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DEPARTMENT OF ECONOMICS

Working Paper

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

By

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

Deepankar Basu* Duncan K. Foley†

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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. The two U.S. business cycles preceding the 2007 crisis produced"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 in seeming to be an "output-less crash". 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 increase in real GDP since the official end of the Great Recession in second quarter of 2009 had even less impact 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 "output-less crashes" 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, had an enormous effect on the 2010 mid-term elections in the U.S.[1] From a longer term labor perspective, the weakening of the relationship between measured real GDP growth and employment poses serious questions about the viability of globalizing growth strategies for economic development in the U.S. economy and around the world. Understanding these developments will be a necessary first step in fashioning alternatives to neoliberal economic policies that can generate growth in employment and protect labor interests such as the right to collective bargaining, adequate wages and benefits, acceptable working conditions, adequate and secure pensions, and democratic political institutions.[2]

What lies behind the changing relationship between real output and employment in the

[1] `http://thecaucus.blogs.nytimes.com/2010/07/19/mystery-for-white-house-where-did-the-jobs-go/?emc=eta1`

[2] Even as the unemployment rate remains stuck above 9%, corporate profits have been reported to have increased at record rates: `http://economix.blogs.nytimes.com/2010/11/12/a-high-water-mark-for-profits/`

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 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 output-less crashes 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. 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.

2 Okun's Law and the Kaldor-Verdoorn Effect

There are two different theoretical traditions that can be used to study the relationship between output or aggregate demand and employment, a mainstream tradition that starts with the work of Arthur Okun (1962), and a heterodox tradition that begins with Verdoorn

(1949); this latter tradition was revived by Kaldor (1966) and has, since then, generated a substantial heterodox body of work.

2.1 Okun's Law

The traditional mainstream starting point for analyses of the employment-output link is "Okun's Law". Okun (1962) drew attention to a stable and statistically significant negative relationship between economy-wide unemployment rate changes and growth rates of real GDP in the U.S. economy (Knottek, 2007; Delong, 2009; Daly and Hobijn, 2010; IMF, 2010; Gordon, 2010). Okun offered two versions of the relationship: (a) a negative relationship between quarterly changes in the unemployment rate and the growth rate of real GDP, and (b) a negative relationship between the output gap (deviation of real GDP from "potential" output) and the unemployment gap (deviation of the unemployment rate from some benchmark value). The first version has been called, in the subsequent literature, the "difference" version of Okun's Law, and both a static and a dynamic specification of this version has been widely studied. The second version has been called the "gap" version of Okun's Law; its popularity seems to have diminished because estimates of the output gap require estimates of variables like potential output or a benchmark unemployment rate like the NAIRU which are not directly observable.

The *static* difference version of Okun's Law, in which an intuitive interpretation of the coefficients is easiest to explain, is written as

$$\Delta u_t = a + bg_t^Y + \varepsilon_t, \tag{1}$$

where u_t refers to the aggregate unemployment rate, and g_t^Y refers to the rate of growth of real GDP. The coefficients, a and b, in this equation have direct intuitive interpretations. To see this, let us focus on the regression function:

$$\Delta u_t = u_t - u_{t-1} = a + bg_t^Y = b(g_t^Y + \frac{a}{b}). \tag{2}$$

Thus, $-(a/b)$ represents the growth rate of real output that keeps the unemployment rate constant. But a constant unemployment rate implies that the volume of employment is growing at the same rate as the labour force. This can be ensured, in turn, if the growth of real output is the sum of the growth rate of the labour force and the growth rate of productivity (real output per worker). Thus, $-(a/b)$ provides an estimate of the sum of the growth rate of the labour force and the growth rate of productivity, often regarded as the "natural" growth rate of the economy.

What is the interpretation of b? From the regression function we see that if $g_t^Y = 1 - (a/b)$, then $u_t - u_{t-1} = b$, which suggests the following interpretation for b: for every percentage point increase in the growth rate of real output above the natural growth rate, the unemployment rate falls by b percentage points.

The *dynamic* difference specification of the Okun's Law extends the static version by including lags of the independent and dependent variable:

$$\Delta u_t = a + b_1 g_t^Y + b_2 g_{t-1}^Y + b_3 g_{t-2}^Y + b_4 \Delta u_{t-1} + b_5 \Delta u_{t-2} + \varepsilon_t. \tag{3}$$

While the dynamic version is better for forecasting, the coefficient b_1 loses its simple and intuitive interpretation. In the dynamic version the Okun coefficient, b_1, captures the partial effect of contemporaneous output growth on the change in the unemployment rate.[3]

At the time of Okun's original study, available data indicated that growth in the output of the economy as a whole of about three percent would reduce unemployment (or neglecting labor force participation changes, increase employment) by one percent. Over time estimates of b_1 were revised to about one-half, implying that overall economic growth of two percent would increase employment by one percent. In this context "output" is measured as real value added (with small corrections, Real Gross Domestic Product), which in turn is estimated by deflating sectoral or economy-wide Gross Domestic Product by an appropriate price index.

We depart from this widely used methodology of studying economy-wide Okun's Law type of relationships in two ways. First, we carry out the analysis at a more disaggregated level of industries and industry groupings. Second, we frame our study as investigating the relationship between employment growth and output growth rather than between the unemployment rate and output growth. The second point is related to the first since, in the presence of inter-industry labor mobility, it is not possible to meaningfully define industry-level unemployment rates.

2.2 Verdoorn's Law

The relationship between employment growth and output growth also plays a central role in heterodox macroeconomics, where it is usually called the "Kaldor-Verdoorn Effect". Verdoorn (1949) noticed, in studying statistics describing the recovery of the European economies after WWII, that sectoral employment growth tended systematically to fall short of measured sectoral output growth. Nicholas Kaldor (1966, 1967, 1975) elevated this relationship to a central place in his demand-driven models of economic growth, in contrast to the neoclassical production function. The Kaldor-Verdoorn effect also plays an important role in post-Keynesian thinking about the impact of demand-driven economic growth on labor productivity change.

The empirical regularity noted by Verdoorn (1949) – that employment growth tended systematically to fall short of measured output growth for a number of capitalist economies recovering from WWII – was provided a theoretical underpinning by Kaldor (1966, 1967)

[3]The gap version of Okun's law, which we will not pursue in this paper, relates to the relationship between the output gap and the deviation of the aggregate unemployment rate from some benchmark value (the unemployment gap). A popular form of the gap version uses the NAIRU as the benchmark unemployment rate and is, thus, written as

$$(u_t - u_t^*) = c + d(Y_t - Y_t^*) + \varepsilon_t,$$

where u_t^* stands for the NAIRU, Y_t is real GDP and Y_t^* is potential output. The coefficient of interest, in this case, is d, the partial effect of the output gap on the unemployment gap: if the output gap changes by 1 percentage point, the unemployment gap changes by d percentage points. Probably because this version requires the estimation of quantities like the potential output and the NAIRU, which are not directly observable, it is less popular among researchers.

using the idea of increasing returns to scale. Classical economists since Adam Smith have emphasized the presence of static and dynamic economies of scale (or increasing returns) in manufacturing activities – which we can now generalize to all industrial activities – as being the most important engine of aggregate economic growth. What is the logic underlying this claim? A greater extent of the market, i.e., stable and growing sources of demand for industrial products, spurs a greater division of labor leading both to greater specialization and a higher differentiation of production; both of these cause higher productivity by generating greater skill and know-how leading, in turn, to product and process innovation. A characteristic of this classical logic of increasing returns, as emphasized by Young (1928), is that it operates at the aggregate and not firm level; it is a "macro-phenomenon" because much of the economies of scale result from increased differentiation that results in the emergence of "new processes and new subsidiary industries". Hence, testing for the presence of economies of scale at the level of the firm, as has often been done by economists of neoclassical persuasion, is an improper way to assess the strength of the classical logic of increasing returns. Kaldor (1966, 1967) provided an alternative, and theoretically more sound, method to test the presence of aggregate scale economies.

Kaldor interpreted Verdoorn's Law, in light of the classical logic of increasing returns, as an assertion about a positive relationship between output growth and productivity growth, with the causality running from the former to the latter due to the presence of static and dynamic economies of scale. It is important to note that Verdoorn's Law relates to a dynamic rather than a static relationship, a relationship between *growth rates* of output and productivity rather than between their *levels*. Why is this so? This is primarily because technological progress arising from "learning by doing" (Arrow, 1962) underlies Verdoorn's Law, as we have indicated above; it is "not just a reflection of the economies of large-scale production." (Kaldor, 1966). Since productivity, or real output per capita, is a measure of what economists call the "standard of living", Kaldor's rendition of Verdoorn's Law can be immediately seen as leading to a theory of demand-led economic growth. Thus, the rate of growth of output (standing as a proxy for aggregate demand or the extent of the market) becomes the factor limiting the rate of growth of productivity (standard of living) in sharp contrast to the neoclassical growth model (Solow, 1956; 1957) with resource constraints (e.g., labor and capital) as limiting factors.

A demand-constrained vision of economic growth such as is implied by Verdoorn's Law has a straightforward testable implication: a regression of productivity growth (dependent variable) on output growth (independent variable) should throw up a coefficient (on output growth) that is statistically significantly positive but less than unity. The coefficient on output growth should be positive to capture the positive impact of demand growth on productivity growth; and it should be less than unity to emphasize the fact that productivity growth is *limited* by the growth of demand. Such an empirical relationship between output growth and productivity growth, in turn, implies a positive relationship between output growth and employment growth of a similar nature. Since productivity growth increases less than one-for-one with output growth, it must be the case that the latter is positively correlated with employment growth with the partial effect of output growth on employment

growth less than unity.

We could have approached the matter from the other end too. Presence of static and dynamic scale economies imply that output growth will be in excess of employment growth. This immediately implies, since productivity growth is the difference of output growth and employment growth, that output growth must be positively correlated with productivity growth. By either route, we come to understand Kaldor's statement that Verdoorn's Law "asserts that with a higher rate of growth of output, both productivity and employment increase at a faster rate, the regression coefficients with respect to each being of the same order of magnitude." (Kaldor 1966; 1967).

Thus the Kaldor-Verdoorn Law can be seen as postulating a positive relationship between the growth rate of output and the growth rate of productivity (defined either as output per hour or output per worker) in the industrial sector of an economy, with special emphasis on the manufacturing industries. If g_t^Y represents the growth rate of output, g_t^y represents the growth rate of productivity then the Kaldor-Verdoorn Law can be stated as

$$g_t^y = -\alpha + (1-\beta)g_t^Y + \varepsilon_t. \tag{4}$$

Since the rate of growth of productivity is the difference between the rate of growth of output and the rate of growth of employment, the same relationship could also be stated as

$$g_t^E = \alpha + \beta g_t^Y + \varepsilon_t, \tag{5}$$

where g_t^E represents the growth rate of labour (either hours of work or number of workers). The most important coefficient in the Kaldor-Verdoorn regression is β (often called the Verdoorn coefficient or the Kaldor-Verdoorn effect), which gives the partial effect of output growth on employment growth: if the rate of growth of output increases by 1 percentage point, the rate of growth of employment increases by β percentage points.[4] Note that the reciprocal of $(1-\beta)$ gives the degree of returns to scale: if $(1-\beta)$ is significantly less than unity so that $1/(1-\beta)$ is significantly greater than unity, this provides evidence in favour of increasing returns to scale.

Following the celebrated debate between Rowthorn (1975a, 1975b) and Kaldor (1975), the growth rate of capital per worker, g_t^k, is also included as a regressor to control for the effect of capital accumulation; this modified version of the Verdoorn Law, which Michl (1985) termed the augmented technical progress function, emerges as:

$$g_t^y = -\alpha + (1-\beta)g_t^Y + \gamma g_t^k + \varepsilon_t.$$

Since the rate of growth of productivity is the difference between the rate of growth of output and the rate of growth of employment, the same relationship could also be stated as

$$g_t^E = \alpha + \beta g_t^Y + \gamma g_t^k + \varepsilon_t,$$

[4]Note that we depart a little from convention by calling β the Kaldor-Verdoorn effect; it is probably more common to call $(1-\beta)$ the Kaldor-Verdoorn effect. We stick to this alternative terminology because our analysis focuses on the link between employment and output growth.

where g_t^E represents the growth rate of labour (either hours of work or number of workers). The interpretation of the crucial parameter, β, remains the same as in the case without the growth rate of the capital-labour ratio: if $(1-\beta)$ is significantly less than unity so that $1/(1-\beta)$ is significantly greater than unity, this provides evidence in favour of increasing returns to scale.

While the effects of scale economies express themselves as a macro-phenomenon, as Kaldor had pointed out following Young (1928), he also insisted that there was an important sectoral dimension to keep in mind. The "phenomenon" of increasing returns that underlies Verdoorn's Law, according to Kaldor, is "particularly associated with so-called "secondary" activities – with industrial production, including public utilities, construction, as well as manufacturing – rather than the primary or tertiary sectors of the economy." (Kaldor, 1966). Why is this so?

The primary sector – agriculture and mining – can be expected to display the operation of diminishing returns due to the presence of a fixed input to production (e.g., land), as the classical economists had stressed; hence, the primary sector would not display strong Verdoorn effects since increasing returns to scale do not operate in such production activities. In the tertiary sector, which includes activities like transportation, wholesale and retail trade, banking and financial services, professional services, etc., on the other hand, increasing returns to scale are either not very strong or their effects, when present, peter out relatively fast. "Over much of this field [i.e., services], learning by experience must clearly play a role but economies of scale are nearly not so prominent and are exhausted more quickly." Why?

> Throughout a considerable part of this sector "productivity" is a meaningless notion, since "output" cannot be measured independently of "input". In areas, such as hairdressing, catering, or laundries, where output could, in principle, be measured independently, economies of scale, internal or external, are not likely to play an important role. In yet other fields, such as distribution, the growth of *total* output is merely a reflection of the rate of growth of commodity production. The rate of increase of productivity, provided that excess capacity exists, will in this case vary in automatic response to the rate of growth of production in the primary and secondary sectors, and the consequent growth in consumption. It is just as easy to sell two packages of cigarettes to a customer in a shop as one package. This is not meant, of course, to deny that large-scale methods of distribution are superior to small-scale methods, or to minimize the importance of labor-saving innovations, for example, the supermarkets. But the productivity growth resulting from such changes in techniques is not dependent on the rate of growth of aggregate demand: the productivity growth could equally well take place irrespective of whether the total turnover of the distributive sector rise fast or slowly. (Kaldor, 1967, pp. 21-22)

Using a sample of 12 advanced capitalist countries, Kaldor (1966) found strong evidence in support of Verdoorn's Law for the period 1953-54 to 1963-64. Not only did he find evidence of the Verdoorn Law for industrial activities, he also found that the primary and tertiary sectors either displayed a weak or a non-existent effect.

A criticism that has often been made against Kaldor's rendition of Verdoorn's Law, as for instance captured in (4), is the problem of possible endogeneity of output growth (Rowthorn, 1975b; Skott, 1999). If there is an impact of productivity growth on output growth, as might be expected by Kaldor's own argument about cumulative causation and economic growth, then the OLS estimator of β in (4) would be inconsistent and arguments based on such estimates, as for instance in Kaldor (1967), would be incorrect.

There are straightforward ways to deal with this criticism. From an econometric perspective, the problem of endogeneity can be tackled either by using a simultaneous equations approach, as was attempted in Parikh (1978), or by using instrumental variables estimation instead of ordinary least squares. The fact that the estimates in Parikh (1978) are still close to the original estimates of Verdoorn (1949) or Kaldor (1966) suggests, as pointed out by Michl (1985), that the endogeneity problem might not be very acute; hence, OLS estimates can be used as a first approximation of the "true" Verdoorn coefficient. From a theoretical perspective, exogeneity of the rate of output growth does not stand in conflict with Kaldor's cumulative causation argument. The cumulative causation argument can equally well rest on the basis of an effect of the *level* of output on productivity without in any way implying a causal impact of the *rate of growth* of output on productivity growth. Hence, the theoretical criticisms in Rowthorn (1975b) and Skott (1999) might not be all that damaging.

3 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 employment 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 harmonised across time according to the 2002 NAICS codes.[5]

3.1 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 measuable 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; wholesale 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;

[5]Details about this and other data sets used in the paper are collected together in the appendix.

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.

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; adminstrative 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.[6] 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

[6] 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.

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.

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.

3.2 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. 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.

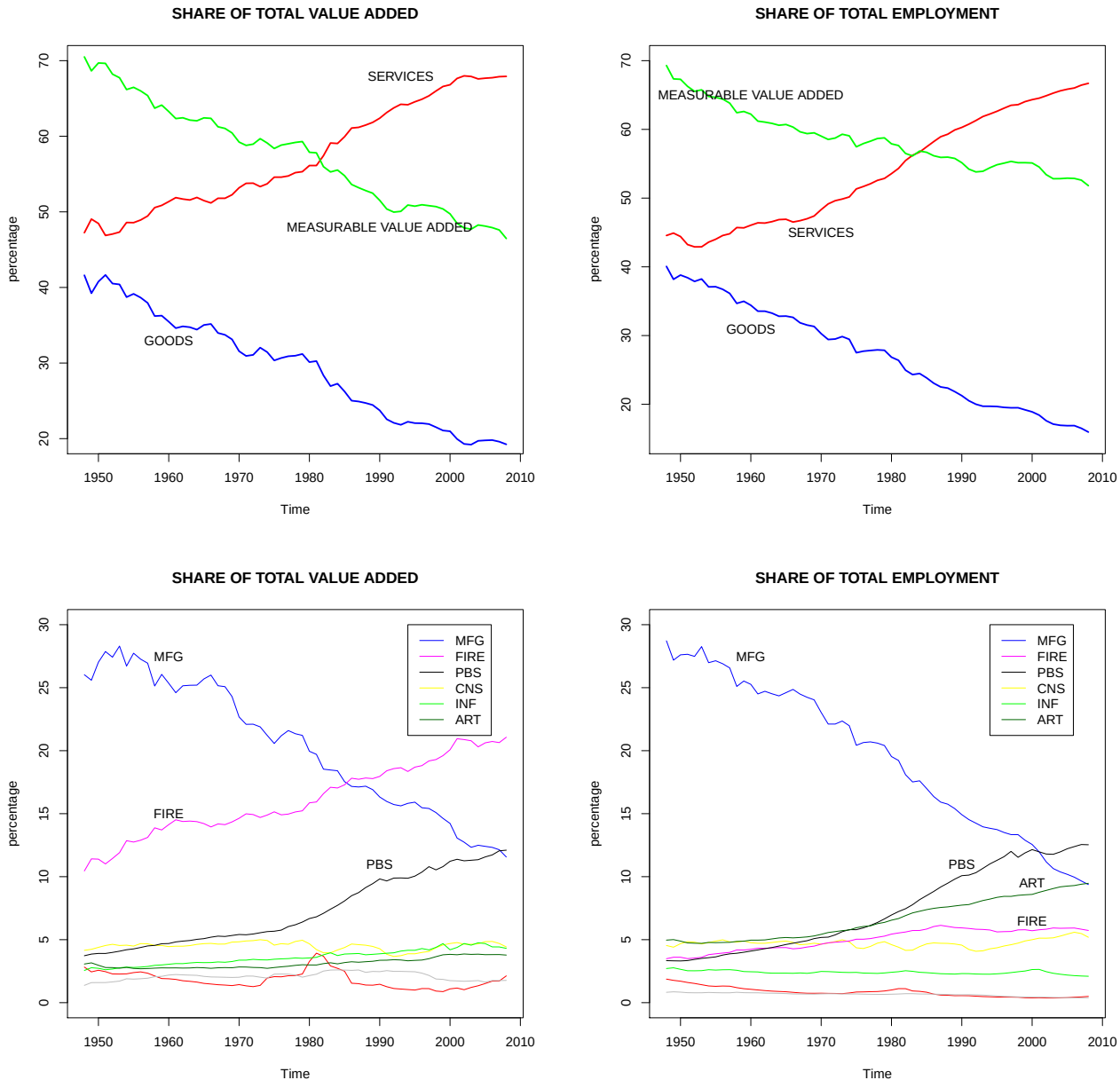

Figure 1: *Changing Sectoral Distribution of Output and Employment, 1948-2009*

Table 1: *Average Annual Compound Growth Rates*

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

4 Employment and Output

4.1 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. We have seen that 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 literature and the Kaldor-Verdoorn literature. We choose to work within the latter tradition because, to our mind, it has the following advantages over the Okun's Law type analysis.

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.[7]

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

[7]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).

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.

For these reasons, we use a dynamic version of the Kaldor-Verdoorn regression equation in (4) to study the changing relationship between output and employment in the post-war U.S. economy:

$$g_t^E = \alpha + \beta g_t^Y + \sum_{i=1}^{n} \gamma_i g_{t-i}^Y + \sum_{j=1}^{m} \delta_j g_{t-j}^E + u_t, \tag{6}$$

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 (6), 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, β in (6), measures the partial effect of output growth on employment output: β 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 coefficient. On the other hand, the long run impact of output growth on employment growth can be measured by β^*, where

$$\beta^* = \frac{\beta + \sum_{i=1}^{n} \gamma_i}{\left(1 - \sum_{j=1}^{m} \delta_j\right)}; \tag{7}$$

β^* 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.[8]

4.2 Some Specification Issues

The model in (6) 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.

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 (6) when the sample size for estimation

[8] In the context of Okun's Law-type analyses, a parameter like β^* is known as dynamic beta; for details on dynamic betas see, International Monetary Fund (2010).

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; we will allow for two lags of the independent variable to capture dynamic effects. Hence, the model we estimate is

$$g_t^E = \alpha + \beta g_t^Y + \gamma_1 g_{t-1}^Y + \gamma_2 g_{t-2}^Y + u_t, \tag{8}$$

with the contemporaneous Kaldor-Verdoorn coefficient given by β and the long run Kaldor-Verdoorn coefficient given by

$$\beta^* = \beta + \gamma_1 + \gamma_2. \tag{9}$$

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 (8). Rowthorn (1975b) and Skott (1999), as we have already seen, have pointed to the possibility of the endogeneity of growth rate of output in a regression like (8) 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 (8): 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 the Appendix 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.[9] 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 (6) by OLS gives reasonably accurate estimates of the "true" elasticities, both short run and long run, of employment with respect to output. That the instruments used for the endogeneity tests are indeed exogenous can be seen from the results reported in Table (7) in the Appendix 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.

[9]This analysis uses quarterly data; for details of the construction of the data set, see the Appendix.

4.3 Evolution of Relationship over Time

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. To do so, we estimate the model in (6) without lagged dependent variables for each post-War business cycle (peak-to-peak).[10] 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 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 2010Q2.[11]

Figure 2 and 3 plot the short run and long run Kaldor-Verdoorn coefficient over each post-War business cycle. The first row of Figure 2 and 3 give plots for the whole economy, and the non-financial value-adding sector of the economy[12]; 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 2 and 3.

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 2 and 3. 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

[10]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.

[11]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.

[12]The non-financial value-adding sector (NFVA), in this section and the next, is composed of the private goods-producing industries (mining, construction and manufacturing) and the private services-producing sector *less* finance, insurance & real estate. Thus, the NFVA in this sector is not identical to the MVA sector of section 3. Lack of national income data at sufficiently disaggregated levels prevent us from making the two definitions identical.

Table 2: *Testing for Decline in Elasticities*

	Post-War Period		Neoliberal Period	
SECTOR	Short-Run	Long-Run	Short-Run	Long-Run
ALL	4.16***	4.20***	2.71***	2.12**
NFVA	2.43***	2.07**	1.86**	1.82**
PGD	5.77***	4.61***	4.43***	3.15***
CNS	3.41***	3.13***	5.09***	2.08**
PSV	1.30	2.77***	1.37	1.36
FIR	-1.23	-0.89	0.66	2.93***

[a] 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 (10); a large positive value of the test statistic is evidence against the null. Significance levels: ***: 1 percent; **: 5 percent.

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 2 and 3 – and drives the result for the whole goods-producing sector.

While visual inspection of trends in Figures 2 and 3 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 elasticities – 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 β_1 and β_2 respectively in the two business cycles respectively. Let s_1^2 and s_2^2 be the heteroskedasticity and autocorrelation consistent (HAC) estimators of the variance σ_1^2 and σ_2^2, respectively, of

the OLS estimators $\hat{\beta}_1$ and $\hat{\beta}_2$. Then, the test statistic

$$t = \frac{(\hat{\beta}_1 - \hat{\beta}_2)}{\sqrt{s_1^2 + s_1^2}} \tag{10}$$

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.

4.4 Decomposition of Kaldor-Verdoorn Effect

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

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

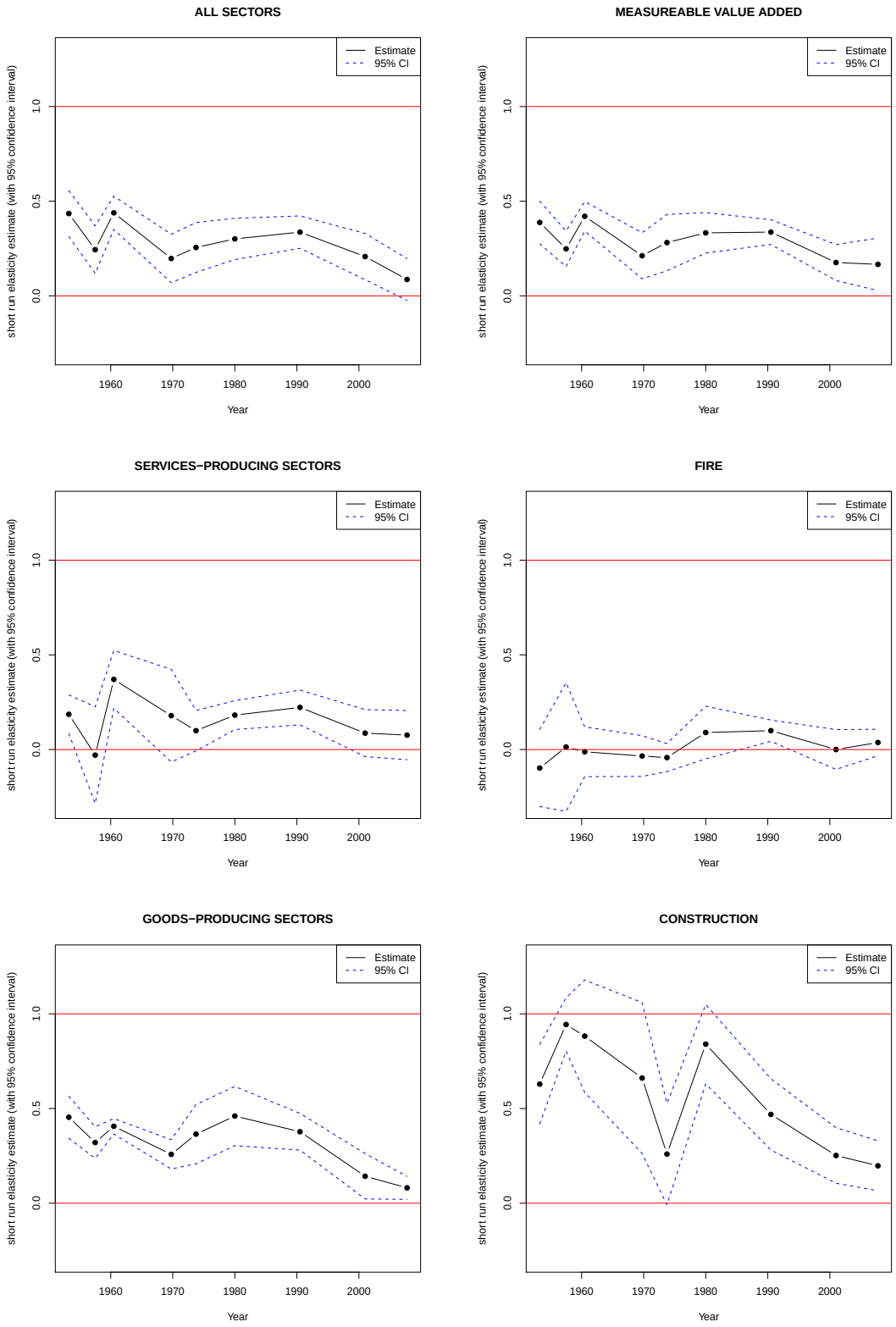

Figure 2: *Short Run Kaldor-Verdoorn Coefficient over Business Cycles (peak-to-peak)*

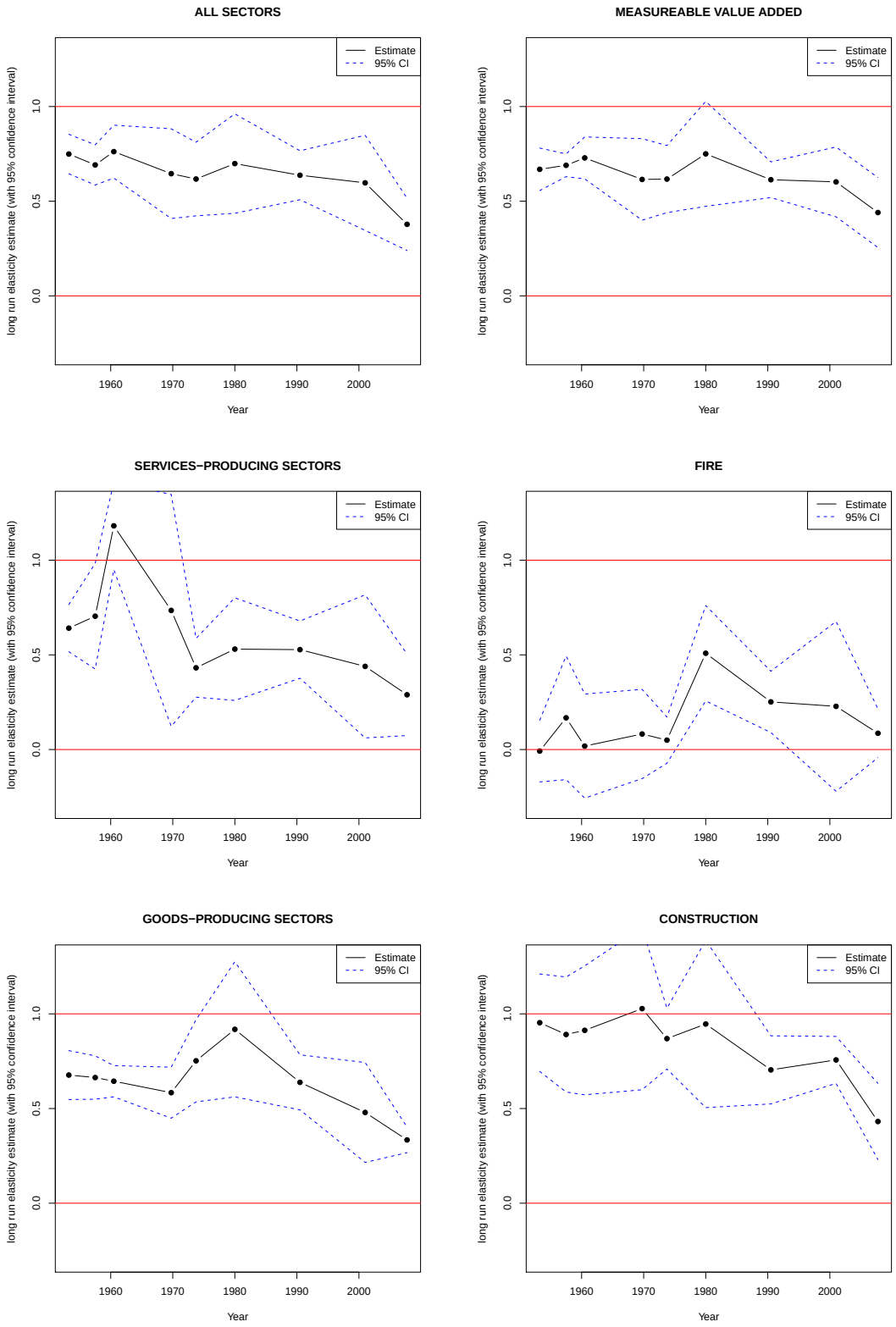

Figure 3: *Long Run Kaldor-Verdoorn Coefficient (without lagged dependent variable) over Business Cycles (peak-to-peak)*

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

$$\begin{aligned}\beta =& \frac{dg_E}{dg_Y} \\ =& S_E^A \beta^A \frac{dg_Y^A}{dg_Y} + (1 - S_E^A)\beta^B \frac{dg_Y^B}{dg_Y} + (g_E^A - g_E^B)\frac{dS_E^A}{dg_Y} \\ \approx& S_E^A \beta^A \frac{\Delta g_Y^A}{\Delta g_Y} + (1 - S_E^A)\beta^B \frac{\Delta g_Y^B}{\Delta g_Y} + (g_E^A - g_E^B)\frac{\Delta S_E^A}{\Delta g_Y},\end{aligned}$$

where β is the marginal effect of output growth on employment growth for the whole economy, and β^A and β^B are the marginal effects of output growth on employment growth for 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 β, β^A and β^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, $\Delta g_Y^A / \Delta g_Y$, and estimates of the marginal effects of output growth on employment growth $\hat{\beta}^A$ and $\hat{\beta}^B$ in the two sectors:

$$\hat{\beta} \approx \hat{\beta}^A (S_E^A \frac{\Delta g_Y^A}{\Delta g_Y}) + \hat{\beta}^B (1 - S_E^A)\frac{\Delta g_Y^B}{\Delta g_Y} + (g_E^A - g_E^B)\frac{\Delta S_E^A}{\Delta g_Y}. \tag{11}$$

For a period when the relative employment shares in the two sectors remain unchanged, the last term in (11) drops out and we have

$$\hat{\beta}_{CSE} \approx \hat{\beta}^A (S_E^A \frac{\Delta g_Y^A}{\Delta g_Y}) + \hat{\beta}^B (1 - S_E^A)\frac{\Delta g_Y^B}{\Delta g_Y}, \tag{12}$$

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.

Table 3: *Decomposition of Kaldor-Verdoorn Coefficients (PGD and PSV)*[a]

	Contemporaneous		Long Run	
Cycle	(1)	(2)	(3)	(4)
1948Q4-1953Q2	0.41	0.31	0.73	0.67
1953Q2-1957Q3	0.26	0.25	0.74	0.71
1957Q3-1960Q3	0.45	0.34	0.80	0.90
1960Q3-1969Q4	0.20	0.18	0.65	0.85
1969Q4-1973Q4	0.27	-2.05	0.64	-2.28
1973Q4-1980Q1	0.35	0.50	0.80	0.97
1980Q1-1990Q3	0.37	0.27	0.66	0.52
1990Q3-2001Q1	0.21	0.06	0.61	0.19
2001Q1-2007Q4	0.11	0.08	0.42	0.31

[a] Columns 1 and 3 give the estimated Kaldor-Verdoorn coefficient, i.e, $\hat{\beta}$ in (8); 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 (12).

Table 4: *Decomposition of Kaldor-Verdoorn Coefficients (NFVA and PVT-less-NFVA)*[a]

	Contemporaneous		Long Run	
Cycle	(1)	(2)	(3)	(4)
1948Q4-1953Q2	0.41	0.40	0.73	0.69
1953Q2-1957Q3	0.26	0.25	0.74	0.70
1957Q3-1960Q3	0.45	0.50	0.80	0.86
1960Q3-1969Q4	0.20	0.13	0.65	0.40
1969Q4-1973Q4	0.27	0.35	0.64	0.77
1973Q4-1980Q1	0.35	0.30	0.80	0.70
1980Q1-1990Q3	0.37	0.33	0.66	0.60
1990Q3-2001Q1	0.21	0.71	0.61	2.24
2001Q1-2007Q4	0.11	0.19	0.42	0.50

[a] Columns 1 and 3 give the estimated Kaldor-Verdoorn coffeicient, i.e, $\hat{\beta}$ in (8); 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 (12).

5 The Discrepancy in the Current Recession

With the results of this analysis at hand, we are now ready to return to one of the motivating questions of this paper: the huge 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^E_{t+k} and $\hat{g}^E_{t+k}$ 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 (8) 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

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

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

$$\hat{\bar{g}}^E = \left\{ \sqrt[n]{(1+\hat{g}^E_t)\ldots(1+\hat{g}^E_{t+n-1})} - 1 \right\} \times 400. \tag{13}$$

For instance, for computing the forecast peak-to-trough (average annual) employment growth rate for the 1991 recession, the model in (8) 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 (8). The forecast average annual growth rate of employment is then computed with the help of (13). Figure 4 plots $\bar{g}^E$ and $\hat{\bar{g}}^E$ for all the post-war downturns for the 6 industry grouping under investigation.

The comparison of the recovery period between actual and forecast employment growth is carried out in a similar manner. Since data is 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 four 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

$$\tilde{g}^E = \left\{ \sqrt[5]{(1+g^E_t)(1+g^E_{t+1})(1+g^E_{t+2})(1+g^E_{t+3})(1+g^E_{t+4})} - 1 \right\} \times 400;$$

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

$$\hat{\tilde{g}}^E = \left\{ \sqrt[5]{(1+\hat{g}^E_t)(1+\hat{g}^E_{t+1})(1+\hat{g}^E_{t+2})(1+\hat{g}^E_{t+3})(1+\hat{g}^E_{t+4})} - 1 \right\} \times 400. \tag{14}$$

For instance, for computing the forecast trough-to-recovery (average annual) employment growth rate for the 1991 recession, the model in (8) 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 (8). The forecast average annual growth rate of employment is then computed with the help of (14). Figure 5 plots $\tilde{g}^E$ and $\hat{\tilde{g}}^E$ for all the post-war downturns 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 busniess 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.

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. This raises the question of explanations for these structural changes.

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,

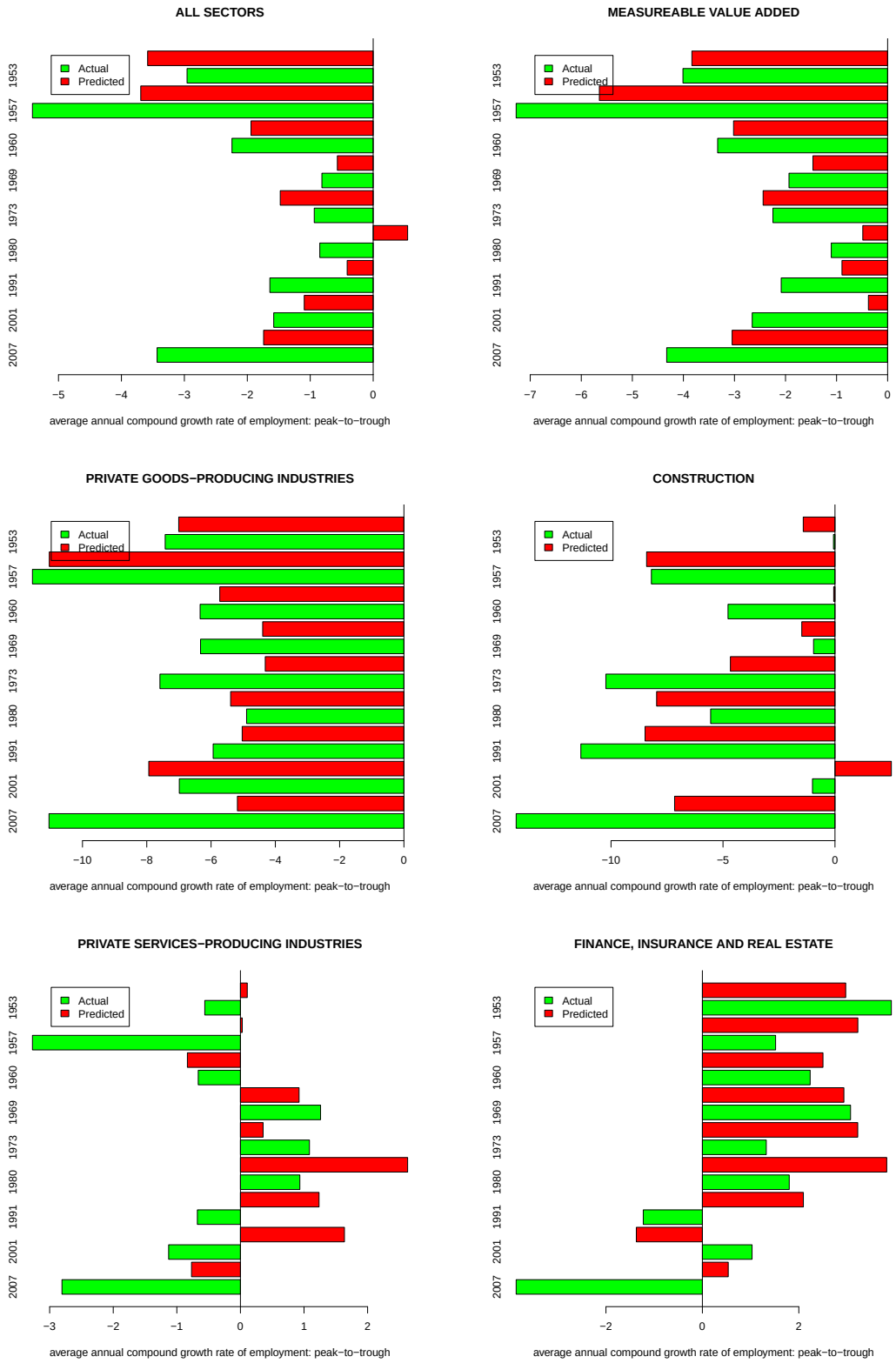

Figure 4: *Actual Versus Predicted Average Annual Compound Growth Rate (%) of Employment: Peak-to-Trough*

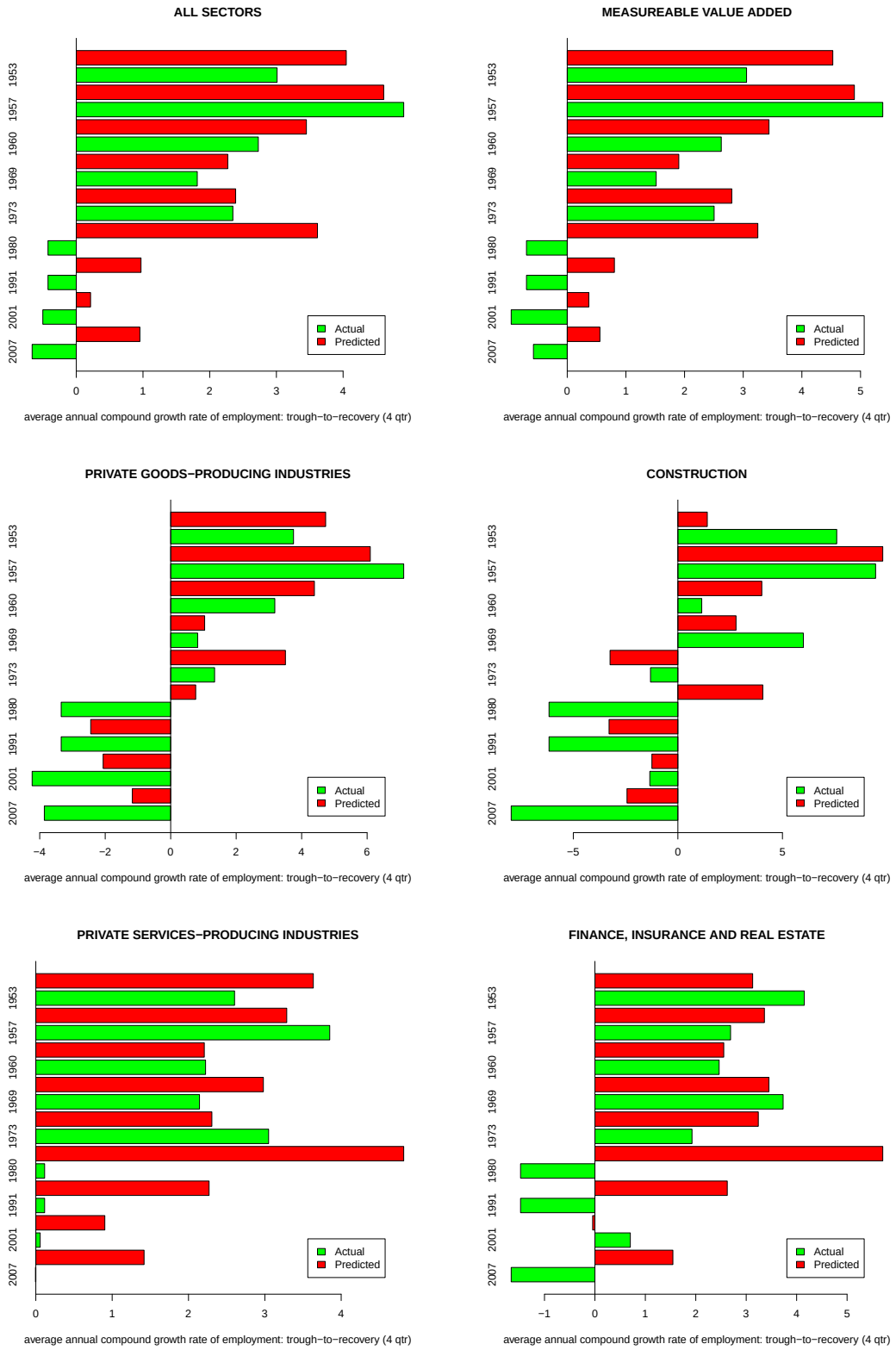

Figure 5: *Actual Versus Predicted Average Annual Compound Growth Rate (%) of Employment: Trough-to-Recovery*

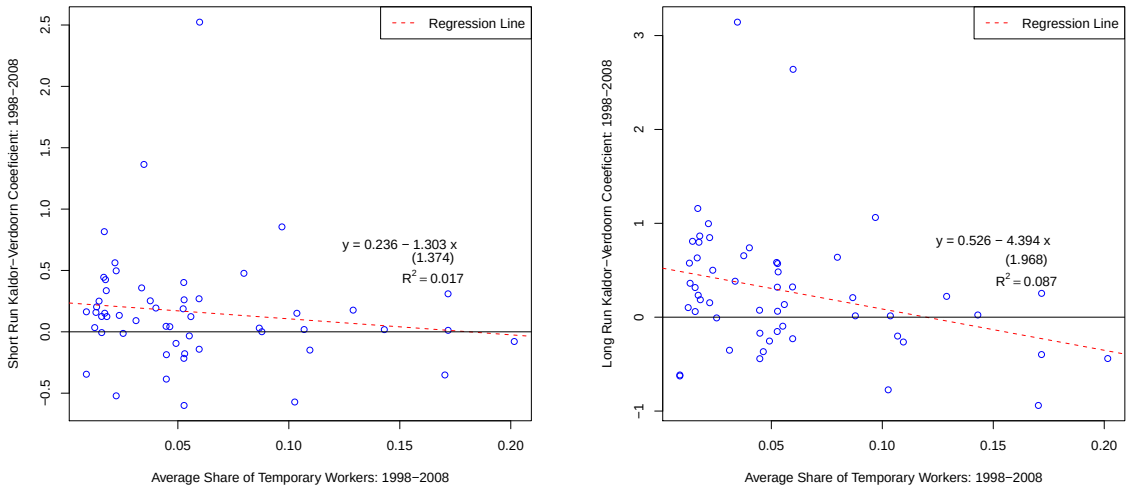

Figure 6: *Scatterplot of Kaldor-Verdoorn Coefficients Against Share of Temporary Workers for 54 U.S. Private Industries, 1998-08*

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 3, 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.[13]

Figure 6 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 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.

[13]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.

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. Thus when a computer manufacturer pays bonuses to its executives, the payments have no impact on measured value added in the sector; they shift income from residual profits to compensation of employees. On the other hand, when a financial institution pays bonuses to its employees, measured value added in the sector increases.

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 measureable 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 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.

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7 Appendix

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 endogenity tests of (8) 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.

7.1 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).

7.2 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).

7.3 Tests of Endogeneity

Here we report results from two statistical tests of the endogeneity of growth rate of output in (8): 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 6 and 5 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 (6) 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 (8).

Table 5: *HAC Score Test of Endogeneity*

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

[a] The null hypothesis is that the growth rate of output is exogenous in (8); 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*[a]

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

[a] The null hypothesis is that the growth rate of output in (8) 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*

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

[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`.