations in aggregate demand and the impact of aggregate demand on employment, NMVA is a better choice than NI as an index. The superiority of NMVA as a business cycle and employment indicator is understandable because narrow measured value added is much more closely related to aggregate demand than the imputed value added in service industries like FIRE, which, as we have seen, have a growing weight in NI and GDP.

3 Employment and Output at the Industry Level

3.1 Empirical Model

We now turn to an investigation of the changing relationship between output and employment, not only at the aggregate level but also at more disaggregated, industry, levels. There are two distinct strands of the literature that can be used to study the changing relationship between output and employment, the Okun’s Law (OL) literature and the Kaldor-Verdoorn (KV) literature. The OL literature studies the relationship between growth rate of aggregate output and changes in the unemployment rate; the KV literature, on the other hand, investigates the relationship between the growth rate of output and growth rate of employment (or productivity). We choose to work within the Kaldor-Verdoorn tradition for three reasons.

First, Okun’s Law as a theoretical relationship is a reduced form relationship; it does not have any deeper theoretical underpinning other than the simple idea that producing output requires the use of labour power. The Kaldor-Verdoorn Law, on the other hand, can be derived from more primitive theoretical ideas; hence, it can be plausibly understood as a structural relationship obtaining in capitalist economies and has been used as such within the heterodox macroeconomics tradition, for instance as a “stylized fact” in the Dixon-Thirlwall (1975) model.\footnote{The Kaldor-Verdoorn relationship can be derived in several ways. For instance, it can be arrived at by combining Kaldor’s technical progress function with an accelerator type relationship. It can also be derived by formalizing Allyn Young’s ideas about increasing returns to scale within a neoclassical aggregate production function framework (McCombie, Pugno and Soro, 2002).}

Second, Okun’s Law-type analyses establish a relationship between the growth of output and changes in the aggregate unemployment rate, the relationship being mediated through changes in the labour force participation rate. Thus, the Okun coefficient, can change if the labour force participation rate changes with the relationship between output growth and employment remaining unchanged. The Okun’s Law framework is therefore not suitable if one is interested in primarily investigating the relationship between output growth and employment changes. The Kaldor-Verdoorn tradition, on the other hand, by directly focusing
on the relationship between output growth and employment growth offers precisely such a framework.

Third, while the Okun’s Law-type analysis is pitched at the aggregate level, the Kaldor-Verdoorn framework naturally allows for analysis at more disaggregated levels. Since, in the absence of a sectorally captive labour force, unemployment rates cannot be meaningfully defined at the industry level Okun’s Law type analysis cannot be naturally extended from the aggregate to the industry levels.  

We use a dynamic version of the Kaldor-Verdoorn regression equation in Kaldor (1966) to study the changing relationship between output and employment in the post-war U.S. economy:

\[ g_t^E = \alpha + \beta g_t^Y + \sum_{i=1}^{n} \gamma_i g_{t-i}^Y + \sum_{j=1}^{m} \delta_j g_{t-j}^E + u_t, \]  

where \( g_t^E \) stands for growth rate of employment, \( g_t^Y \) stands for the growth rate of real output, \( u_t \) stands for an error term.

There are two parameters of interest that emerge from the estimation of (1), one which measures the contemporaneous effect of output growth on employment growth and the other that captures the long run impact of output growth on employment growth. On the one hand, the crucial parameter, \( \beta \) in (1), measures the partial effect of output growth on employment output; \( \beta \) gives the change in the growth rate of employment that will result from a one percentage point change in the growth rate of real output; we will call this the short run (or contemporaneous) Kaldor-Verdoorn (KV) coefficient. On the other hand, the long run impact of output growth on employment growth can be measured by \( \beta^* \), where

\[ \beta^* = \frac{\beta + \sum_{i=1}^{n} \gamma_i}{\left(1 - \sum_{j=1}^{m} \delta_j\right)}; \]  

\( \beta^* \) gives the change in the growth rate of employment that will result from a one percentage point change in the growth rate of real output when we allow the effect to completely work itself out over time, i.e., allowing lagged effects to kick in.

### 3.2 Some Specification Issues

The model in (1) is similar in structure to what is referred to in the literature as the dynamic version of Okun’s Law (Knotek, 2007; IMF, 2010); dynamics is allowed into the model through two channels: lagged independent variable and lagged dependent variable. The first specification issue that we wish to discuss is related to the question of whether lagged dependent variables should be included in the empirical model.

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8 An exception is Palley (1993), which presented a multi-sector approach to Okun’s Law.

9 In the context of Okun’s Law-type analyses, a parameter like \( \beta^* \) is known as dynamic beta; for details on dynamic betas see, International Monetary Fund (2010).
Despite its wide use in the literature, we believe that there are serious drawbacks to including lags of the dependent variable in a model like (1) when the sample size for estimation is not very large. In a time series setting, inclusion of lagged dependent variables violate key exogeneity assumptions and make the OLS (ordinary least squares) estimates of the parameters inconsistent. Though the inclusion of lagged dependent variables can be justified in a large sample setting, our focus on business cycle length time periods for estimation of the model recommends that we avoid including lagged dependent variables. Often times, inclusion of lagged dependent variables is justified as a mechanism for dealing with problems of serial correlation in the errors; this is not necessary as heteroskedasticity and autocorrelation consistent (HAC) standard errors can be used to deal with problems of serial correlation of errors without, at the same time, introducing the problems of inconsistent estimation that comes with lagged dependent variables. Hence, the focus of our analysis will be on the model without lagged dependent variables; on the other hand, we will allow for two lags of the independent variable to capture dynamic effects. Hence, the model we estimate is

$$ g_t^E = \alpha + \beta g_t^Y + \gamma_1 g_{t-1}^Y + \gamma_2 g_{t-2}^Y + u_t, $$

(3)

with the contemporaneous Kaldor-Verdoorn coefficient given by $\beta$ and the long run Kaldor-Verdoorn coefficient given by

$$ \beta^* = \beta + \gamma_1 + \gamma_2. $$

(4)

Even in the model without lagged dependent variables, we need to address one important specification issue: possible endogeneity of the growth rate of output in (3). Rowthorn (1975b) and Skott (1999) have pointed to the possibility of the endogeneity of growth rate of output in a regression like (3) and have asserted that single-equation estimation methods are thereby invalid. To address this issue, we report results from two statistical tests of the endogeneity of the growth rate of output in (3): the HAC score test (Wooldridge, 1995) and the C-statistic type test of endogeneity (Hayashi, 2000). The idea behind both tests derives from Hausman (1978) and relies on comparing key statistics that would be “close” to each other for cases with and without endogeneity of the relevant regressor. The null hypothesis, in both cases, is that the relevant regressor – growth rate of output, in our case – is exogenous and large p-values imply that the null cannot be rejected. Table (6) and (5) in Appendix A report the p-values from these tests for the nine post-War business cycles and the six major sectors that are studied in this paper.\footnote{This analysis uses quarterly data; for details of the construction of the data set, see Appendix A.} In an overwhelming number of cases, the high p-value suggest that the null hypothesis – exogenous rate of growth of output – cannot be rejected. This implies that estimating the parameters of (1) by OLS gives reasonably accurate estimates of the “true” KV coefficients, both short run and long run. That the instruments used for the endogeneity tests are indeed exogenous can be seen from the results reported in Table (7) in Appendix A which reports p-values from Hansen’s overidentification test; for this test, the null hypothesis is that the instruments are exogenous and thus large p-values imply that the null cannot be rejected at standard levels of statistical significance.
4 The Discrepancy in the Current Recession

We are now ready to turn to one of the motivating questions of this paper: the startling discrepancy between employment-output dynamics in the current recession and what one would expect on the basis of past trends.

To highlight the discrepancy between actual and “predicted” employment changes, we compute out-of-sample forecast for the average annual compound growth rate of employment allowing for lagged effects of observed output growth rates and compare it to observed growth rates of employment during the same period. To fix notations, suppose, starting in period $t$, a downturn lasts for $n$ quarters. Let $g_{t+k}^E$ and $\hat{g}_{t+k}^E$ denote the actual and forecast quarter-over-quarter growth rate of employment between quarter $t+k-1$ and $t+k$ respectively, where $k = 0, 1, \ldots, (n-1)$, and forecasting is done using model (3) with a data set extending over the previous peak-to-peak business cycle.

The actual average annual compound growth rate of employment in the downturn, $\bar{g}^E$, is given by

$$\bar{g}^E = \left\{ \sqrt[n]{(1 + g_{t}^E)(1 + g_{t+1}^E)(1 + g_{t+2}^E)(1 + g_{t+3}^E)(1 + g_{t+n-1}^E)} - 1 \right\} \times 400;$$

on the other hand, the forecast average annual compound growth rate of employment in the downturn, $\hat{\bar{g}}^E$, is given by

$$\hat{\bar{g}}^E = \left\{ \sqrt[n]{(1 + \hat{g}_{t}^E)(1 + \hat{g}_{t+1}^E)(1 + \hat{g}_{t+2}^E)(1 + \hat{g}_{t+3}^E)(1 + \hat{g}_{t+n-1}^E)} - 1 \right\} \times 400. \quad (5)$$

For instance, for computing the forecast average annual peak-to-trough employment growth rate for the 1991 recession, the model in (3) is estimated with a data set that runs from 1980Q1 to 1990Q3. The estimated parameters are then used to compute forecast growth rates for each of the quarters in the recession using (3). The forecast average annual growth rate of employment is then computed with the help of (5). Figure 4 plots $\bar{g}^E$ and $\hat{\bar{g}}^E$ for all the post-war downturns for the 6 industry grouping under investigation.\footnote{In this paper, we use NBER dates for business cycle turning points.}

The comparison of the recovery period between actual and forecast employment growth is carried out in a similar manner. Since, at the time of writing, data was available for the current recovery for only a 5 quarter period after the trough in 2009Q2, we have chosen to focus on a 5 quarter period after each trough to compare the forecast and actual growth rates of employment during the recovery period. For a 5 quarter recovery after the trough starting in period $t$, the actual average annual compound growth rate of employment during the recovery, $\tilde{g}^E$, is given by

$$\tilde{g}^E = \left\{ \sqrt[5]{(1 + g_{t}^E)(1 + g_{t+1}^E)(1 + g_{t+2}^E)(1 + g_{t+3}^E)(1 + g_{t+4}^E)} - 1 \right\} \times 400;$$
Figure 4: Actual Versus Predicted Average Annual Compound Growth Rate (%) of Employment: Peak-to-Trough
<table>
<thead>
<tr>
<th>Sector</th>
<th>Average Annual Compound Growth Rate (%): Trough-to-Recovery (4 qtr)</th>
<th>Actual</th>
<th>Predicted</th>
</tr>
</thead>
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<td><strong>PRIVATE GOODS−PRODUCING INDUSTRIES</strong></td>
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<tr>
<td><strong>PRIVATE SERVICES−PRODUCING INDUSTRIES</strong></td>
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<tr>
<td><strong>FINANCE, INSURANCE AND REAL ESTATE</strong></td>
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**Figure 5:** Actual Versus Predicted Average Annual Compound Growth Rate (%) of Employment: Trough-to-Recovery
on the other hand, the forecast average annual compound growth rate of employment in the recovery period, $\hat{g}^E$, is given by

$$\hat{g}^E = \left\{ \sqrt[5]{(1 + \hat{g}_{t}^E)(1 + \hat{g}_{t+1}^E)(1 + \hat{g}_{t+2}^E)(1 + \hat{g}_{t+3}^E)(1 + \hat{g}_{t+4}^E)} - 1 \right\} \times 400. \quad (6)$$

For instance, for computing the forecast trough-to-recovery (average annual) employment growth rate for the 1991 recession, the model in (3) is estimated again with a data set that runs from 1980Q1 to 1990Q3. The estimated parameters are then used to compute forecast growth rates for each of the 5 quarters in the recovery using (3). The forecast average annual growth rate of employment is then computed with the help of (6). Figure 5 plots $\tilde{g}^E$ and $\hat{g}^E$ for all the post-war recoveries for the 6 sectors under investigation.

The most striking trend emerging from Figure 4 and 5 is the aggregate evidence of a structural break in the relationship between employment and aggregate demand sometime during the 1980s (beginning of the neoliberal period), especially during the recovery phase of business cycles. The first chart in the first row in Figure 5 (whole economy) shows that for all recoveries prior to the double-dip recession in 1980, predicted and actual employment changes in the 5 post-trough quarters moved in the same direction; both were positive though different in magnitude. During the 1982 recovery, this trend was reversed for the first time: while predicted employment change was positive, actual employment change was negative. In the next three recessions, this trend reversal has continued unabated.

5 Evolution of Industry Output-Employment Relationships

Our main interest is not in studying the relationship between output and employment over the whole post-war period, but in investigating how that relationship has changed over time. The pattern of change emerges clearly from rolling regressions and a decomposition analysis. In the following subsections we present results from variable width (business-cycle length) rolling regressions and a decomposition analysis to highlight the declining trend in the coefficient relating output growth to employment growth.

5.1 Variable Width Rolling Regressions

For variable width rolling regressions, we estimate the model in (3) for each post-War business cycle (peak-to-peak).\(^{12}\) In essence, thus, these are variable width rolling regressions with business cycle window lengths.

These regressions give us the short run and long run Kaldor-Verdoorn coefficient, which are then plotted across time to inspect the changing pattern of the response of employment to output growth. Data for these rolling regression plots come from the BEA (for aggregate output) and the BLS for industrial employment. The short peak-to-peak cycle between 1980Q1 and 1981Q3 is ignored; instead, the whole period from 1980Q1 and 1990Q3 is considered one peak-to-peak cycle giving us a total of nine cycles.

\(^{12}\)The short peak-to-peak cycle between 1980Q1 and 1981Q3 is ignored; instead, the whole period from 1980Q1 and 1990Q3 is considered one peak-to-peak cycle giving us a total of nine cycles.
output) and the BLS (for employment). Aggregate output is proxied by national income at the industry level; this data is available at a quarterly frequency from NIPA Tables 6.1 B, C and D of the BEA. Nominal national income has been deflated by the GDP deflator to arrive at a measure of real output. Nonfarm employment data at the industry level is available at a monthly frequency from Table B1 of the BLS; this data is converted into a quarterly frequency by averaging monthly data for relevant months in a quarter. Thus, the data set for the rolling regression plots run from 1948Q1 to 2010Q3.\textsuperscript{13}

Figure 6 and 7 plot the short run and long run Kaldor-Verdoorn coefficient over each post-War business cycle. The first row of Figure 6 and 7 give plots for the whole economy, and the non-financial value-adding (NFVA) sector of the economy\textsuperscript{14}; the second row covers the whole private services-producing industries and FIRE (the largest component of the services sector); the last row displays elasticities for the whole private goods-producing industries and construction. Three striking trends emerge from Figure 6 and 7.

First, for the whole economy and the NFVA sector of the economy, there has been a sharp fall in both the short run and the long run Kaldor-Verdoorn coefficient; there is a discernible downward trend in the first rows of Figure 6 and 7. The short run Kaldor-Verdoorn coefficient has fallen from about 0.4 to around 0.1; the long run coefficient has declined from the region of 0.8 to around 0.3. Both figures display decade long (or longer period) fluctuations around the downward trend. The downward trend for the long run Kaldor-Verdoorn coefficient is especially pronounced since the mid-1980s.

Second, the private services-producing industries taken together do not display any declining trend for the whole post-war period. FIRE, the largest component of the private services-producing sector, has always had a numerically small (i.e., close to zero) short run Kaldor-Verdoorn coefficient; there is no observable trend in the Kaldor-Verdoorn coefficient for FIRE. The long run Kaldor-Verdoorn coefficient, on the other hand, does display a significant downward trend from the early 1980s.

Third, the private goods-producing industries behave very differently from the services-producing industries. The private goods-producing industries as a whole display a significant downward trend in both the short run and long run Kaldor-Verdoorn coefficient over the whole post-war period. Though there is an upward trend in the early 1970s, that gets quickly reversed and there is a pronounced decline since the mid-1970s. Manufacturing, the largest component of the private goods-producing industries, displays the same trend – though we do not include the manufacturing sector in Figure 6 and 7 – and drives the result for the whole goods-producing sector.

\textsuperscript{13}In deciding on the data source to use for the analysis in this paper we faced a trade-off between level of disaggregation and frequency. The AIA data is available at the 1 and 2 digit level of NAICS but at an annual frequency; the BEA national income data is available at a quarterly frequency but does not report values for all the NAICS codes. For the regression analysis we chose the quarterly frequency data set and sacrificed some disaggregation.

\textsuperscript{14}The NFVA sector is composed of the private goods-producing industries (mining, construction and manufacturing) and the private services-producing sector less finance, insurance & real estate. Note that NFVA is a broader measure of value-added than MVA (and by implication NMVA) defined in an earlier section. Lack of national income data at sufficiently disaggregated levels prevent us from computing MVA at a quarterly frequency; hence, we use NFVA instead.
Table 2: Testing for Decline in Elasticities

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>Post-War Period</th>
<th>Neoliberal Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short-Run</td>
<td>Long-Run</td>
</tr>
<tr>
<td>ALL</td>
<td>4.16***</td>
<td>4.20***</td>
</tr>
<tr>
<td>NFVA</td>
<td>2.43***</td>
<td>2.07**</td>
</tr>
<tr>
<td>PGD</td>
<td>5.77***</td>
<td>4.61***</td>
</tr>
<tr>
<td>CNS</td>
<td>3.41***</td>
<td>3.13***</td>
</tr>
<tr>
<td>PSV</td>
<td>1.30</td>
<td>2.77***</td>
</tr>
<tr>
<td>FIR</td>
<td>-1.23</td>
<td>-0.89</td>
</tr>
</tbody>
</table>

The null hypothesis is that the estimates of Kaldor-Verdoorn coefficient is same between the business cycles at the two ends of the period under consideration; the (one-sided) alternative is that the coefficient is larger in the initial period. The entries in the table are the values of the test statistic in (7); a large positive value of the test statistic is evidence against the null. Significance levels: ***: 1 percent; **: 5 percent.

While visual inspection of trends in Figures 6 and 7 show significant declines in the values of both the short run and the long run Kaldor-Verdoorn coefficient for the whole economy and for most sub-sectors, Table 2 brings statistical evidence to bear on the issue of decline. After all, the decline that is discerned by visual inspection might not be statistically significant; it might be driven by pure sampling error. In Table 2, we report results of testing the null hypothesis that the KV coefficient – both short run and long run – are the same between the business cycles at the two ends of the period under consideration.

Suppose we wish to compare the elasticities between two business cycles, indexed by \( i = 1, 2 \). Let \( \hat{\beta}_1 \) and \( \hat{\beta}_2 \) be the OLS estimators for the true Kaldor-Verdoorn coefficient \( \beta_1 \) and \( \beta_2 \) respectively in the two business cycles respectively. Let \( s^2_1 \) and \( s^2_2 \) be the heteroskedasticity and autocorrelation consistent (HAC) estimators of the variance \( \sigma^2_1 \) and \( \sigma^2_2 \), respectively, of the OLS estimators \( \hat{\beta}_1 \) and \( \hat{\beta}_2 \). Then, the test statistic

\[
t = \frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{s^2_1 + s^2_1}}
\]

is distributed asymptotically as a standard normal random variable under the null

\[ H_0 : \beta_1 = \beta_2. \]

The first two columns report the test statistic for testing the null that the short run and the long run Kaldor-Verdoorn coefficient is same for the following two peak-to-peak business cycles: 1948Q4–1953Q2, and 2001Q1–2007Q4 (i.e., the whole post-war period); the next two columns report the test statistic for comparisons between the following two peak-to-peak business cycles: 1973Q4-1980Q1 and 2001Q1–2007Q4 (i.e., the neoliberal period). The alternative hypothesis is that the Kaldor-Verdoorn coefficient in the initial period is higher
than that in the final period; hence, a positive and large value of the test statistic reported in Table 2 is strong evidence against the null of no change in the Kaldor-Verdoorn coefficient over time.

Two interesting facts that emerge from Table 2. First, the services-producing industries (PSV) and its largest component, finance, insurance and real estate (FIR), either fail to reject the null hypothesis or reject it in a much weaker fashion than the other sectors. This seems to suggest that the growing strength of the Kaldor-Verdoorn effect has been much more prominent in the non-services part of the economy. Second, the rejection of the null hypothesis is weaker in the neoliberal period than for the whole post-war period. This is because the declining trend in the Kaldor-Verdoorn coefficient was arrested and even significantly reversed for about a decade long period before the onset of neoliberalism.

5.2 Decomposition of Kaldor-Verdoorn Effect

The interpretation of the evidence presented in Figure 6 and 7 suggest that the service sector, especially FIRE, behaves differently from the rest of the economy. Hence, the following question arises naturally: is the decline in the KV coefficient that we have documented in the previous section driven primarily by the sectoral shift in the U.S. economy that we have documented in an earlier section? To address this question, we carry out a simple decomposition exercise in this section.

Suppose the economy is composed of two sectors, A and B. For instance, A could refer to the goods-producing industries (PGD) and B could refer to the services-producing industries (PSV); or, A could refer to the value-adding sectors (NFVA) and B could refer to the non-value-adding sectors (i.e., the aggregate economy less NFVA). Let subscripts Y and E refer to output and employment and superscripts A and B refer to the two sectors that make up the aggregate economy. Thus, $g_Y$, $g_Y^A$ and $g_Y^B$ refers to the growth rate of output in the aggregate economy and the two sectors respectively; similarly, $g_E$ refers to the growth rate of employment in the aggregate economy, $g_E^A$ and $g_E^B$ refers to the growth rates of employment in sectors A and B respectively. If $S_E^A$ refers to the share of sector A in total employment, then

$$g_E = S_E^Ag_E^A + (1 - S_E^A)g_E^B;$$

differentiating the above expression w.r.t. $g_Y$ (the growth rate of aggregate output), we get

$$\beta = \frac{dg_E}{dg_Y} = S_E^A\beta_A \frac{dg_Y^A}{dg_Y} + (1 - S_E^A)\beta_B \frac{dg_Y^B}{dg_Y} + (g_A^E - g_B^E) \frac{dS_E^A}{dg_Y};$$

$$\approx S_E^A\beta_A \frac{\Delta g_Y^A}{\Delta g_Y} + (1 - S_E^A)\beta_B \frac{\Delta g_Y^B}{\Delta g_Y} + (g_A^E - g_B^E) \frac{\Delta S_E^A}{\Delta g_Y},$$

where $\beta$ is the marginal effect of output growth on employment growth for the whole economy, and $\beta^A$ and $\beta^B$ are the marginal effects of output growth on employment growth for
Figure 6: Short Run Kaldor-Verdoorn Coefficient over Business Cycles (peak-to-peak)
Figure 7: Long Run Kaldor-Verdoorn Coefficient (without lagged dependent variable) over Business Cycles (peak-to-peak)
sector $A$ and $B$ respectively. Note that the last step gives us an approximation because we replace differentials (i.e., instantaneous change) with differences (i.e., change over a finite time period).

Thus, if $\hat{\beta}$, $\hat{\beta}^A$ and $\hat{\beta}^B$ are consistent estimators of $\beta$, $\beta^A$ and $\beta^B$ for some time period, then we have the following decomposition of $\hat{\beta}$ in terms of the relative shares of the two sectors in total employment $S_E^A$, the relative growth rates of output in the two sectors, $\Delta g^A_Y / \Delta g_Y$, and estimates of the marginal effects of output growth on employment growth $\hat{\beta}^A$ and $\hat{\beta}^B$ in the two sectors:

$$\hat{\beta} \approx \hat{\beta}^A (S_E^A \Delta g^A_Y / \Delta g_Y) + \hat{\beta}^B (1 - S_E^A) \Delta g^B_Y / \Delta g_Y + (g^A_E - g^B_E) \Delta S_E^A / \Delta g_Y.$$ (8)

For a period when the relative employment shares in the two sectors remain unchanged, the last term in (8) drops out and we have

$$\hat{\beta}_{CSE} \approx \hat{\beta}^A (S_E^A \Delta g^A_Y / \Delta g_Y) + \hat{\beta}^B (1 - S_E^A) \Delta g^B_Y / \Delta g_Y,$$ (9)

where $\hat{\beta}_{CSE}$ gives the value of the Kaldor-Verdoorn coefficient that would have approximately arisen under a constant share of employment (hence the subscript CSE). Table 3 and 4 give values of $\hat{\beta}$ and $\hat{\beta}_{CSE}$, i.e., both short run and long run Kaldor-Verdoorn coefficients, for two different sectoral decompositions. In Table 3, the total private sector is broken up into goods-producing and services-producing industries; in Table 4, the total private sector is decomposed between a value-adding sector (NFVA) and a value-using sector (PVT less NFVA). In Table 3 and 4 comparison of columns (1) and (2) for the short run Kaldor-Verdoorn coefficient, and comparison of columns (3) and (4) for the long run coefficient shows that the value of both coefficients fall over the post-War period even when share of employment remains unchanged between goods and services-producing industries, and between NFVA and non-NFVA.

This decomposition, therefore, highlights the important fact that the fall in the Kaldor-Verdoorn coefficient for broad aggregates of the U.S. economy reflects both the shift of value added toward the service sector (which has a lower coefficient) and a fall in the coefficients in the subsectors themselves.\textsuperscript{15}

6 Explanations

The evidence we have presented here suggests that the Kaldor-Verdoorn effect has become significantly stronger in the U.S. economy in recent decades, and that this fact is one of the factors at the root of the changing connection between measured real output and employment.\textsuperscript{16} This raises the question of explanations for these structural changes.

\textsuperscript{15}For the 1969–1973 business cycle, the growth rate of the goods-producing sector was large and negative; that is driving the coefficients in columns 2 and 4 in Table 3 to be so large and negative.

\textsuperscript{16}Increase in the KV coefficient implies weakening of the KV effect.
Table 3: Decomposition of Kaldor-Verdoorn Coefficients (PGD and PSV)$^a$

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Contemporaneous</th>
<th>Long Run</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>1948Q4-1953Q2</td>
<td>0.41</td>
<td>0.31</td>
</tr>
<tr>
<td>1953Q2-1957Q3</td>
<td>0.26</td>
<td>0.25</td>
</tr>
<tr>
<td>1957Q3-1960Q3</td>
<td>0.45</td>
<td>0.34</td>
</tr>
<tr>
<td>1960Q3-1969Q4</td>
<td>0.20</td>
<td>0.18</td>
</tr>
<tr>
<td>1969Q4-1973Q4</td>
<td>0.27</td>
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</tr>
<tr>
<td>1973Q4-1980Q1</td>
<td>0.35</td>
<td>0.50</td>
</tr>
<tr>
<td>1980Q1-1990Q3</td>
<td>0.37</td>
<td>0.27</td>
</tr>
<tr>
<td>1990Q3-2001Q1</td>
<td>0.21</td>
<td>0.06</td>
</tr>
<tr>
<td>2001Q1-2007Q4</td>
<td>0.11</td>
<td>0.08</td>
</tr>
</tbody>
</table>

$^a$ Columns 1 and 3 give the estimated Kaldor-Verdoorn coefficient, i.e., $\hat{\beta}$ in (3); columns 2 and 4 give the value of the Kaldor-Verdoorn coefficient computed under the assumption that the share of employment does not change over the business cycle, i.e., $\hat{\beta}_{CSE}$ in (9).

Table 4: Decomposition of Kaldor-Verdoorn Coefficients (NFVA and PVT-less-NFVA)$^a$

<table>
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<tr>
<th>Cycle</th>
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<th>Long Run</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
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</tr>
<tr>
<td>1948Q4-1953Q2</td>
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<td>1969Q4-1973Q4</td>
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<td>1990Q3-2001Q1</td>
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<td>0.71</td>
</tr>
<tr>
<td>2001Q1-2007Q4</td>
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<td>0.19</td>
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$^a$ Columns 1 and 3 give the estimated Kaldor-Verdoorn coefficient, i.e., $\hat{\beta}$ in (3); columns 2 and 4 give the value of the Kaldor-Verdoorn coefficient computed under the assumption that the share of employment does not change over the business cycle, i.e., $\hat{\beta}_{CSE}$ in (9).
Three possible explanations are: a shift in the U.S. labor market to a greater reliance on temporary workers (flexible labor); the fact that, as Kaldor noted, “real output” in service-producing sectors is not independently measured from income in those sectors, so that some observed increases in real output are illusory (mis-measurement of real output); and globalization, which leads to restructuring of production so as to shift low-value-added employment from the U.S. to lower-wage regions of the world (global restructuring). We discuss each of these possibilities in the light of the evidence we have presented.

6.1 Flexible Labor

One of the major explanations offered in the mainstream literature for the discrepancy between actual and predicted employment changes that is often construed as a “breakdown” of Okun’s Law, is what might be called the “flexibilization of labor” (for instance captured by the increase in the share of temporary workers in the workforce) across industries. This argument was used by Groshen and Potter (2003) to explain the jobless recovery after the 2000 recession in the U.S.; a broader but similar argument has been made in the 2010 World Economic Outlook of the IMF using a cross-country framework (IMF, 2010).

This argument is straightforward. When the labor regime becomes more flexible and unionization rates go down, firms cut down on the permanent workforce and replace them with temporary workers. When there is an increase in demand during business cycle upturns, firms hire temporary workers rapidly and in a slump they shed most of their temporary workforce. Thus, job losses are now “permanent” in nature as opposed to temporary layoffs of permanent workers, i.e., job losses lead to permanent severing of employer-employee ties rather than temporary severing of employer-employee ties with the implicit assumption of a resumption of the relationship after the economic storm is weathered. In the context of technological change and globalization of production (i.e., relocation and outsourcing), the increase in the share of the temporary workforce increases the possibilities of “structural change” (i.e., permanent shift of jobs across sectors, industries, regions and even countries). When demand does revive during the upswing of the business cycle, the hiring process is much more subdued because some of the jobs are simply not there anymore and creating new jobs takes more time in the face of increased uncertainty. Hence, recoveries are jobless.

There is certainly a ring of plausibility to this argument; the idea of flexibilization of labor seems to fit in with the general neoliberal turn since the late 1970s. But we don’t think this argument captures the whole story. Even though the increasing flexibilization of the workforce can probably explain the tepid job growth during recoveries, it is not clear whether this effect remains in effect over the whole business cycle. If flexibilization increases the ease of the hiring and firing process, the subdued employment response of output growth during the recovery phase might come together with increased responsiveness during the downturn (when the temporary workforce is rapidly shed) and the advanced phase of the upturn (when temporary workers are rapidly hired to meet the growing demand). It is, therefore, possible that when we look at the whole business cycle, the effect of flexibilization on the relationship between output growth and employment washes out or is even reversed. A careful reading of the evidence, in fact, suggests both cross-sectional and time series
problems with the “flexible labor” explanation for the diminished employment response of output growth.

The flexibilization explanation would predict that over the past few decades, as the share of temporary workers has increased in the workforce, labor laws have been diluted and unionization has fallen, the response of employment growth to output growth must have increased. With the increasing ease of the hiring-firing process, the response of employment to output changes would presumably go up over the business cycles (other than during the initial phase of recoveries). The time series evidence presented in the variable window rolling regression plots, for instance in Figure 7, seem to suggest exactly the opposite: the partial effect of output growth on employment growth has fallen over the last few decades.

We carried out a simple exercise to test the cross-sectional validity of the flexibilization argument for the U.S. Using AIA data from the BEA, we computed the short run and long run Kaldor-Verdoorn coefficient for the 54 industries with 3 (or 4) digit NAICS code over the period 1998-2008. For this period, the BEA also gives data on total (permanent and temporary) and full-time (permanent) workers at the industry level. This allowed us to compute the average share of temporary workers across industries during the same period.\(^\text{17}\)

Figure 8 gives scatter plots of the short run and the long run Kaldor-Verdoorn coefficient against the average share of temporary workers for the 54 industries with 3 (or 4) digit NAICS code. A regression line is included in each figure, the left figure for short run and the right figure for long run coefficient. The slope of the regression line for the short run Kaldor-Verdoorn coefficient scatter plot is negative (−1.303) but statistically insignificantly

\(^{17}\)The AIA data of the BEA does not give the break-up of employment into temporary and permanent workers before 1998; hence, we had to limit our cross-sectional analysis to the period 1998-2008.
different from zero (standard error = 1.374); the $R^2$ for the regression is small at 0.017. On the other hand, the slope of the regression line for the long run Kaldor-Verdoorn coefficient scatter plot is negative ($-4.394$) and statistically significant (standard error = 1.968); the $R^2$ for this regression becomes larger to 0.087. Thus, in a simple cross-sectional regression framework, the variation in the share of temporary workers in the workforce across industries either does not explain much of the variation in the Kaldor-Verdoorn coefficient or has a negative impact on it (in line with the time series evidence and against the "flexibilization" hypothesis).

We are thus led to conclude that neither the time series nor the cross-sectional evidence supports growing labor flexibility as an adequate explanation of the changing relationship between output and employment observed in the U.S. economy over the past few decades.

### 6.2 Measurement of Real Output

The evidence reviewed in the previous sections seems to suggest that the growing weight of the services sector, especially the financial sector, is an important part of the explanation for the weakening of the real GDP-employment relationship in the U.S. economy over the last three business cycles. The growing weight of the financial sector systematically leads to real GDP overestimating real output at the aggregate level which explains part of the apparent breakdown of Okun’s Law.

The treatment of services in general, and particularly financial services in the national income accounts, presents several issues. From a Marxian point of view, the incomes of financial capital are transfers of surplus value created in production, and the labor and capital employed in the financial sector are “unproductive” deductions from surplus value. The U.S. national income accounts, however, treat incomes generated in the financial sector as arising from the production of a fictitious imputed output, “financial services”, the value of which is measured by the incomes generated in the sector.

The difference in growth rates between the value-adding sectors and non-value-adding sectors of the U.S. economy we have reported above indicates a significant and growing long-run discrepancy between national income measures of real output and what we have called measurable value added (see Table 1 for details). This discrepancy appears to have an important and growing component at business cycle frequencies, though the small number of cycles available does not permit a formal test of this hypothesis. Although the anemic rise in U.S. GDP over the 5 quarters up to 2010Q3 is not concentrated solely in the financial sector, but spread out over both value-adding and non-value-adding sectors, the downturn was larger and the recovery weaker as measured by MVA.

Since a very large proportion of the increase in U.S. national income over recent decades has occurred in the financial sector, there is a longer-run question as to how the U.S. economy can sustain historical rates of growth of real incomes if value-adding production continues to decline.

There is also evidence that the treatment of imported inputs in the NIPA accounts may bias the measurement of real GDP upward (Houseman et al, 2010). The “double-deflation” method used by BEA to estimate value added leads to an overestimation of the price indexes.
that are used to deflate intermediate goods in a context where more and more of intermediate goods come from the low-cost periphery of the global capitalist system, and hence to raise measured real value added. The quantitative significance of this effect over the business cycle remains to be investigated. We have controlled for this effect in the present paper by calculating real GDP and real MVA as nominal value-added deflated by GDP deflators, rather than using the BEA’s estimates of real GDP calculated through the double-deflation method.

6.3 Global Restructuring

The fall in the partial effect of output growth on employment growth we document here also must reflect to some degree the global restructuring of production (as described in detail in Milberg and Winkler, 2009). Investment in the U.S. economy in recent decades has increasingly taken the paradoxical form of the abandonment of U.S.-located productive facilities as parts of the value-added chain have moved to lower-wage and hence lower-cost locations. This type of investment costs money, since the relocation of production incurs costs both in closing down U.S. facilities and adapting those parts of the production process that remain in the U.S. to changing geographical patterns of supply. If the parts of the value-adding chain that are relocated have lower value-added per worker than average, the effect of this relocation will be an apparent increase in the productivity of the U.S. labor in the jobs that remain. Thus globalization will intensify the Kaldor-Verdoorn effects, not through the traditional channels of learning-by-doing and induced technical change, but through the transfer of low-productivity jobs to low-wage regions of the world.

The dynamic of this restructuring has not been altered by the financial crisis of 2007–8 and the consequent business cycle downturn. If anything, these tendencies may be intensified in business cycle “recoveries”, when it is relatively easy for U.S. firms to respond to increases in demand by more rapid shifts of production to lower-cost locations.

At the level of individual firms, globalization looks much like classic Marx-biased technical change. The firm protects its ability to appropriate surplus value by investing to reduce costs. There are, however, two significant differences. First, in the “trajectory a la Marx” identified by Duménil and Lévy (1995) real wages grow in proportion to value added, leaving the rate of exploitation roughly constant, but with globalization real wages in the U.S. stagnate, and the measured rate of exploitation rises. Second, the overall impact of the classic Marx-biased technical change trajectory is an increase in the productivity of labor in the advanced economies located at the technological frontier, but with globalization the increases in profitability of firms arising from cost-reduction may not increase frontier labor productivity.

A full assessment of the quantitative impact of globalization would require an examination of the evolving structure of the U.S. economy in the context of the world capitalist economy.
7 Conclusion

In this paper, we have investigated the changing pattern of relationship between output and employment in the U.S. economy, both at the aggregate and at disaggregated industry levels. Our empirical investigations lead to the following findings.

First, we find that the contemporaneous impact of output growth on employment growth has been generally higher in the non-services sectors compared to the services sectors (especially FIRE) over the whole post-war period. Second, we find that the impact of output growth on employment growth has remained more or less unchanged in the services sectors but has significantly declined in the non-services part of the U.S. economy.

We explore three alternative explanations for the changing connection between measured real output growth and employment growth in the postwar U.S. economy. First, we scrutinize the “flexible labour” argument and find it wanting. Second, we study some of the problems of measurement, like imputation of value-added for several key services sectors, that attends to the construction of indexes of output like real GDP, and conclude that overestimation of real output at the aggregate level explains part of the phenomenon under investigation. Third, we think that the global restructuring of production under neoliberal conditions could also contribute partly to the weakening of the output-employment linkage.

References


8 Appendix A

The analysis in this paper uses industry-level data at two different frequencies, annual and quarterly. In this Appendix, we provide details of the sources of data and construction of the relevant variables and industry groupings. In the last section of this Appendix, we report results of endogeneity tests of (3) in Table 5 and 6; Table 7 gives p-values of tests of exogeneity of the instruments used for the tests in Table 5 and 6.
8.1 Annual Data

The source of the annual data is the Annual Industry Accounts (AIA) of the BEA which provides GDP-by-Industry data for the US economy for the period 1947 to 2009. The BEA has converted the historical industry-level time series from the SIC to the NAICS; hence, the AIA now provides a consistent industry-level data series running all the way back to 1947. We extract two variables from this data series: (1) nominal gross value added, and (2) total employment. Nominal gross value added is defined as gross output (i.e., total sales or receipts and other operating income) less cost of intermediate inputs (energy, material and purchased services); the nominal gross value added figure is deflated by the aggregate GDP deflator (from NIPA Table 1.1.4) to arrive at real gross value added. Total employment is defined in the AIA as the total number of persons employed which includes both permanent and temporary workers. We use real gross value added as a measure of output and the total of permanent and temporary workers as a measure of employment, at the industry level, for our analysis.

We use the following industry-level groupings for the annual analysis: ALL (the whole economy), PVT (the total private industries sector), PGD (the private goods-producing industries), PSV (the private services-producing industries), MVA (the measureable value- adding industries, which includes agriculture, mining, construction, manufacturing, utilities, transportation, information services, and arts & entertainment), CNS (construction), MFG (manufacturing), WTD (wholesale trade), RTD (retail trade), TWR (transportation and warehousing), INF (information services) FIR (finance, insurance and real estate), PBS (professional and business services), EHS (education and health services), ART (art, entertainment, accommodation and food services), OTH (other services excluding government).

8.2 Quarterly Data

We use two sources to construct our quarterly dataset, national income for major industry groupings from NIPA Table 6.1 B, C and D of the BEA and employment data from the BLS. Since, to the best of our knowledge, the BEA does not provide GDP-by-Industry data at a quarterly frequency, we turned to NIPA Table 6.1 to construct a proxy for this. NIPA Table 6.1 B, C and D provides nominal national income type data for major industry groupings. Since gross domestic product is the sum of national income, indirect business taxes and depreciation (capital consumption allowances), national income for major industry groupings can be used as a proxy for net value added. We use the real national income, i.e., national income deflated by the GDP deflator as a measure of output at the industry level for our analysis at a quarterly frequency.

Major revisions of industry classifications by the BEA might raise compatibility issues in the use of time series of national income data at disaggregated levels. For instance, the national income-type data in NIPA Table 6.1 till 1986Q4 uses the 1972 SIC; the data from 1987Q1 to 2000Q4 uses the 1987 SIC; and the data from 2001Q1 onwards uses the 2002 NAICS. The increase in the national income for the services-producing industries between 1986Q4 and 1987Q1 or between 2000Q4 and 2001Q1 seems to be arising partly from the
re-classification exercise whereby some industries are moved from the goods-producing to the services-producing categories. Thus, a part of the increase in the reported value-added by services-producing industries would increase because of re-classification and not because of real increase in produced output. Though this might, in general, bias the estimates of the Kaldor-Verdoorn coefficient for the services-producing industries, our results would probably not be overly affected because we compare whole business cycles and not particular years. Moreover, among the nine peak-to-peak business cycles that we analyze only one, the 1980–1990 cycle, straddles reclassification years.

Employment data has relatively fewer problems; it is taken from Table B-1 of the BLS which gives the total number of employees on the payroll at the industry level at a monthly frequency. A quarterly series is constructed by averaging employment figures for the months in a quarter. This is then used as a measure of employment for the analysis at a quarterly frequency.

We use the following six industry groupings for the quarterly analysis: ALL (the whole economy), NFVA (the nonfinancial value adding sector, i.e., the total private sector less FIRE), PGD (the private goods-producing industries, i.e., agriculture, mining, construction and manufacturing), CNS (construction), PSV (the private services-producing industries, i.e., the total private sector less the goods-producing industries), and FIR (finance, insurance and real estate).

8.3 Tests of Endogeneity

Here we report results from two statistical tests of the endogeneity of growth rate of output in (3): the HAC score test (Wooldridge, 1995) and the C-statistic type test of endogeneity (Hayashi, 2000). The idea behind both tests derives from Hausman’s (1978) original work and relies on comparing key statistics that would be “close” to each other for cases with and without endogeneity of the relevant regressor. The null hypothesis, in both cases, is that the relevant regressor – growth rate of output, in our case – is exogenous and large p-values imply that the null cannot be rejected. Table 5 and 6 report the p-values from these tests for the nine post-War business cycles and the six major sectors that are studied in this paper using quarterly data. In an overwhelming number of cases, the reported p-value are high and suggest that the null hypothesis – exogenous rate of growth of output – cannot be rejected (small p-values are highlighted in red). This implies that estimating the parameters of (1) by OLS gives reasonably accurate estimates of the “true” Kaldor-Verdoorn coefficients, both short run and long run. That the instruments used for the endogeneity tests are indeed exogenous can be seen from the results reported in Table 7 which reports p-values from Hansen’s overidentification test; the null hypothesis is that the instruments are exogenous and thus large p-values imply that the null cannot be rejected at standard levels of statistical significance. In Table 5 and 6, we present p-values for tests of endogeneity in (3).
### Table 5: HAC Score Test of Endogeneity

<table>
<thead>
<tr>
<th>Business Cycle (Peak-to-Peak)</th>
<th>ALL</th>
<th>NFVA</th>
<th>PGD</th>
<th>CNS</th>
<th>PSV</th>
<th>FIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948Q4-1953Q2</td>
<td>0.1962</td>
<td>0.2563</td>
<td>0.3372</td>
<td>0.4645</td>
<td>0.2038</td>
<td>0.0660</td>
</tr>
<tr>
<td>1953Q2-1957Q3</td>
<td>0.1409</td>
<td>0.0953</td>
<td>0.1663</td>
<td>0.1651</td>
<td>0.0616</td>
<td>0.1280</td>
</tr>
<tr>
<td>1957Q3-1960Q2</td>
<td>0.1066</td>
<td>0.5492</td>
<td>0.8717</td>
<td>0.2414</td>
<td>0.0157</td>
<td>0.7931</td>
</tr>
<tr>
<td>1960Q2-1969Q4</td>
<td>0.3155</td>
<td>0.4291</td>
<td>0.2953</td>
<td>0.0500</td>
<td>0.2577</td>
<td>0.4333</td>
</tr>
<tr>
<td>1969Q4-1973Q4</td>
<td>0.8426</td>
<td>0.9925</td>
<td>0.2455</td>
<td>0.6148</td>
<td>0.4608</td>
<td>0.2155</td>
</tr>
<tr>
<td>1973Q4-1980Q1</td>
<td>0.2632</td>
<td>0.2003</td>
<td>0.0654</td>
<td>0.0742</td>
<td>0.2485</td>
<td>0.0592</td>
</tr>
<tr>
<td>1980Q1-1990Q3</td>
<td>0.5334</td>
<td>0.3330</td>
<td>0.0028</td>
<td>0.0078</td>
<td>0.5780</td>
<td>0.3272</td>
</tr>
<tr>
<td>1990Q3-2001Q1</td>
<td>0.3704</td>
<td>0.0862</td>
<td>0.1513</td>
<td>0.4598</td>
<td>0.1350</td>
<td>0.3255</td>
</tr>
<tr>
<td>2001Q1-2007Q4</td>
<td>0.6742</td>
<td>0.1934</td>
<td>0.8921</td>
<td>0.1031</td>
<td>0.1945</td>
<td>0.8212</td>
</tr>
</tbody>
</table>

*The null hypothesis is that the growth rate of output is exogenous in (3); the statistic reported in this table is the p-value. The following three instruments are used: aggregate consumption expenditure on goods, aggregate fixed investment, total government expenditure. Details of the test are available in Wooldridge (1995); the test can be implemented in STATA using the postestimation command estat endogenous option with ivregress.

### Table 6: C-Statistic Type Test of Endogeneity

<table>
<thead>
<tr>
<th>Business Cycle (Peak-to-Peak)</th>
<th>ALL</th>
<th>NFVA</th>
<th>PGD</th>
<th>CNS</th>
<th>PSV</th>
<th>FIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948Q4-1953Q2</td>
<td>0.3964</td>
<td>0.2393</td>
<td>0.2158</td>
<td>0.9203</td>
<td>0.4244</td>
<td>0.7232</td>
</tr>
<tr>
<td>1953Q2-1957Q3</td>
<td>0.8741</td>
<td>0.8706</td>
<td>0.9876</td>
<td>0.7813</td>
<td>0.3805</td>
<td>0.6080</td>
</tr>
<tr>
<td>1957Q3-1960Q2</td>
<td>0.4882</td>
<td>0.7446</td>
<td>0.9436</td>
<td>0.4874</td>
<td>0.5772</td>
<td>0.8487</td>
</tr>
<tr>
<td>1960Q2-1969Q4</td>
<td>0.4324</td>
<td>0.6520</td>
<td>0.2293</td>
<td>0.1602</td>
<td>0.3755</td>
<td>0.1945</td>
</tr>
<tr>
<td>1969Q4-1973Q4</td>
<td>0.9793</td>
<td>0.9145</td>
<td>0.9929</td>
<td>0.9030</td>
<td>0.2230</td>
<td>0.2925</td>
</tr>
<tr>
<td>1973Q4-1980Q1</td>
<td>0.3699</td>
<td>0.3703</td>
<td>0.6403</td>
<td>0.1431</td>
<td>0.6856</td>
<td>0.3796</td>
</tr>
<tr>
<td>1980Q1-1990Q3</td>
<td>0.6492</td>
<td>0.2987</td>
<td>0.0485</td>
<td>0.1262</td>
<td>0.9171</td>
<td>0.4983</td>
</tr>
<tr>
<td>1990Q3-2001Q1</td>
<td>0.5111</td>
<td>0.9229</td>
<td>0.8248</td>
<td>0.6148</td>
<td>0.9976</td>
<td>0.8685</td>
</tr>
<tr>
<td>2001Q1-2007Q4</td>
<td>0.6710</td>
<td>0.3740</td>
<td>0.6097</td>
<td>0.1748</td>
<td>0.3276</td>
<td>0.9821</td>
</tr>
</tbody>
</table>

*The null hypothesis is that the growth rate of output in (3) is exogenous; the statistic reported in this table is the p-value. The following three instruments are used: aggregate consumption expenditure on goods, aggregate fixed investment, total government expenditure. Details of the test are available in Hayashi (2000); the test can be implemented in STATA using the endog option with ivreg2.
### Table 7: Hansen’s Overidentification Test

<table>
<thead>
<tr>
<th>Business Cycle (Peak-to-Peak)</th>
<th>ALL</th>
<th>NFVA</th>
<th>PGD</th>
<th>CNS</th>
<th>PSV</th>
<th>FIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948Q4-1953Q2</td>
<td>0.6289</td>
<td>0.7398</td>
<td>0.8951</td>
<td>0.3486</td>
<td>0.5118</td>
<td>0.3965</td>
</tr>
<tr>
<td>1953Q2-1957Q3</td>
<td>0.4448</td>
<td>0.6458</td>
<td>0.6915</td>
<td>0.3991</td>
<td>0.6943</td>
<td>0.5844</td>
</tr>
<tr>
<td>1957Q3-1960Q2</td>
<td>0.9073</td>
<td>0.4501</td>
<td>0.4289</td>
<td>0.6483</td>
<td>0.4469</td>
<td>0.4771</td>
</tr>
<tr>
<td>1960Q2-1969Q4</td>
<td>0.7610</td>
<td>0.5542</td>
<td>0.9581</td>
<td>0.4721</td>
<td>0.5585</td>
<td>0.9026</td>
</tr>
<tr>
<td>1969Q4-1973Q4</td>
<td>0.3358</td>
<td>0.3321</td>
<td>0.3362</td>
<td>0.7299</td>
<td>0.9730</td>
<td>0.3774</td>
</tr>
<tr>
<td>1973Q4-1980Q1</td>
<td>0.4718</td>
<td>0.4203</td>
<td>0.3767</td>
<td>0.6689</td>
<td>0.4077</td>
<td>0.4645</td>
</tr>
<tr>
<td>1980Q1-1990Q3</td>
<td>0.1995</td>
<td>0.4375</td>
<td>0.7058</td>
<td>0.6198</td>
<td>0.2836</td>
<td>0.3570</td>
</tr>
<tr>
<td>1990Q3-2001Q1</td>
<td>0.2618</td>
<td>0.2589</td>
<td>0.1624</td>
<td>0.3297</td>
<td>0.2984</td>
<td>0.3135</td>
</tr>
<tr>
<td>2001Q1-2007Q4</td>
<td>0.5167</td>
<td>0.4102</td>
<td>0.4526</td>
<td>0.5859</td>
<td>0.4947</td>
<td>0.3516</td>
</tr>
</tbody>
</table>

*a* The null hypothesis is that the instruments used for the tests that are reported in Table (5) and (6) - aggregate consumption expenditure on goods, aggregate fixed investment, total government expenditure, and the lagged output growth rates - are exogenous; the statistic reported in this table is the p-value associated with the overidentification test. Details of the test are available in Hayashi (2000); the test can be implemented in STATA using the postestimation command `ivreg2`. 