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Rising Wage Dispersion between White-Collar and Blue-Collar Workers and Market Concentration: The Case of the USA, 1966-2011[*]

by Ilhan Dögüs

Abstract

In this paper, I address the simple question "What types of employees have been steadily paid more by what type of employers?" and I suggest that rising market concentration has a significant structural impact on the wage differentials between white and blue-collar workers. The innovative contribution of this paper is to reveal this relationship of structural causality, which has been hitherto absent from the literature. The argument is tested via fred.stlouisfed annual datasets for the USA between 1966 and 2011 using Vector Autoregressive Model. The findings show that the responses of wage dispersion to one-unit shock in market concentration are positive and significant over a period of 10 years. Furthermore, 18% of variations in wage dispersion in the short-run and 30% of variations in the long-run are explained by market concentration.

Key words: market concentration, wage differentials, white-collar and blue-collar workers

JEL codes: L1, D4, J31

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... [T]he struggle about money-wages primarily affects the distribution of the aggregate real wage between different labour-groups, and not its average amount per unit of employment, as we shall see, on a different set of forces. The effect of combination on the part of a group of workers is to protect their relative real wage. The general level of real wages depends on the other forces of the economic system.

(Keynes, 1936: 14)

1. Introduction[1]

The stagnancy of wages in last decades in the USA (Pew Research)[2] refers to observation of overall average wages. However, the decomposition of real wages reveals that whereas the real hourly wages of the 10th percentile has decreased by 6,77% and of the 50th percentile by 5,98% from 1980 to 2011, the real hourly wages of the 90th percentile has increased by 28,6% during the same period (stateofworkingamerica.org, Figure 4C). The share of the top 1% of wage-earners in the USA has increased from 7,7% in 1980 to 14,1% in 2007 (stateofworkingamerica.org, Figure 4G).

An April 2016 Issue Brief of Council of Economic Advisers (CEA)[3] reports that market concentration in the USA has increased and that "*for 1977-2013 firm entry rates have declined over time, whereas firm exit rates have been more or less steady*" (CEA, 2016: 5). "*[B]y using plant-level data from the U.S. Census Bureau covering the entire manufacturing sector over the 1997 to 2007 period*," Blonigen and Pierce (2016: 4) of the Federal Reserve Board found that "*evidence for increased average markups from M&A activity is significant and robust*" (ibid., 24). In addition, some New-Keynesian studies[4] have documented the rise in markup in the US due to increased market concentration at the macro level. For example, the Aggregate Price-Cost Markup calculated by Nekarda and Ramey (2013: 11) has a similar path as my own calculation of market concentration (See Figure 1) by way of the ratio of value added to the wages of production workers as based on Gordon (1998)[5]. Other datasets that confirm the increase in market concentration in the USA at the macro level are as follows: Percentage of U.S. Manufacturing Industries in which Largest Four Companies Accounted for at Least 50 Percent of Shipment Value in Their Industries, 1947-2007 (Foster et al. 2012; see Figure 4) and asset share of top 100 firms (Brennan, 2016: 16).

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[1] This paper is a part of cumulative dissertation which deals with the relationship between market concentration and financialisation by way of the widening wage gap between white collar and blue-collar workers.

[2] http://www.pewresearch.org/fact-tank/2014/10/09/for-most-workers-real-wages-have-barely-budged-for-decades/

[3] https://www.whitehouse.gov/administration/eop/cea

4 See Afonso and Jalles (2015), Nekarda and Ramey (2013), Gali (1994), and Gali et al. (2007).

[5] In subsection 4.1, the measurement of concentration by way of the ratio of value added to the wages of production workers will be discussed in detail.

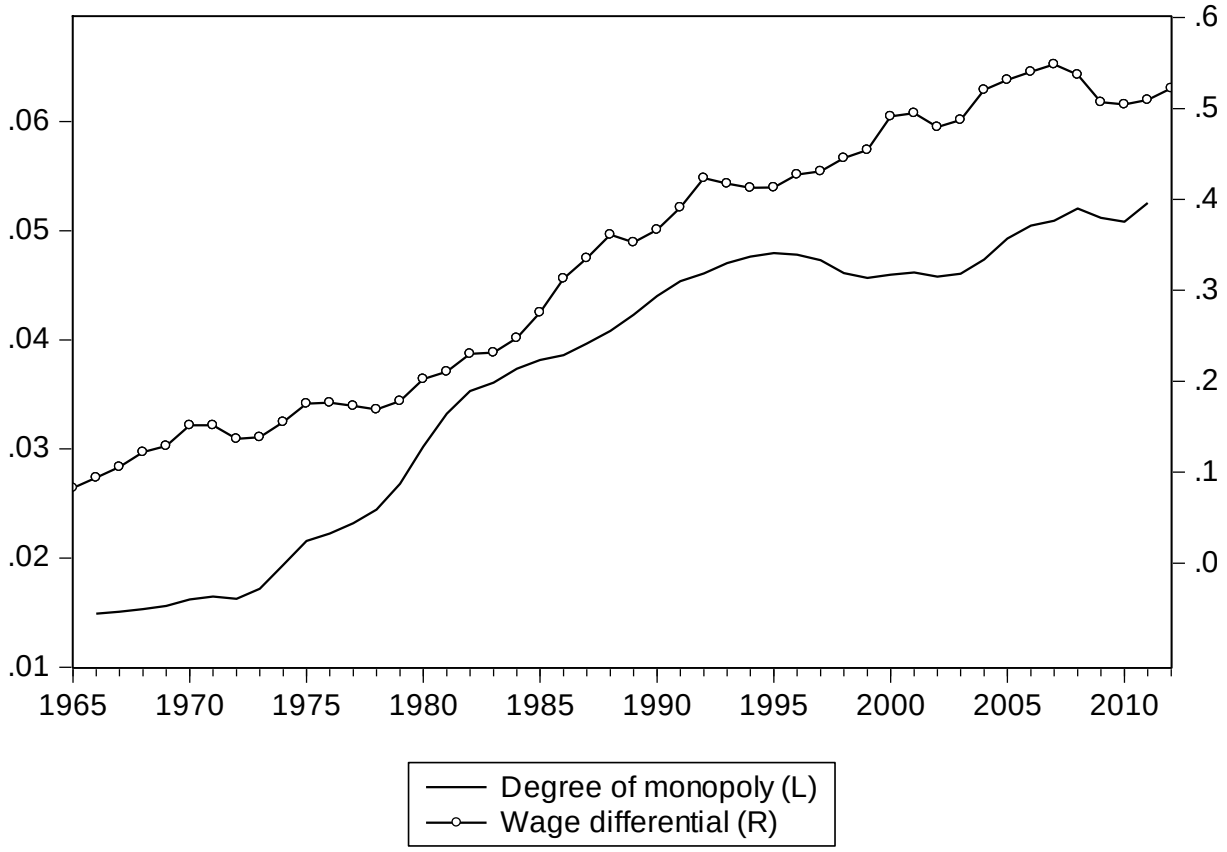

Figure 1: Market concentration (Degree of monopoly=Ratio of value added to the wages of production workers) and Wage differential (=ratio of salaries of ancillary workers to the wages of production workers). 1966-2011, annual data, USA. Sources: Own calculations based on https://fred.stlouisfed.org/.

Market structure plays a crucial role with respect to wage inequality, since the "*struggle about money-wages*" (Keynes, 1936) is different across different types of employees and employers and also "*because the structure determines the behavior of the firms*" (Sawyer, 1981: 147). More precisely, the greater bargaining power of workers employed by large dominant firms, which can easily have their prices reflect changes in their costs, allows them to increase their money-wages more easily than weaker workers employed by competitive small- and medium-sized enterprises (SMEs), which cannot so readily adjust their prices to reflect cost changes (Allen, 1968).

Starting from the fact that "*the top-end wage inequality has increased more than low-end wage inequality*" (Lemieux, 2008), in accordance with the question "What types of employees have been steadily paid more by what type of employers?", this paper aims to examine the relationship between wage inequality and market concentration (see Figure 1), which has not hitherto been elaborated in the literature.

The higher impact of *industry internal* wage inequality (by 85-90%), as compared to *cross-industry* wage inequality, on overall wage inequality in the USA between 1965-2015 (Kristal and Cohen, 2016: 12) shows (i) that increased wage inequality across all sectors has been a macro issue, not a sectoral issue. Moreover, a long-lasting secular increase in wage differential indicates a structural change. (ii) If "*the struggle about money-wages*" (Keynes, 1936) within all sectors has been differentiated, then wage dispersion has to cover all occupations in all sectors. Since occupations are categorized

mainly as ancillary labor (white-collar work) and production labour (blue-collar work), the analysis relies on this distinction.[6]

My distinction between white and blue-collar workers has nothing to do with the skill-level of workers, unlike that proposed by the SBTC approach. Rather, it is based on the tasks workers perform. The essential point is whether these tasks are ancillary, innovative tasks whose purpose is to increase the market share / market power of the firm or tasks whose purpose is simply to produce goods and services. Blue-collar workers may also be highly-skilled, in order to be able to manage computers during the production process[7]. Gordon lists a wide range of ancillary tasks aimed at increasing market share (Gordon, 1998: 327)[8].

Two main approaches on wage differentials dominate the literature. Whereas the Skill-Biased Technological Change (SBTC) approach[9] identifies the computerization of production as the main reason behind wage dispersion, according to the alternative approach, which I call the Institutional Change approach[10], rising wage differentials have been mainly driven by institutional changes (such as de-unionization, stagnating real minimum wages, performance-based pay, deregulation of labour markets, decentralisation of collective agreements [Wallerstein, 1999], a declining share of the government sector in employment, etc.). Kristal and Cohen claim that "*the decline of pay-setting institutions is almost twice as important as technology-driven demand for skilled labour in explaining rising inequality within US industries*" (Kristal and Cohen, 2016: 21).

In short, the debate is about whether wage dispersion has been driven by market forces or non-market forces. However, this debate has neither adequately considered the impact of change in market structure on wage dispersion nor its impact on market and non-market forces. Both approaches fail clearly to indicate what types of firms have been paying superior wages to a high-skilled labour force. They rely on assumptions that are appropriate to an average representative firm.

This is not to say that I reject the impact of computerization and institutional changes on wage dispersion. What I try to show is that market structure also has a significant impact on wage dispersion[11], based on the assumption that market structure

6 Due to the fall in the employment share of blue-collar workers, wage dispersion between blue-collar workers employed by large firms and those employed by small firms is negligible. Moreover, the relevant data was not available.

7 The white-collar/blue-collar distinction might appear confusing, since some jobs might correspond to white-collar jobs despite their having nothing to do with increasing market power. Nonetheless, it represents the option that can be most readily tackled by way of analysis of the available data. Calling innovative ancillary labour white-collar work and manual labour blue-collar work would not lead to crucial empirical and theoretical shortcomings, despite the existence of challenging examples such as cleaners, accountants, etc.

8 See Blanchflower and Oswald (1990) for a similar definitions and a similar distinction.

9 See Aghion et al. (2001), Aghion and Howitt (2002), Autor et al (2005 and 2008), Autor (2014), Acemoglu (1998, 1999 and 2003), Acemoglu, and Autor (2010 and 2011), Burstein et al (2016), and Katz (1999).

10 See Card (2001), Card and DiNardo (2002), Card, et.al (2004), DiNardo et.al (1996), Kristal and Cohen (2016), Lemieux (2008) and Sjöberg, (2008), Freeman (1993 and 2005), Wallerstein (1999) and Wallerstein and Western (2000), and Herr et al (2014).

11 The relationships between market concentration and both institutional changes (such as unionization, regulations, minimum wage, etc.) and technological changes lie outside the scope of this paper. For a discussion of the relationship between market concentration and unionization, see Hodson (1983),

differentiates the positions of employers and employees and thereby differentiates the struggle about money-wages among employees.

In this paper, it will be suggested that increased market concentration has a significant and structural impact on the widening wage differentials between white and blue-collar workers (or, to put it differently, on the gap between the salaries of ancillary labour and the wages of production workers)[12].

To put it differently, the relationship between market concentration, on the one hand, and wage dispersion between white-collar and blue-collar workers, on the other, is a relationship of structural causality. By the word *structural*, I mean to imply that the relationship is not merely temporary and contingent, but has a long-lasting (and even maybe a path-creating) impact[13]. Since the increase in market concentration indicates a change in market structure[14], its relationship with wages implies a structural causal relation.

The argument relies theoretically on Minsky's understanding of the output-price setting of price-taker and price-maker firms: In contrast to dominant price-maker firms, "*price-taking firms will tend to have smaller overhead and validating costs of capital per unit of output than price-making firms*" (Minsky, 1986: 181). In keeping with this conception, I assume that in a more concentrated market structure, employment and pay of ancillary white-collar labour will be higher than manual blue-collar labour. More precisely, I do not discuss firm-size wage premiums among the same type of workers or intra-firm wage premiums (Jirjahn and Kraft, 2007), but rather a structural change in the market that causes wage dispersion among workers performing different tasks at the macro-level.

The argument will be tested by way of US annual data for the period between 1966 and 2011 using Vector Autoregressive (VAR) Model, as it is assumed that market concentration leads to wage dispersion in the long-term in the manner of a structural cause. The reason for using a US macro data set covering a 45-year time span is to demonstrate and to capture this long-run structural tendency during the recent decades in which the dramatic changes in question have taken place.

The paper is structured as follows. After a brief review of the literature in section two, section three deals with the relationship between market structure and wage structure: namely, the theoretical explanation as to why white-collar workers' salaries and employment share has a tendency to be higher in concentrated markets. Section four tests the argument empirically using a VAR model by way of the impulse response function (which reveals whether the causality is direct or not) and variance decomposition analysis. Finally, the last section concludes.

Conyon (1992 and 1994), and Henley (1987), as well as Gordon (1998). De-unionization might be associated with the increase in the share of white-collar workers (see Figure 2), who have a relatively lower tendency to unionize (Aghion et al., 2001 and Mishel, 2012). See footnote 17 for suggested readings on the relationship between competition and innovation.

[12] The question as to whether change in market concentration is the main factor and SBTC and institutional changes merely secondary factors calls for further research.

[13] The flipside of this relationship, viz. that rising wage dispersion consolidates and spreads the concentration across sectors through white-collar workers' consumption of expensive high-end goods produced by other dominant firms in other sectors, calls for further research.

[14] A structural break in market concentration took place in 1982. See table 7 for structural break-test results.

2. Review of the Literature on the Relationship between Market Concentration and Wage Dispersion

Lin and Tomaskovic-Devey (2013) and the outdated contributions of Irfan (1979), Bruce (1968), Allen (1968), and Jones and Laudadio (1975) are the only studies that I could find that consider the relationship between market structure and wage differentials. However, their analyses refer to concentration at the sectoral level and wage dispersion between industries, not at the macro level, as discussed in this paper.

Bruce (1968) and Irfan (1979) cannot support their hypotheses through empirical analyses. Irfan (1979: 40) found that market concentration (measured by the share of the four largest firms) had an only marginally significant (10% level) and weak impact on wage dispersion in Pakistan between 1969 and 1971. Bruce (1968) concludes that

> *What is not clear is whether the source of these relative wage gains has been the product-market monopoly power of the firms involved. In part, the observed relation between concentration and wage increases may have been spurious.* (Bruce, 1968: 365)

Using the Canadian dataset for the period between 1965 and 1969, Jones and Laudadio (1975) found that goods market imperfection has a role on wage differentials by way of higher unionization in concentrated sectors. But they did not employ the same theoretical reasoning as this paper and they did not focus on the macro level. Allen concludes that "*concentration was significantly and almost continuously associated with larger annual increases in earnings from 1951 to 1962*" (Allen, 1968: 359).

Lin and Tomaskovic-Devey (2013), on the other hand, do not take into account concentration as a leading decisive factor. Rather, they employ it in their regression only as a control variable and find that it has a negative relationship with wage inequality, even though they also found that it has a positive impact on managerial pay.

Autor et al. (2005) consider changing employment composition with regard to rising upper-end wage inequality. They do not, however, take into account the rise of higher-paid white-collar workers as a function of an increase in market concentration at the macro level. Antonczyk et al. (2010) found that in the case of western Germany between 2001 and 2006, firm size played only a small role in wage inequality (Antonczyk et al., 2010: 21 and 40). Card et al. (2016) claim that firm size matters for wage inequality with regard to productivity differences for the same occupation groups. But they do not deal with the rise in market concentration and change in the composition of occupations (i.e. with respect to white- and blue-collar workers).

Besides Minsky (1986: 174), Gordon (1998) and Sawyer (1985: 27), Cowling (1982) also recognizes that the rising degree of monopoly, i.e. concentration, is associated with increasing overhead costs (namely, non-production costs including the salaries of white-collar workers) in the UK economy since the mid-1960s (Cowling, 1982: 173). However, this work is also outdated.

Fernandes et al. (2014a), Murphy (2013), and Hartzell and Starks (2003) deal with the relationship between level of competition and executive pay, but not specifically with the wage differential between white-collar and blue-collar workers. Fernandes et al. (2014b) discusses skill premium and concentration. Its findings, however, stand in

contradiction to the argument of this paper: "*increased product market competition, which resulted from deregulation, increased the returns to a university degree and the returns to skill*".

Almeida-Santos et al. (2010) deals with wage dispersion between white-collar and blue-collar workers, but merely in relation to training.

Palley (2006 and 2015) deals with the impact of wage dispersion between managers and production workers on growth and on the character of the growth in question (i.e. wage-led or profit-led), but not with market concentration. Vasudevan (2015) emphasizes the role of managerial class in rising the markup rate, but not the role of white-collar workers as this paper does.

Thus one of the original contributions of this paper is to reveal the structural relationship between market concentration and wage differential and to test it via contemporary macro-data.

3. Understanding the Wage Structure via the Market Structure

For a more coherent and comprehensive explanation of rising wage inequality, it should first be clarified what type of firms pay more to what type of employees. However, economists have not paid attention to the impact of firm size on wage dispersion, because of the belief that "*inter-size wage differentials are minor*" (Tachibanaki, 1997: 12). This belief might arise from the fact that they pay attention to *intra-occupational inequality* among firms (generally speaking, within blue-collar occupations and white-collar occupations, taken separately), but not to *cross-occupational inequality*.

Cross-occupational inequality has to be taken into account, due to the fact that large firms employ more and pay more on overhead and to ancillary salary earners – namely, white-collar workers (who carry out innovative tasks such as R&D, design and differentiation of products, financial/capital market operations, market research, advertising and sales operations, etc.) – as compared to manual labour (blue-collar workers) (Minsky, 1986).

Tachibanaki claims that the wage gap between white-collar and blue-collar workers is a universal fact, apart from a few exceptions (Tachibanaki, 1997: 2). However, there is no explanation provided for the increase in wage dispersion that has been experienced in the last three decades.

Regarding why white-collars are paid more, it has been argued that white-collar jobs require education and training to handle more complicated and difficult tasks (Tachibanaki, 1997: 2-3).

However, the abovementioned non-production tasks performed by white-collar workers are not paid more just because they are complicated and difficult, but also because they function to increase or at least to preserve the market share of the firm (Kalecki, 1954; Minsky, 1986; Sawyer, 1981 and 1985; Shepherd, 1997; Steindl, 1990). In the case of such tasks, whether through cost-reducing new production technologies or through demand-elasticity reducing product differentiations and advertising (Sawyer, 1981: 107-111), the aim is to reduce the break-even point of the firm where costs and revenues are

equalized (Steindl, 1990: 305-306). Once the break-even point has been lowered, the firm can either charge a higher markup or reduce its prices to drive rivals out of the market or to prevent new entries into the market. Hence, as Steindl notes, "*break-even point is a measure of the degree of monopoly*" and "*the break-even point will be lower if mark-up is higher*" (ibid., 307).

In this connection, it could be argued that large dominant firms are inclined to employ and pay more to white-collar workers, in order to increase and/or maintain their dominance. Due to their stronger balance sheets, larger firms are more capable of doing so (Minsky, 1986: 181). Small firms, due to their more elastic demand curves and restrictive cost structures, cannot afford to employ and to pay white-collar workers as much as large firms.[15]

It should be noted that I do not mean that large firms pay higher wages merely after white-collar workers have accomplished innovative tasks and if they have increased the firm's market share. Rather, the already dominant large firms, as well as firms that endeavor to challenge the dominant firms via innovation, employ relatively more and hence pay more to white-collar workers than blue-collar workers for their market-power-increasing innovative tasks.[16] Wright stresses that "*large-scale, monopoly corporations, therefore, would be expected to have steeper income gradients within their managerial structures than would smaller, competitive enterprises*" (Wright, 1979: 90).

Sawyer asserts that the risks and costs of innovations that are brought about by the employment of scientists and engineers favour large firms (Sawyer, 1981: 126) and he notes that in the mid-1960s in the UK, large 100 firms accounted for 69.5% of R&D programs.[17] The United States Department of Agriculture provides more current empirical evidence, showing that market concentration in the agriculture sector has increased from 1994 to 2009 and the "*the largest agricultural input firms are responsible for a large and growing share of global agricultural research and development*" (USDA, 2012)[18].

Hence, R&D and the computerization of production technology, which might be conceived as technological instrument for reducing the break-even point, have for the most part been first introduced by large firms that can afford them. Innovation does not drop from the sky by itself; rather, it is a byproduct of market forces.

[15] SMEs running non-production businesses (such as consulting, finance, accounting, insurance, advertising, market research, and so on) can be regarded as derivative of the rising market concentration, since these SMEs mostly undertake outsourced tasks. For a discussion outsourced tasks and global value chains, see Gereffi et al. (2005).

[16] As premiums, fees, commissions, and bonuses in return for the success of white-collar workers are not recorded in income statements under wages and salaries, we cannot conceive of them in terms of a wage differential that reflects the difference between the salaries of ancillary labour and the wages of production labour.

[17] For discussion from a Schumpeterian viewpoint of the (inverted U-shaped) relation between level of competition and innovation or technological advances, see Tingvall (2006), Crespi (2008), and Aghion (2005). Very briefly, this literature suggests that after a certain point of market concentration, as long as they can keep their market share under the given conditions, dominant firms do not innovate, even though they can afford to do so, because of lower competitive challenges.

[18] http://www.ers.usda.gov/amber-waves/2012-december/rising-concentration-in-agricultural-input-industries-influences-new-technologies.aspx#.V87qtjVMr6n

Elucidating the relationship between the break-even point and overhead costs (paid to white-collar worker) by way of price-output settings of firms would help us to comprehend why larger firms pay and employ more white-collar workers and thereby how wage differentials have essentially been driven by rising market concentration.

One of the most important differences between the price-output settings of price-taking small firms and price-making large firms is that whereas price-makers can vary their output level between a lower break-even point and an upper break-even point[19] in a wider range against deviations in demand[20], price-takers do not have this possibility[21]. This is because price-takers "*are forced to accept what they can get; they take price as a parameter and set output along their MC* [marginal cost] *curve*" (Minsky, 1986: 181).

The second important difference between price-taking and price-making firms is the gap between their cost curves. Firstly, the gap between the price level and average technologically determined costs (i.e. average direct production costs; ADPC), namely markup (ibid., 173), is wider in the case of oligopoly. Secondly, larger firms have a wider gap between ADPC and average overhead costs (AVOV), as they employ more white-collar workers (in sales operations, advertising, marketing, design, R&D, business management, etc.) in pursuit of enhancing and preserving their market share.[22] For example, Sawyer reports that according to the findings of Marcus, based on a sample of 78 consumer goods industries, advertising can contribute to industrial concentration (Sawyer, 1981: 118).

From this it could be inferred that a higher markup, and a higher share of AVOV within costs, would widen the gap between the lower break-even point and the upper break-even point, since innovative tasks performed by overhead labour lower the break-even point and thereby increase the markup. Minsky underscores this point as follows:

> *Market power, which allows a firm to constrain price movements when demand falls, may be a prerequisite for the use of expensive and highly specialized capital assets and large-scale debt financing*. (Minsky, 1986: 181)

However, "*price-taking firms will tend to have smaller overhead and validating costs of capital per unit of output than price-making firms* (ibid., 181). This is because in order to have a buffer against falling prices, smaller competitive firms have to hold debt and overhead costs at a lower level and near to technologically-determined costs. It is thus that they are able to survive if prices fall dramatically.

The other factor explaining why the share of white-collar workers within employment

[19] Beyond the lower break-even point, revenues exceed costs; and beyond the upper break-even point, costs again exceed revenues.

[20] Being able to vary output corresponds to large firms' ability to hold the desired excess capacity, as Steindl (1952) has pointed out.

[21] See Lee (1999) for discussion of Post-Keynesian pricing theory. I prefer Minsky's pricing model, as he considers the role played by the financial situation (cash-flows) of firms in pricing decisions.

[22] Minsky defines this difference "*as allocations of profits, a use of the surplus*" (Minsky, 1986: 173). It is, however, debatable whether salaries of white-collar, ancillary workers should be considered as wage costs or allocation of profit. Although it falls outside the scope of this paper, I would just like to point out that in order to be able to define salaries of ancillary labour as "profit allocation", they would have to be paid under the condition of profit realization. If they are paid regardless of profit realization, like wages to production labour, then they must be considered as wage costs. King and Regan (1976) criticizes Kalecki, since he treats salaries as fixed costs.

rises with market concentration is that *"overhead, advertising, research and development expenditures, and staffs will be protected until output approaches and even falls below O1*[23]*"* (ibid., 180). Besides the higher blue-collar unemployment rate, according to the database of the *Bureau of Labour Statistics (BLS)*, the average displacement rate of white-collar workers between 1981 and 1998 was 2.71%, whereas for blue-collar workers it was 4.62%.[24] The argument is also supported by the findings of Dwyer and Wright (2003: 304), which suggest that net job creation in the top-paying quintiles was not negative during the contractions of 1973-74 and 1980-82[25].

Two main concerns explain the protection afforded the employment of ancillary white-collar workers: (i) the higher turnover costs of white-collar workers due to training and replacement costs; and (ii) the market-share-increasing strategic role of the tasks performed by white-collars.

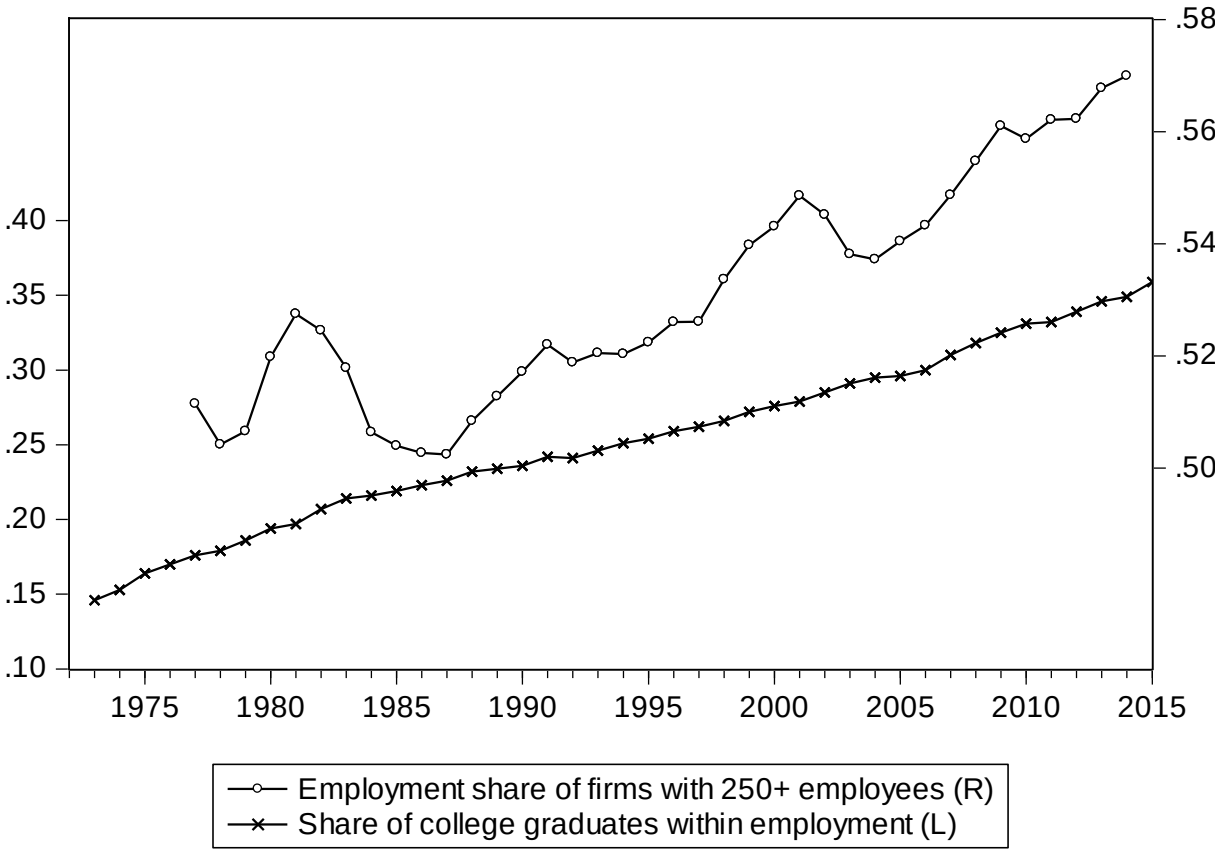

Figure 2: Share of college graduates within employment and employment share of firms with more than 250 employees, 1973-2015, USA. Source: http://www.epi.org/data/#?preset=wage-education and http://www.census.gov/ces/dataproducts/bds/data_firm.html

As a result, as the ratio of white-collars workers to blue-collar workers – or, in other words, the share of overhead costs within overall production costs – rises, higher markups become more applicable (Sawyer, 1985: 27). As Minsky puts it:

[23] O1 refers to the lower break-even point.
[24] http://www.bls.gov/opub/ted/2001/july/wk5/art04.txt
[25] It was only during the contraction of 1990-92 that it was negative, but still less so than in the other quintiles. This means that the contraction of 1990-92 caused large firms' output to fall under the break-even point.

> *If the ratio of overhead and ancillary wages to technologically determined wages is higher for every output, then the markup and the price of the product will be greater for every level of output than in the absence of such spending*. (Minsky, 1986: 174)

Within this framework, the rise of white-collar workers[26] (as shown in Figure 2) seems to be the product not only of exogenous SBTC, but also of market concentration, since dominant firms employ "*expensive and highly specialized capital assets*" (Minsky, 1986: 181) and white-collar workers, in order to enhance and preserve their market power and market share.

It should be kept in mind that the diffusion of a new innovation – either in production technologies or in advertisement, sales promotions, product differentiation, etc. – introduced by a single (large) firm depends on the employment share of white-collar workers in other firms: workers that are need to implement and adopt or to imitate this new innovation. The higher share of white-collar workers within an industry expedites the diffusion of new innovations to other firms. This, in turn, creates a path in which market concentration and the employment of white-collar workers feed back upon themselves until a certain threshold has been reached.

Since the market power of price-takers is restricted, their ability to employ ancillary labour and the share of overhead costs in their costs are also restricted as compared to large firms. The combination of Figure 1 and Figure 2 would support this argument: There is a very strong relationship between the rise of white-collar workers' share in employment composition and measured market concentration. This relationship will be tested in the empirical part.

In the case of a concentrated market, effective demand is structurally weakened by the increased wage dispersion between white and blue-collar workers (see Figure 1), as this leads to a decrease in the purchasing power of blue-collar workers and to an increase in the savings of white-collar workers. The following price equation helps to explain this:

$$Pc = \frac{Wc}{Ac}(1 + \frac{WiNi}{WcNc} + \frac{Df}{WcNc} + \frac{\pi T\pi}{WcNc} + \frac{C\pi}{WcNc} - \frac{Sw}{WcNc})^{27}$$

Equation 1: Price equation of Minsky. Source: Minsky (1986: 171)

If we modify Minsky's price equation (Equation 1) by replacing the Wi and Ni (wages and numbers of workers in the capital goods producing sector) with Ww, Nw (wages and numbers of white-collar workers) and the Wc and the Nc (wages and numbers of workers in the consumption goods producing sector) with wages and numbers of blue-collar workers (Wb, Nb), we obtain:

$$Pc = \frac{Wb}{Ab}(1 + \frac{WwNw}{WbNb} + .. - \frac{Sw}{WbNb})$$

Equation 2: Modified price equation

[26] The share of college graduates has increased from 14.6% in 1973 to 35.9% in 2015 (See http://www.epi.org/data/#?preset=wage-education)

[27] Df stands for trade deficit, $\pi T\pi$ for goverment deficit, Cπ for consumption out of profits, Sw for savings out of wages.

Minsky does not himself modify his equation in terms of white and blue-collar workers, but makes a statement that supports the procedure:

> *The greater the ratio of wage income from ancillary and overhead services to wage income that is determined by technology, the higher the demand price per unit of output relative to technologically mandated production costs*. (ibid., 174)

From this point of view, the differentiation of the struggle about money-wages between blue-collar and white-collar workers can be better understood. The higher-markup-charged, high-end goods produced by dominant firms are consumed mostly by higher-paid white-collar workers employed by large firms, whereas lower-paid blue-collar workers' consumption of these expensive goods is more restricted.

In other words, in the case of concentrated markets, higher markups are reflected in a higher price level, as white-collar workers validate their own employment via their consumption, which has been enabled by the higher wage dispersion (ibid., 174).

There are two main empirical findings that support the argument that the main leading factor behind rising wage dispersion is an increase in market concentration. Firstly, as reported by Kristal and Cohen, about 85-90% of overall wage dispersion in the USA between 1965 and 2015 was brought about by industry-internal wage dispersion. The rest (15%) can be attributed to dispersion between industries (Kristal and Cohen, 2016: 12). If the wage dispersion between industries had a stronger impact on overall dispersion, then it would be possible to say that (i) the dispersion has increased merely because of some technological, institutional or other external changes, which led only some industries to expand and thereby to be able to pay more as compared to other industries and (ii) that this process has not been diffused to other sectors.

In this sense, the argument that a sectoral shift (i.e. a shift from the production to the service sector) might be an explanatory factor behind wage dispersion (Heise, 1997: 369) appear to be unconvincing for two reasons: firstly, since labour supply would adapt to the changes in sectoral requirements in the long-run, which might reduce wage dispersion. Secondly, all sectors, including the service sector, have experienced both concentration and wage dispersion (See Figure 3).

The stronger impact of industry-internal wage dispersion on overall dispersion also confirms that all sectors have experienced the rise of large firms that can more readily afford the payment and employment of white-collar workers. This point justifies the use of market concentration at the macro-level, since the concentration in question is a structural and a macro issue.

The second point is that top-end wage inequality has increased more than low-end wage inequality (Lemieux, 2008). According to my own calculations based on *The State of America*[28] dataset, whereas for male wage-earners, wage inequality between the 50^{th} and 10^{th} percentiles has increased in the USA from 1973 to 2012 by 5.7% (and for female wage earners, by 6.55%), the dispersion between the 90^{th} and 50^{th} percentiles of male wage earners has widened by 32.8% (for female workers, by 28.9%). The faster increase in top-end wage dispersion as a function of managerial pay-schemes is also a result of an increasing number of large firms, which prioritize the employment of

[28] http://stateofworkingamerica.org/chart/swa-wages-figure-4k-wage-inequality-men/

managerial white-collar workers and can afford it. Tosi et.al. show that "*firm size accounts for more than 40% of the variance in total CEO pay*" (Tosi et.al., 2000: 329). In a report for the World Bank[29], Kelly et al. (2017: 170) show that wage inequality in Europe has been driven by firm inequality. Shin reports that "*the main driver of the widening gap between executives and workers was the rise in executive compensation, rather than stagnant wages for workers*" (Shin, 2014: 29-30) and that "*firms hired external CEOs tend to have a wider wag gap*" (ibid., 19).

To sum up, as wage dispersion (i.e. paying more to employees than other firms) requires larger firms, a structural, secular increase in wage dispersion would not be possible if there was no structural, secular rise in market concentration. That is to say that without any change in market structure, which might have been underpinned by SBTC and/or institutional change, a change in wage differential would be temporary, since the workforce would adapt to the changing requirements in the medium or long-run[30].

4. Empirical Evidence

This chapter deals with empirical testing of the main argument that there is a direct relationship of structural causality between wage dispersion and market concentration.

Before testing the structural relationship between a widening wage differential and market concentration at the macro level, an industry-level comparison would be helpful. Figure 3 depicts the co-movement of the growth rates of wage differentials and of market concentration ratios (revenue share of 50 largest firms) from 1997 to 2012 in trade, and the transportation and FIRE (finance, insurance and real estate) sectors[31]. The transportation sector has experienced the highest level of concentration and also of wage dispersion, whereas the FIRE sector has experienced the lowest.

[29] https://www.worldbank.org/en/region/eca/publication/digital-dividends-in-eca

[30] For example, the share of low-wage workers with a high school degree increased from 48% in 1968 to 79% in 2012 (See Mishel, 2014). This shows that low-wage workers have upgraded their skills.

[31] Only these three sectors were available for comparison from both sources.

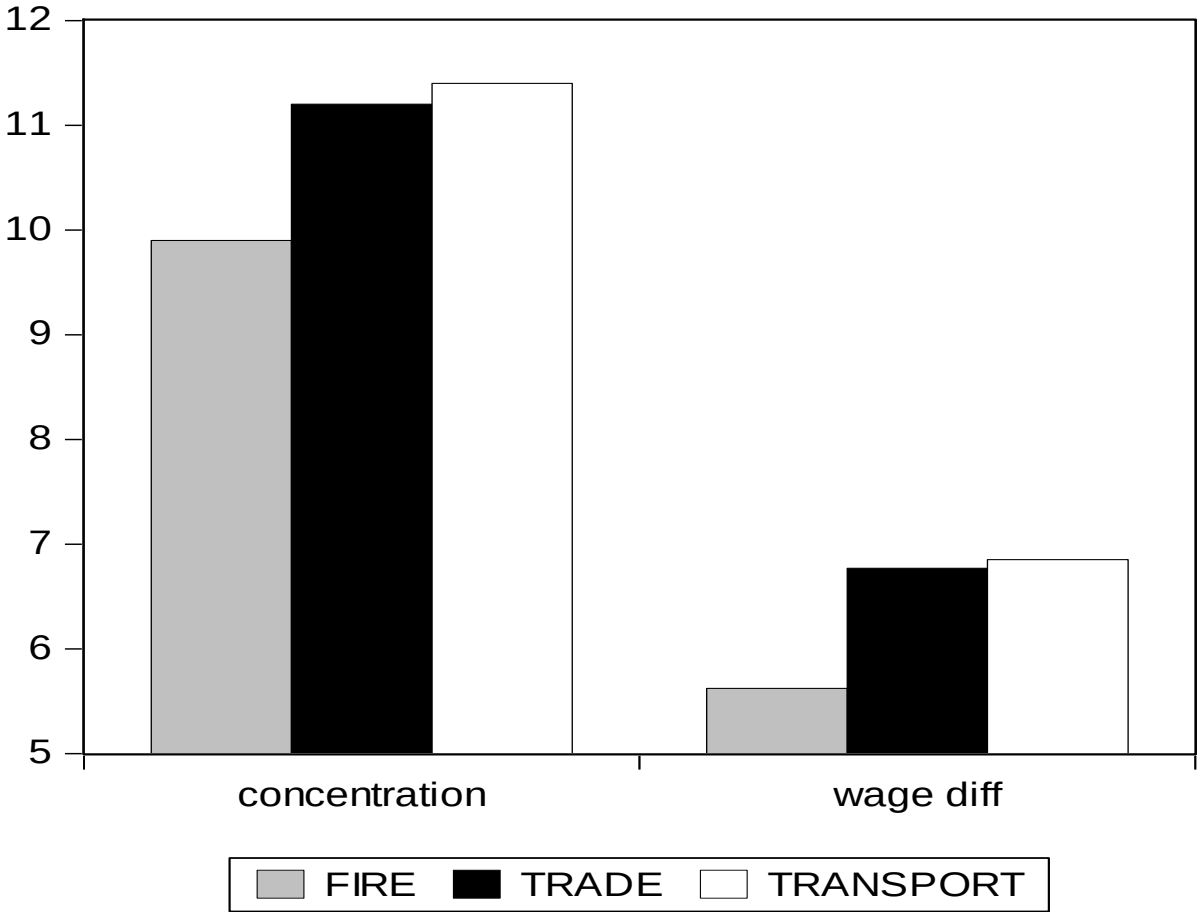

Figure 3: Growth rates of market concentration ratios (Revenue share of 50 large firms) and of wage differentials (=log wage 90/50) in FIRE, trade and transportation sectors from 1997 to 2012, USA. Sources: census.gov and Kristal and Cohen (2016: 14) respectively.

4.1. Description and Justification of the Dataset

In this subsection, I define the variables and elaborate the theoretical reasoning behind their employment in the model.

4.1.1. Degree of Monopoly

Per Kaleckian theory (Kalecki, 1954), it is assumed that firms would be able to charge a higher markup rate per unit of production over their labour and raw material costs in line with their market power: "*The increasing market concentration tends undoubtedly to raise the degree of monopoly in the long run*" (Kalecki, 1990: 247). More concentrated markets would be characterised by higher markup rates (Kalecki, 2009: 30; cited in Rugitsky, 2013).

From a Steindlian perspective, the second crucial feature of concentrated markets is that dominant firms have a tendency to maintain a higher (desired) level of excess capacity as a "barrier to entry", i.e. in order to be able to prevent potential new entries into the market that could be spurred on by the higher markups, and as a precautionary measure, such as to be able to maintain their market share in case of unexpected demand shocks (Steindl, 1952: 55). Secondly, concerning costs, Steindl states that *"average cost of larger equipment with excess capacity is smaller than average cost of smaller equipment with full capacity. So that long run cost curve declines"* (ibid., 10). To put it

differently, with the increase of capital equipment size, firms might enjoy decreasing average cost due to excess capacity.

As firms try first to protect the employment of white-collar workers (Minsky, 1986: 180) and by virtue of the the higher displacement rate of blue-collar workers, greater excess capacity implies a higher unemployment rate of blue-collar workers, who represent the main source of ADPC. A correllation of 0.74 between excess capacity[32] and the blue-collar unemployment rate[33] in the period 1973-2011 supports this reasoning.

It can be inferred that in the case of a concentrated market structure, the share of production wages within value added (the opposite of Equation 3) would be lower, since prices go up due to the higher markup that is made possible both by the lower price elasticity of demand of white-collar workers and by the higher employment share and higher salaries of white-collar workers, whose innovative tasks reduce the break-even point.

As a lower share of production wages within value added also reflects a lower break-even point, Gordon's (1998) proposition to measure the degree of monopoly by "*the ratio of value added to wages of production labour*" represents a better measurement of concentration, since value added includes profits after taxes and cost of capital.[34] Besides being consistent with the foregoing theoretical reasoning based on Kalecki (1954) and Steindl (1990), it also has the advantage of leaving out the "*counter-cycle performance of simple Kaleckian calculation of degree of monopoly*" (Kriesler, 1987: 38).

Secondly, it better corresponds to the output-price-cost settings in which markups are charged over ADPC, which mainly consist of wages paid to production labor and raw materials (Minsky, 1986: 174). Thirdly, it is also consistent with Equation 2, which explains the price level via the ratio of the number and salaries of white-collar workers to the number and wages of blue-collar workers.

The calculation of the degree of monopoly (m) is as follows: The ratio of Gross value added of nonfinancial corporate business (a)[35] to the total wages of production labor, which is calculated as the product of Average Hourly Earnings of Production and Nonsupervisory Employees in Total Private Sector (p)[36] times total hours worked (h)[37]:

$$m = \frac{a}{p * h}$$

Equation 3: Degree of Monopoly

An aggregate concentration measurement has the advantage of capturing both changing concentration within industries and the changing shares of industries within GDP

[32] See https://fred.stlouisfed.org/series/TCU
[33] http://www.stateofworkingamerica.org/charts/unemployment-job-category/
[34] Value Added = Net Operating Profit After Taxes (NOPAT) - Invested Capital * Weighted Average Cost of Capital (WACC). It should be noted that the simple Kaleckian calculation of the degree of monopoly (or Lerner Index), which overlooks capital costs, might not provide accurate results.
[35] https://fred.stlouisfed.org/series/A455RC1Q027SBEA
[36] https://fred.stlouisfed.org/series/AHETPI
[37] https://fred.stlouisfed.org/series/TOTLQ

(Cowling, 1982: 161)[38].

Nevertheless, in order to check the plausibility of the ratio of value added to wages of production workers as a measurement of market concentration at the macro level, in addition to the Figure 3, the following chart could be useful. It shows the number and percentage of US manufacturing industries in which the largest four companies accounted for at least 50 percent of shipment value in their industries.

Figure 4: Number and Percentage of U.S. Manufacturing Industries in which the Largest Four Companies Accounted for at Least 50 Percent of Shipment Value in Their Industries, 1947-2007. Source: Calculation of Foster et al. (2011) based on census.gov[39]

4.1.2. Wage Differential

As I am directly dealing with the dispersion between wages of production workers and salaries of overhead labour and I have argued that the difference between them determines the markup rate, I employ the ratio of average hourly wages of non-production (overhead) workers to average hourly wages of production workers to measure the wage differential at the macro level.

The wage differential (wd) as the ratio of the salaries of ancillary white-collar non-production workers to the wages of blue-collar production workers is calculated as follows:

[38] Two reasons why I do not prefer an average weighted Herfindahl-Hirschman Index (HHI) or the share of the n-largest firms within the sector, which is the most common measurement for concentration, is that, firstly, the available data is not provided as continuous time-series and, secondly, it is not clear how to calculate the weight of sectors relative to their shares in GDP or to their capital or employment intensity for the purpose of obtaining a proper measurement. Thirdly, and more importantly, as import firms also have a significant share in consumer goods and services, the share of n-largest US-firms might not give accurate results. Finally, as pointed out by Kriesler (1987: 24), HHI does not consider the structure (elasticity) of demand.

[39] https://monthlyreview.org/2011/04/01/monopoly-and-competition-in-twenty-first-century-capitalism

$$wd = \frac{c/h - p}{p}$$

Equation 1: Wage Differential

In the equation, *c* stands for compensation of all employees[40], *h for* total worked hours[41], and *p* for the annual average hourly wages paid to production workers[42]. The numerator gives the average hourly wages paid to ancillary (overhead) non-production employees: namely, to white-collar workers.

It could be argued that it would be plausible to employ top-end wage dispersion (see the wage differential between the 90th and 50th percentiles, as shown in Figure 5) in the model to capture the wage dispersion between white and blue-collar workers and its long-run structural relationship with market concentration. However, top-end wage inequality might contain the impacts of non-economic factors such as age, ethnicity, race, gender, experience, region, public sector employment, and so on. The 97-percent correlation of the wage differential between white-collar and blue-collar workers (see Figure 1) with the wage differential 90/50 confirms that it also can be considered as top-end wage inequality.

Another reasonable criticism could be that the college premium should be employed in the model instead of the wage differential between production workers and non-production ancillary labour. This might also represent an appropriate and useful tool for challenging the SBTC approach, which employs it in defense of the argument that computerization has led to wage dispersion.

[40] https://fred.stlouisfed.org/series/A576RC1
[41] https://fred.stlouisfed.org/series/TOTLQ
[42] https://fred.stlouisfed.org/series/AHETPI and https://fred.stlouisfed.org/series/A132RC1

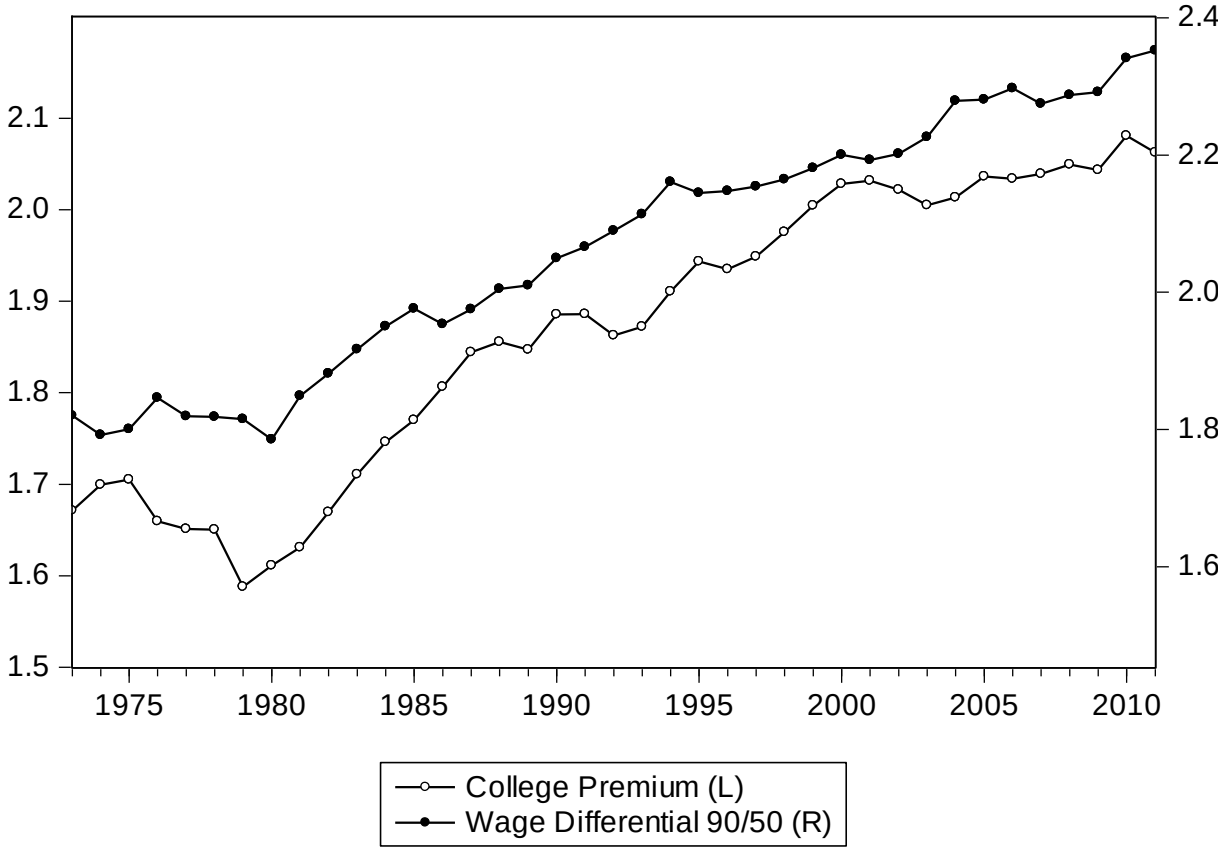

Figure 5: College Premium (wage difference ratio of college graduates to high school graduates) and Wage Differential between 90th and 50th Percentiles. 1973-2011. Sources: epi.org/data/#?preset=wage-education and stateofworkingamerica.org, Figures 4K and 4L.

Secondly, a comparison of occupation and education based on datasets of the *Consumer Expenditure Survey* suggests[43] that we can assume that non-production workers consist of college-graduates and that this would not lead to any serious empirical or theoretical shortcomings. However, employing the college premium for wage dispersion might not give accurate results, due to the underemployment of college graduates (i.e. their employment in jobs that do not require college degrees), which has increased from 25,2% in 2000 to 28,2% in 2011, and also because wages of the 20th percentile of college graduates have experienced a decline of 4,5% in the same period, whereas the wages of the 90th percentile of college graduates increased by 2,1%. (See stateofworkingamerica.org, Figures 4AJ and 4AK.) Thirdly, the college premium does not consider the workers who have had some years of college without completing a degree and who accounts for approximately 19% of the workforce[44]. These workers might be employed in white-collar jobs as well. Finally, since the college premium was stable during the 2000s, due to rising underemployment of college graduates, whereas wage inequality between 90th and 50th percentiles (see Figure 5) increased, the college premium seems not to be an accurate indicator for measuring wage inequality.

4.2.The Model

Before running the data analysis, it is worth emphasizing that employment of white-collar workers performing innovative tasks (such as R&D, advertisement,

[43] Results are available upon request.
[44] http://www.epi.org/data/#?preset=wage-education

financial/capital market operations, market research, etc.) to reduce the break-even point in order, such as to be able to charge a higher markup, is not the sole factor behind rising market concentration. It is rather a contributing factor, which is meant to maintain or increase the market share of the firm. As indicated by Toporowski (2016), Brennan (2016), Minsky (1986), and Blonigen and Pierce (2016), market concentration is a matter of privatizations and capital market operations, such as mergers & acquisitions and hostile takeovers, rather than of goods market operations.

> *The dominant corporations of today, such as General Electric, Tata, Boeing, or Microsoft, did not achieve their preeminence through their ability to produce electrical equipment, steel, aircraft, or software better than their competitors, but by buying up those competitors in the stock market*. (Toporowski, 2016: 4)

As the main argument of the paper is that there is a structural and direct causal relationship between market concentration and wage dispersion, a VAR model with impulse response function and variance decomposition analysis is one of the best options for examining such an argument[45]. In VAR Model, "*each endogenous variable is assumed to depend on lagged values of itself and of all other endogenous variables*" (Dées and Güntner, 2016: 5). Such an assumption is appropriate both for market concentration and wage dispersion, since, as pointed out above, they feed back upon themselves. The non-stationarity of variables (see Table 1 in the appendix) confirms that both variables are being affected by their lagged values.

As the variables have either non-stationarity or trend and have no co-integration problem, I employ their log differences and run an unrestricted Vector Autoregressive Model with E-Views 8. AIC (Akaike Information Criterion) suggests a 2-period lag length. The LM Autocorrelation test results also indicate that the model has no autocorrelation problem. The model also has no stability problem, according to the Inverse Roots of the AR Characteristic Polynomial. (See the appendix for all test results).

In line with theoretical framework outlined above, I prefer to align the variables within the model as follows: degree of monopoly (m), wage differential (wd). So the VAR(2) model equation has the following form:

$$m_t = c_1 + ß_{11}^1\, m_{t-1} + ß_{12}^1\, wd_{t-1} + ß_{11}^2\, m_{t-2} + ß_{12}^2\, wd_{t-2}$$

$$wd = c_1 + ß_{21}^1\, m_{t-1} + ß_{22}^1\, wd_{t-1} + ß_{21}^2\, m_{t-2} + ß_{22}^2\, wd_{t-2}$$

Equation 5: VAR(2) Model Equation

As this paper deals merely with the causality running from market concentration to wage dispersion, the flipside of the relationship (i.e. causality running from wage dispersion to concentration) is neglected and left for another paper – this despite the fact that VAR Model assumes that the relationship is bi-directional.

4.3. Results

[45] As to why I do not opt for any endogenous or exogenous control variable in the model, it is due to the fact that what is being tested is merely whether the causality is a direct or not.

The impulse response function reveals whether the causality between variables is direct or not and variance decomposition analysis "*provides valuable supplementary information about the interlinkages among the variables in the model*" (Greenwood-Nimmo and Tarassow, 2013: 12). Both analyses provide structural clarification of how strong and how long-lasting the effects are. Moreover, the impulse response function has an advantage inasmuch as it reveals that the power of the effects is not stable, but rather might fluctuate and might even turn in the opposite direction (from positive to negative and vice-versa) after a certain time.

Tarassow (2010) describes what is being analyzed by way of the impulse response function and variance decomposition as follows:

> *impulse-response function which computes the propagation over time of a shock on the variable of interest. The variance decomposition analyzes the relative impact of a shock in one variable on the total variance of the variable of interest – it measures the relative impact of a structural shock for the explanation of the total variance of the dependent variable.* (Tarassow, 2010: 14-15).

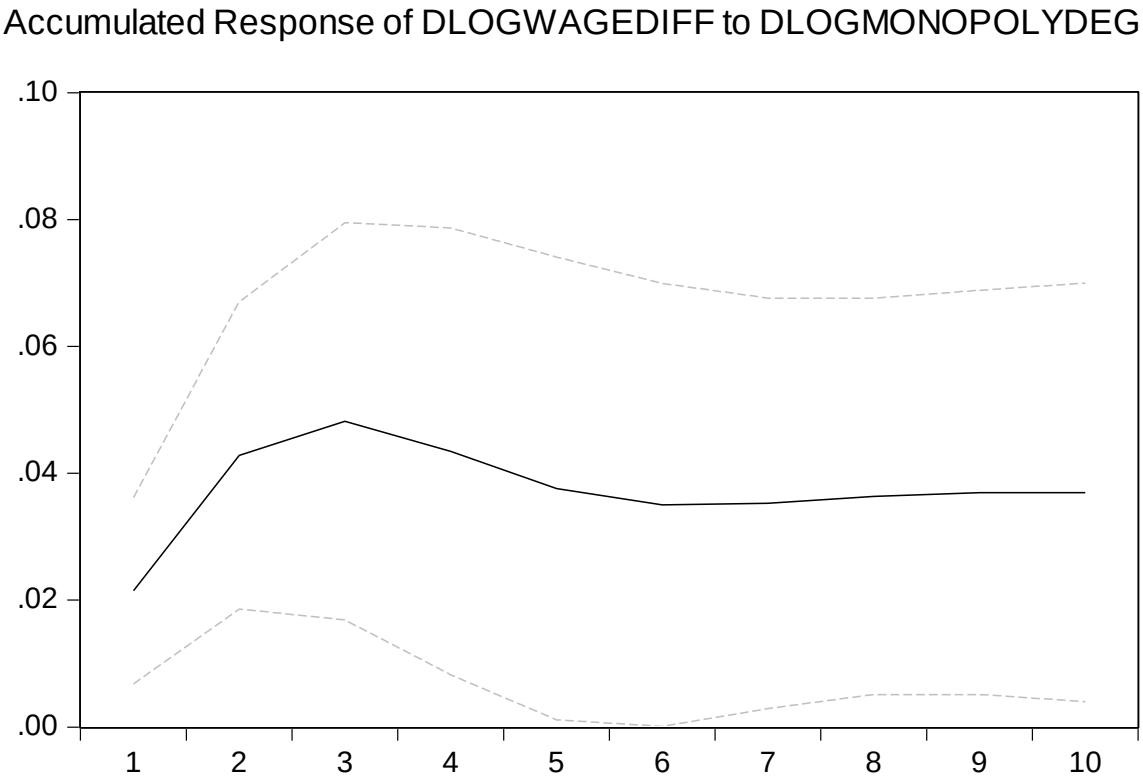

Figure 6: Impulse Response Function Results[46] for the period 1966-2011

Analysis of the impulse response function results shown in Figure 6 is as follows[47]:

[46] The IRF-figures represent the accumulated responses, since the growth rates (log differences) of the variable are employed in the model. Secondly, accumulated responses indicate that the shocks create a path: i.e. that the responses are not temporary. The dotted lines represent the standard errors, i.e. the 95% significance level. If both of the dotted lines are not in the same area (i.e. if one is above and the other is under the 0 (zero)), then responses are not significant. In this case, one period represents one year, since the data is annual.

[47] See Table 5 in the appendices for the values.

The responses of wage differential to concentration are positive and significant over 10 periods and peaks at the 3rd period. This result does not falsify and in fact strongly supports the main argument of this paper that large firms in higher concentrated markets, or firms endeavoring to increase their market share, can employ and pay more to white-collar workers, in order to preserve or increase their market shares thanks to innovative tasks performed by white-collar workers. As the impulses do not die out, we can conclude that responses to the shocks are not temporary, but rather long-lasting, and that the shocks seem to have created a path, i.e. led to a structural change.

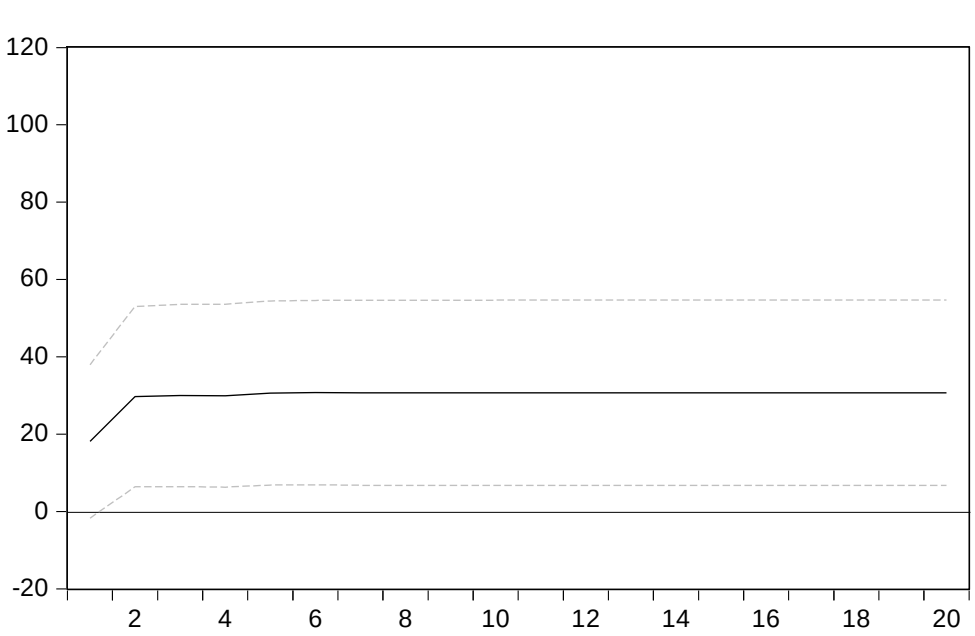

Figure 7: Variance Decomposition Analysis Results

In the short term, as shown by Figure 7, 18% of the variations in wage differential are due to market concentration and this figure reaches 30% at second period and thereafter. The fact that 30% of long-term variations in wage differential are explained by market concentration confirms that the relationship is one of structural causality[48].

5. Conclusion

This paper has addressed the very simple question "What types of employees have been paid more by what type of employers?" and it has been argued that there is a direct and structural relationship at the macro level between market concentration and wage differentials between white-collar and blue-collar workers.

VAR Model analysis results based on US-data between 1966 and 2011 show that the hypothesis that the relationship is structural has not been falsified at least at 95% confidence level. The findings show that the responses of wage dispersion to one-unit shock in market concentration are positive and significant over 10 years. Furthermore, 18% of variations in wage dispersion in the short-run and 30% of variations in the long-run are explained by market concentration. As the responses of wage differential to shocks of market concentration are not temporary, but rather long-lasting and do not die

[48] See Table 6 in Appendices fort the values

out, the shocks seem to have created a path.

It could be inferred that if the employment share and salaries of white-collar workers had not increased due to concentration, then the concentration would not be structural and long-lasting. Rather, it would be temporary, since higher concentration strengthens its relationship with wage dispersion.

The paper has made some innovative contributions to the literature by incorporating market structure and wage structure in a dynamic empirical analysis of the contemporary macro dataset. Firstly, it has revealed the relationship between market concentration, on the one hand, and wage dispersion between white-collar and blue-collar workers, on the other.

Secondly, the paper opens a new space in which to discuss an issue stressed by Palley (2006 and 2015): viz. that the distribution of wage income among wage earners represents a decisive factor not only with respect to personal income distribution, but also with respect to the "*functional income distribution between capital and labour which is a function of market structure*" (Kalecki, 1971).

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APPENDICES: TEST RESULTS

Null Hypothesis: DEGREEOFMONOPOLY has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.817551	0.6792
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEGREEOFMONOPOLY(-1)	-0.050881	0.027995	-1.817551	0.0766
D(DEGREEOFMONOPOLY(-1))	0.702901	0.120775	5.819901	0.0000
C	0.000924	0.000389	2.376999	0.0223
@TREND("1960")	4.17E-05	2.83E-05	1.473008	0.1486

Null Hypothesis: WAGEDIFFERENTIAL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.825316	0.9563
Test critical values:	1% level	-4.148465	
	5% level	-3.500495	
	10% level	-3.179617	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WAGEDIFFERENTIAL(-1)	-0.050425	0.061098	-0.825316	0.4133
C	0.013402	0.004702	2.849910	0.0064
@TREND("1960")	0.000400	0.000651	0.614844	0.5416

Table 1: Unit Root Test Results

Date: 03/19/17 Time: 03:20
Sample (adjusted): 1968 2011
Included observations: 44 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: MONOPOLYDEGREE WAGEDIFF
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.202540	17.26708	25.87211	0.3953
At most 1	0.153047	7.308820	12.51798	0.3134

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.202540	9.958257	19.38704	0.6233
At most 1	0.153047	7.308820	12.51798	0.3134

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 03/06/17 Time: 19:47
Sample (adjusted): 1969 2011
Included observations: 43 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: DEGREEOFMONOPOLY WAGEDIFFERENTIAL
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.221050	15.70929	25.87211	0.5160
At most 1	0.109101	4.967544	12.51798	0.6010

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.221050	10.74175	19.38704	0.5401
At most 1	0.109101	4.967544	12.51798	0.6010

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DEGREEOF...	WAGEDIFF...	@TREND(61)
246.8599	-36.25354	0.151856
169.6347	27.81374	-0.439878

Table 2: Johansen System Co-integration Test Results

VAR Residual Serial Correlation LM ...
Null Hypothesis: no serial correlation...
Date: 03/06/17 Time: 19:43
Sample: 1960 2015
Included observations: 43

Lags	LM-Stat	Prob
1	4.296185	0.3674
2	1.916220	0.7512
3	1.497050	0.8272
4	5.013765	0.2859
5	1.654699	0.7989
6	8.865466	0.0646
7	5.531986	0.2369
8	0.821504	0.9355
9	1.240684	0.8714
10	2.087900	0.7196
11	7.482715	0.1125
12	5.502069	0.2395

Probs from chi-square with 4 df.

Table 3: Serial Correlation Test Results

VAR Lag Order Selection Criteria
Endogenous variables: DLOGMONOPOLYDEGREE DLOGWAGEDIFF
Exogenous variables: C
Date: 03/06/17 Time: 19:40
Sample: 1960 2015
Included observations: 39

Lag	LogL	LR	FPE	AIC	SC	HQ
0	143.8641	NA	2.37e-06	-7.275084	-7.189773	-7.244475
1	163.8747	36.94258*	1.05e-06	-8.096138	-7.840206*	-8.004312
2	169.1171	9.140548	9.83e-07*	-8.159850*	-7.733295	-8.006806*
3	171.2446	3.491290	1.09e-06	-8.063824	-7.466648	-7.849563
4	174.4582	4.944046	1.14e-06	-8.023498	-7.255700	-7.748018
5	178.4569	5.741679	1.16e-06	-8.023429	-7.085010	-7.686733
6	181.4294	3.963419	1.25e-06	-7.970740	-6.861699	-7.572826

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4: Lag Order Selection Criteria

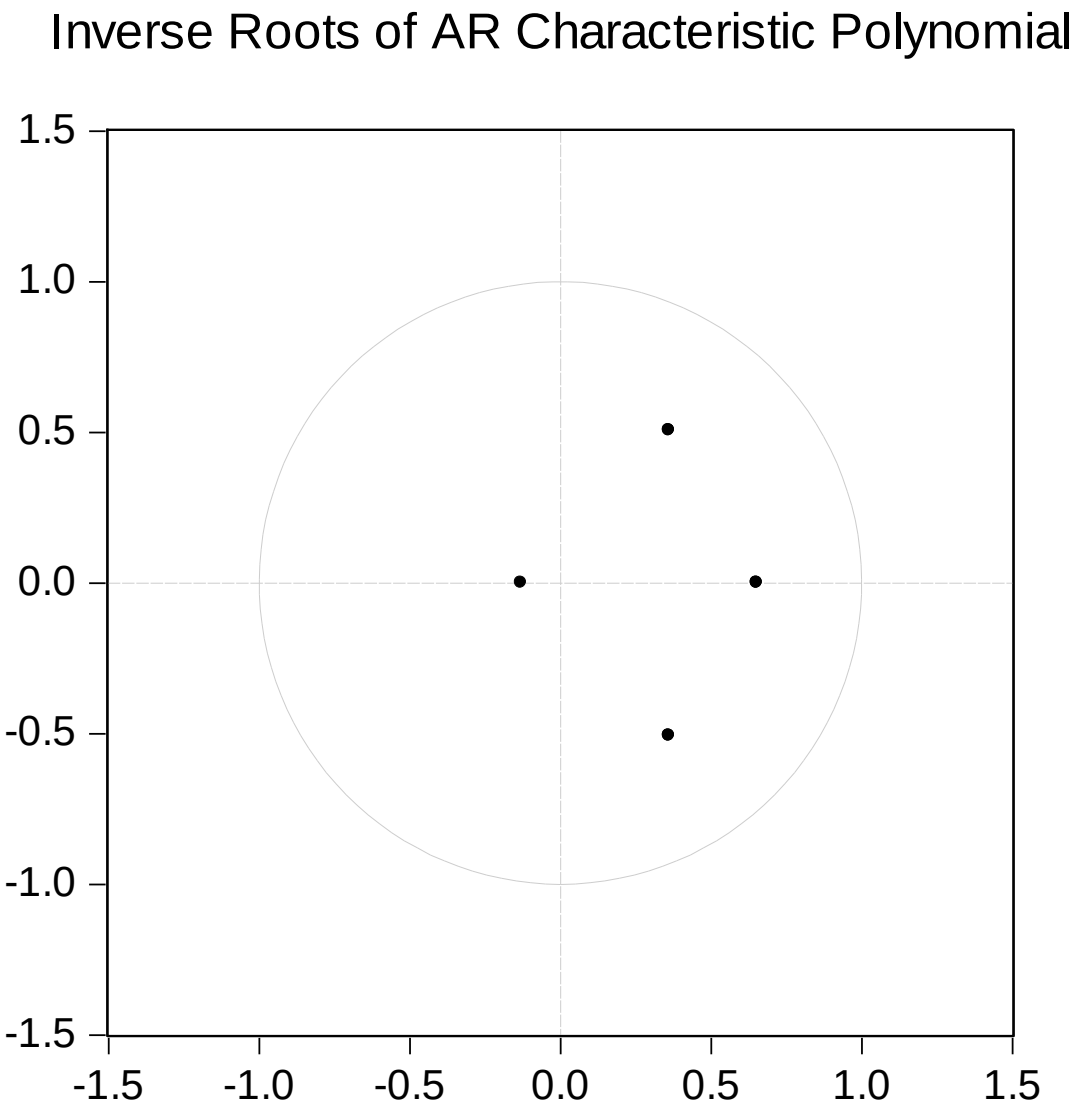

Figure 8: Inverse Roots of AR Characteristic Polynomial

Accumulated Response of DLOGW...		
Period	DLOGMON...	DLOGWAG...
1	0.021478	0.045668
2	0.042794	0.054817
3	0.048182	0.048603
4	0.043444	0.041086
5	0.037601	0.038736
6	0.035004	0.040338
7	0.035248	0.042662
8	0.036337	0.043890
9	0.036969	0.043987
10	0.036965	0.043655
Cholesky Ordering: DLOGMONOP...		

Table 5: Impulse Response Function

Variance Decomposition of DLOGWAGEDIFF:			
Period	S.E.	DLOGMON...	DLOGWAG...
1	0.050467	18.11239	81.88761
2	0.055543	29.68186	70.31814
3	0.056148	29.96561	70.03439
4	0.056847	29.92802	70.07198
5	0.057195	30.60896	69.39104
6	0.057276	30.72770	69.27230
7	0.057324	30.67843	69.32157
8	0.057347	30.68937	69.31063
9	0.057351	30.69769	69.30231
10	0.057352	30.69666	69.30334
Cholesky Ordering: DLOGMONOPOLYDEGREE D...			

Table 6: Variance Decomposition

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L sequentially determined breaks
Date: 04/11/17 Time: 02:26
Sample: 1960 2015
Included observations: 45
Breakpoint variables: MONOPOLYDEGREE(-1) C
Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:			1
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	13.59991	27.19982	11.47
1 vs. 2	5.864459	11.72892	12.95

* Significant at the 0.05 level.
** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	1982	1982

Table 7: Structural-Break Test: Market Concentration