WHAT LABOUR FORCE CHARACTERISTICS HAVE THE GREATEST IMPACT ON PRODUCTIVITY ACROSS OECD COUNTRIES?

DANIEL FALLEN BAILEY
Senior Sophister

In the aftermath of the financial crisis many countries sought recovery through improved labour force productivity. In this econometric investigation, Daniel Fallen Bailey examines the factors affecting labour productivity across countries. His results question the overarching emphasis sometimes placed on labour market efficiency, highlighting the importance of more worker-friendly measure like real wage and employment protection.

Introduction

This research paper aims to answer the question of what characteristic of a country's labour force has the greatest impact on productivity levels. The idea for such a topic stems from the fact that economists are at the intriguing but often perplexing stage of emergence from a great recession, where can begin the analysis of the shape of recoveries of various countries. Taking from simple Cobb-Douglas production theory, we understand Total Factor Productivity (of which labour productivity is a fundamental element) to unambiguously increase a country's level of economic growth (Sorenson and Whitta-Jacobsen, 2010). Thus, after the systemic global shock of 2008, many countries have naturally sought improvements in labour productivity as a pathway to recovery.

The paper, motivated by research on various countries' attempts at such a recovery, aims to account for differences in productivity levels seen across OECD countries, and will attempt to discover what defining feature(s) or characteristic(s) of a country's labour force have the greatest effect on overall outcomes of productivity levels.

Motivation and Literary Review

This paper was motivated by research of various economies' attempts at productive recoveries from the crisis. One finds that many new theories and discussions have been put

forward to explain the overall factors affecting differentials in outcomes across these regions.

One such theory is presented by The Economist (2014b), who stipulate that Britain has experienced a 'productivity puzzle' since the crisis. This is due to soaring employment levels, coupled with stagnant levels of economic growth. The Economist (2014b) puts the absence of improvements in TFP down to inflation; relatively high inflation in the region has lowered the real wage level, allowing employers to hire more workers and use them less intensively which has created a productivity lag.

In the US by contrast, relatively low inflation throughout the recovery has kept real wages high. As a result of the costly nature of hiring new workers, unemployment has remained high, only falling 2.1 per cent from a high of 7.8 per cent in January 2009 (Bureau of Labour Statistics (BLS), 2015). But employers appear to have been successful in wringing more work from the existing workforce, and the outcome has seen gains to productivity. Evidence that supports this is seen in the data for productivity levels in the US, which have averaged an annual increase of 1.55 per cent from 2009-2014 (BLS, 2015). The Economist (2014b) magazines theory links real wage levels directly to growth in productivity. However, other articles have emphasised the more idiosyncratic factors behind productivity that are specific to each region.

In 2015, The Economist (2015a; 2015b) put forward a discussion on certain characteristics of the US economy which may reflect its strong performance in productivity and output since the crisis [the US managed to average 2 per cent annual growth in GDP per capita since 2010, impressive considering global growth was only 2.5 per cent in 2014 (World Bank, 2015)]. They highlight that the flexibility of the US labour force combined with the fact that US is at the frontier of global innovation and technology, has created what they label the 'On-Demand' economy (The Economist, 2015b). This is an economy which puts 'job-starved workers in contact with time-starved urban professionals', tapping into the underused resources within society. Characteristics of this economy include a lack of full-time employees or a need for offices, and the resourcefulness to use 'spare cognitive capacity' all across the world (The Economist, 2015a).

Importantly, this has created a rise in the freelance worker. 53 million Americans now work as freelancers, and as many as 1 in 3 people do some sort of freelance work. Small app-based companies are consolidating these workers into a catalogue of on-demand professionals, ready to be contracted only as they're needed. This means companies can solve transient business problems quicker, and more efficiently. This idea is reflective of work by Acemoglu *et al.* (2012), who argue that the USA is at the frontier of world growth with regard to innovation and technology, and that this is facilitated by "unfettered competition and risk taking" which they label 'cut-throat capitalism.'

Overall, this second theory put forward by The Economist (2015a; 2015b) sug

gests that flexibility in the labour force combined with emphasis on research and development are the key to improving productivity, and this accounts for the US' strong performance of growth since the financial crisis.

The combination of these two theories which outline the factors affecting productivity (i.e. firstly the real wage level and second, labour market flexibility combined with innovative research and development) could account for the stagnated recovery of the EU from the downturn. Productivity in the region is sluggish and therefore, stagnant growth figures of less than 2 per cent are forecast for Germany, France and Italy in 2015. EU-wide unemployment is consistently high also, standing at 11.5 per cent in November 2014. As well as this, the threat of deflation in 2014 has prompted the ECB to engage in a program of quantitative easing in the hope of stimulating the economy (Eurostat, 2015; Shellock, 2015).

One reason for this slow recovery of productivity levels however, could be due to the fact that since the crisis, the EU has fallen further from meeting the criteria necessary for an optimal currency area (OCA). These criteria, set out by Mundell (1961) and Mckinnon (1963), are deemed essential if a monetary union is to be feasible for all countries involved. At the heart of such criteria is labour market flexibility, which facilitates the adjustment to asymmetric shocks (McKinnon 1963; Mundell, 1969; Jager and Hafner, 2013). It is arguable that relatively inflexible labour markets, and in particular, relatively strict employment protection legislation is characteristic of the EU, as exemplified by such things as:

1. The high degree of specialisation in the EU since the introduction of the Euro (Jager and Hafner, 2013)
2. Resistance from Germany to the finalising of the Transatlantic Trade and Investment Partnership with the US. Most Germans take issue with the 'harmonisation of regulatory standards and removing barriers to investment' which could result in social dumping (Barysch, 2014)
3. Resistance in France to the Macron Bill in 2014, aimed at addressing the 35-hour week, reducing payroll taxes on companies and loosening Sunday-trading rules. As The Economist (2014a) points out; 'For some Socialists, rest on Sundays is a historic achievement of the labour movement; any attempt to revoke this right is an assault on the very concept of progress.'

Overall therefore, previous research points to a number of factors which could be explaining the variation in productivity levels across major regions of the world economy. This paper will focus on factors to do with inflation (real minimum wage), innovation (R+D expenditure) and labour market characteristics such as the level of temporary em-

ployment contracts, trade union density and the strictness of employment protection legislation. It will also look at Adult education levels to see if this is affecting a countries productivity performance level.

Empirical Approach

In order to hypothesise the determinants which have been outlined above, this essay proposes the following regression:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \qquad (1)$$

where:

Y_i: PRODUCTIVITYLEV - A measure of labour productivity. It represents GDP per hour worked for the 5 years used in the study, in dollars adjusted for PPP.

X_1: TEMPCONTRACTS - The number of contracts of limited duration (temporary employment contracts) expressed as a percentage of total employment.

X_2: REALMINWAGE - Real minimum wage, in dollars adjusted for PPP.

X_3: TRUNIONDENSITY - This represents the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. Density is calculated using survey and administrative data, adjusted for those who are self-employed or non-active.

X_4: ADULTEDUC - Adult Education Levels. This represents the percentage of 25-64 year olds with tertiary level education achieved.

X_5: R+DEXPEND - Spending on Research and Development as a % of GDP.

X_6: STREMPPRO - This represents indicators for the strictness of employment protection legislation. They are synthetic indicators of the strictness of regulation on dismissals. For each year, indicators refer to regulation in force on the 1st of January (OECD, 2013).

Data

All data present in this paper is taken from OECD publications. 21 OECD countries are used in a cross-sectional study across five different years; 2000, 2005, 2009, 2010 and 2012. Data is sourced for each individual variable, for each country from each of the 5 years, and then averaged out. This gives 105 data points for each of the 7 variables used. Table 1 provides a summary of the data. Table 2 gives the 21 countries used. These countries were chosen partly due to data availability and partly due to the fact they provide a good variation of socioeconomic environment.

VARIABLE	OBS	MEAN	STD. DEV	MIN	MAX
PRODUCTIVITYLEV	21	35.55	13.79	15.00	65.94
TEMPCONTRACTS	21	21.11	4.91	12.00	31.05
REAL MIN WAGE	21	13212.15	5801.30	1732.00	21465.60
TR UNION DENSITY	21	21.23	10.88	6.87	54.71
ADULT EDUC	21	27.99	10.32	11.94	47.74
R+DEXPEND	21	1.76	0.82	0.59	3.23
STREMPPRO	21	3.05	1.00	0.00	5.13

Table 1: Data Summary

Australia	Luxembourg
Belgium	Mexico
Canada	Netherlands
Czech Republic	New Zealand
France	Poland
Greece	Portugal
Hungary	Slovak Republic
Ireland	Spain
Japan	Turkey
Korea	United Kingdom
United States	

Table 2: OECD Countries Used

Results

The overall results of the regression can be found in Table 3. The results mean that the original equation (1), posited in the Empirical Approach, can now be written as:

$$\text{PRODUCTIVITYLEV}_i = -0.5426 - 0.2474\beta_1 + 0.0021\beta_2 - 0.0906\beta_3 + 0.1817\beta_4 - 0.4511\beta_5 + 3.7350\beta_6$$

PRODUCTIVITYLEV	COEF	SE	T	P-VALUE
TEMPCONTRACTS	-0.2474	0.33	-0.76	0.46
REAL MIN WAGE	0.0021	0.00	6.57	0.00
TR UNION DENSITY	-0.0906	0.18	-0.49	0.63
ADULT EDUC	0.1817	0.18	0.99	0.34
R+DEXPEND	-0.4511	1.89	-0.24	0.82
STREMPPRO	3.7350	1.25	2.98	0.01
_CONS	-0.5426	8.21	-0.07	0.95

Table 3: Regression Output

Interpreting the Results

Overall, when tested against the null hypothesis of $\beta n = 0$, only 2 variables are found to be statistically significant when using a t-test at the 5% significance level; REALMINWAGE and STREMPPRO. The p-values for these coefficients are lower than 0.05 in both cases, meaning we can reject the null hypothesis that $\beta n = 0$. The lack of other significant variables may be due to the manner in which the data was collected.

However, the R2 for the model is 0.8475, which tells us that 84.75 per cent of the variation in labour productivity is explained by the model -a good result. As well as this, the F statistic for the regression is 15.75, which means the p-value is 0. This implies that the model is statistically significant at predicting labour productivity levels. To show this evidence of linearity, the predicted values of PRODUCTIVITYLEV were generated and shown in a scatter plot alongside the observed data. A 45 degree pattern is expected in order to show linearity in the model. The model does a good job in predicting PRODUCTIVITYLEV.

It is interesting to interpret the signs on the independent variables. Based on the first theory put forward by The Economist in (2014b), we would have expected to see a positive relationship between PRODUCTIVITYLEV and REALMINWAGE. This is due to the implication that when real wage rises, it becomes more costly for employers to take on work, which means that in order to meet given demand, employers need to wring more work from a smaller workforce. Conversely, when real wage falls, the incentive to economise on labour is wiped out and productivity suffers as a result. Employers hire more workers and use them less intensively, forgoing opportunities to innovate.

This intuition is reflected in the positive result seen in the regression. The results

estimate that a one unit increase in real minimum wage will result in a 0.21 increase in labour productivity score. Based on the second theory put forward by The Economist (2015a; 2015b), as well as the work of Acemoglu *et al.* (2012), we would have expected to see a positive relationship between PRODUCTIVITYLEV and TEMPCONTRACTS, as well as PRODUCTIVITYLEV and R+DEXPEND. This is due to the implication that firstly, the more possible it is to hire workers on contracts of limited duration or fixed-term contracts, the more employers can hire solely to solve transient business problems efficiently and quickly, without the added cost of payroll taxes or payroll insurance associated with permanent contracts. Also implied by this theory is the idea that emphasis on research and development, accompanied by such flexibility in the labour force, should have a positive effect on labour productivity.

However, the regression results show an insignificant, but negative result between both PRODUCTIVITYLEV and TEMPCONTRACTS (-0.2474), as well as PRODUC-TIVITYLEV and R+DEXPEND (-0.4511). With regard to TEMPCONTRACTS, the negative relationship may be due to workers not being comfortable with the lack of stability associated with short-term contracts, and thus not achieving their full productive potential. The negative relationship with R+DEXPEND suggests that possibly labour productivity is related more to R+D expenditure per worker as opposed to the percentage of GDP.

And based on the third theory which is extrapolated from the work of McKinnon (1963), Mundell (1969) and Jager and Hafner (2013), as well as data from Eurostat (2015), we would expect a negative relationship between PRODUCTIVITYLEV and TRUNIONDENSITY, and PRODUCTIVITYLEV and STREMPPRO. The implication here is that labour market inflexibilities brought about by a strong trade union presence and strict implementation of employment protection legislation, should have a negative effect on labour productivity.

However, although we see an insignificant and negative relationship between PRODUCTIVITYLEV and TRUNIONDENSITY, we see a positive and statistically significant relationship between PRODUCTIVITYLEV and STREMPPRO. This implies that the more stringently employment protection legislation is carried out, the more productive workers become. It implies that a 1 unit increase in the strictness of STREMPPRO results in an increase in the labour productivity score of 3.74, which is a very strong correlation. This outcome reflects the negative result attained for TEMPCONTRACTS, which implied that workers are less productive in an unpredictable environment.

Issues with the Model

Firstly, tests were carried out to uncover if the model suffered from omitted variable bias. This was tested for by running a Ramsey RESET test. The results in Table 4 suggest that

there is no omitted variable bias in the model. If there were, the omitted variable would not be observed and would end up within the error term, which creates a bias (Wooldridge, 2014).

Ho:	model has no omitted variables
F Statistic	0.70
p-value	0.57

Table 4: Ramsey RESET Test

Secondly, tests were carried out for the presence of heteroskedasticity in the model. This occurs when the variance of the unobservable error term (ϵ_i), conditional on the explanatory variables in the model (X_i), is non-constant given the variables observed. Furthermore, if omitted variables were actually included in the error term, they would be non-constant. In this scenario, there would be difficulties in testing the significance of the model as the OLS t-statistics would not be t-distributed and the F-statistics not F-distributed.

In order to test for this, the residuals were plotted against the predicted values. The result should show no pattern at all (implying homoscedasticity), but if a pattern is present, then the model suffers from heteroskedasticity. Looking at the results in Figure 1, we see a clear pattern in the residuals, implying the presence of heteroskedasticity.
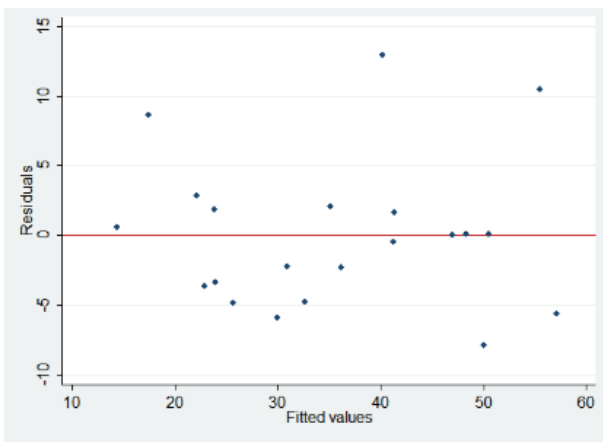

Figure 1: Residuals vs Predicted Values

49

The problem with this is that the standard errors for each coefficient may be wrong as a result. In order to adjust for the issue, we use the heteroskedasticity-robust standard errors, which is obtained by placing 'robust' after the 'regress' command. The regression results in Table 3 have thus been adjusted for this.

Possible Extensions

Firstly, it would be intriguing to see the relationship between R+D expenditure per worker and labour productivity, rather than R+D as a percentage of GDP, as outlined earlier. Secondly, more variables could be included in any future extensions to the model in order to uncover more factors affecting variation in labour productivity. These could include the level of capital employed or the level of infrastructure (particularly broadband levels and quality) in an economy, both of which add to the productive capacity of the labour force. It would also be interesting to further explore the impact of employment protection legislation on labour productivity, which was significant in this model.

Conclusion

The aim of this investigation was to explore what characteristics of the labour force have the greatest impact on labour productivity levels. In conclusion, the results shown in the regression are surprising, given that they have very different implications to the theories which motivated the research question initially. They imply greater importance for workers' real wage and employment protection in harnessing improvements in labour productivity, rather than for the more competitive and aggressive aspects of attempts to economise on labour through temporary contracts and R+D. This is reflective of Acemoglu *et al.* (2012)'s suggestion that many economies range between 'cut-throat' and 'cuddly' capitalism.

The results shown here advocate a move more towards cuddly capitalism, which is reflective of the sort of social democracy found in Western Europe and the Nordic countries (Acemoglu *et al.*, 2012). However, Dolenc and Laporsek's (2013) explanation of the concept of Flexicurity becomes relevant here. They describe this as the balance between flexible employment arrangements (such as temporary contracts) as well as the security and protection of workers in the labour market. Importantly, they show that the right mix of the two policies can be beneficial for labour productivity growth. Despite the results here favouring the side of social protection, this paper would emphasise their balanced view with regard to future policy implications.

References

Acemoglu, D, Robinson, J, Verdier, T. 2012. 'Choosing your own capitalism in a globalized world?'. VOX. [on-line], http://www.voxeu.org/article/cuddly-or-cut-throat-capital-ism-choosing-models-globalised-world [Accessed: 8 February 2015].

Barysch, K. 2014. 'Irrational fear risks depriving Europe of the benefits of trade'. Financial Times. [on-line], http://www.ft.com/intl/cms/s/0/53563c12-5b9e-11e4-a674-00144feab7de.html#axzz41l6Lg677 [Accessed: 10 February 2015].

Bureau of Labour Statistics. 'Overview of BLS Productivity Statistics'. [on-line], http://www.bls.gov/bls/productivity.htm [Accessed: 10 February 2015].

Dolenc, P, & Laporsek, S. 2013. 'Flexicurity Policies and Their Association with Productivity in the European Union'. Prague Economic Papers 22:2:224-39.

The Economist. 2014a. 'Cycling, but where to?'. [on-line], http://www.economist.com/news/europe/21636762-governments-reforms-seem-too-timid-its-critics-abroad-too-bold-its-opponents [Accessed: 8 February 2015].

The Economist. 2014b. 'Labour Markets: A theory of Troubles'. [on-line], http://www.economist.com/blogs/freeexchange/2014/02/labour-markets-0 [Accessed: 9 February 2015].

The Economist. 2015a. 'The future of work: There's an app for that'. [on-line], http://www.economist.com/news/briefing/21637355-freelance-workers-available-mo-ments-notice-will-reshape-nature-companies-and [Accessed: 9 February 2015].

The Economist. 2015b. 'Workers on tap'. [on-line], http://www.economist.com/news/leaders/21637393-rise-demand-economy-poses-difficult-questions-workers-companies-and [Accessed: 9 February 2015].

Eurostat. [on-line], http://ec.europa.eu/eurostat. [Accessed: 3 March 2015].

Jager, J. and Hafner, K. A. 2013. 'The Optimum Currency Area Theory and the EMU: An Assessment in the Context of the Eurozone Crisis'. Intereconomics/Review of European Economic Policy 48:5:315-22. http://dx.doi.org.elib.tcd.ie/10.1007/s10272-013-0474-7 [Accessed: 10 February 2015].

McKinnon, R. 1963. 'Optimum Currency Areas'. American Economic Review, 53:4:717-25.

Mundell, R. 1961. 'A Theory of Optimum Currency Areas'. American Economic Review, 51:4:657-65.

OECD. 2015. 'Adult Education Level (Indicator)'. [on-line], https://data.oecd.org/eduatt/adult-education-level.htm. doi: 10.1787/36bce3fe-en [Accessed: 7 February 2015].

OECD. 2014. 'Earnings: Real Minimum Wages'. [on-line], OECD Employment and Labour Market Statistics. http://dx.doi.org/10.1787/data-00656-en [Accessed: 10 February 2015].

OECD. 2013. 'Employment Protection Legislation: Strictness of Employment Protection Legislation: Temporary Employment'. [on-line], OECD Employment and Labour Market Statistics. doi: http://dx.doi.org/10.1787/data-00319-en [Accessed: 11 February 2015].

OECD. 2015. 'GDP per hour worked'. [on-line], https://data.oecd.org/lprdty/gdp-per-hour-worked.htm. doi: 10.1787/1439e590-en [Accessed: 11 February 2015].

OECD. 2009. Incidence of Part-time Employment, in OECD Factbook 2009. Paris: OECD Publishing. doi: http://dx.doi.org/10.1787/factbook-2009-table71-en [Accessed: 11 February 2015].

OECD. (2015), Infrastructure investment (indicator). doi: 10.1787/b06ce3ad-en. Available at: https://data.oecd.org/transport/infrastructure-investment.htm [Accessed: 10 February 2015].

OECD. 2014. 'Trade Unions: Trade union density'. OECD Employment and Labour Market Statistics. doi: http://dx.doi.org/10.1787/data-00371-en [Accessed: 10 February 2015].

Shellock. 2015. 'Stocks jump and euro slides on ECB QE'. Financial Times. [on-line], http://www.ft.com/intl/cms/s/0/dbb71268-a1e7-11e4-b176-00144feab7de.html#axzz41l6Lg677 [Accessed: 9 February 2015].

Sørensen, P. and Whitta-Jacobsen, H. 2010. Introducing Advanced Macroeconomics: Growth and Business Cycles. London: McGraw-Hill.

Wooldridge, J. M. 2014. Introduction to Econometrics: Europe, Middle East and Africa Edition. London: Cengage Learning EMEA.

World Bank. 'Economy and Growth'. [on-line], http://data.worldbank.org/topic/economy-and-growth [Accessed: 12 February 2015].