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# Wage Growth Puzzles and Technology

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## **Abstract**

Economists have been grappling with both a long-run and a shorter-run wage 'puzzle'. The long-run wage puzzle is why real wages have for decades been growing slower than labour productivity: that is, why the labour share of national income has been falling. The shorter-run puzzle is why nominal wages have for some years been growing slower than model-based forecasts have predicted.

This paper suggests that an important part of the explanation for both puzzles may lie at the individual firm level, rather than at the macro level. The uneven take-up of new technology is resulting in increasing dispersion in productivity performance across firms in a given industry. High productivity firms would appear to be using most of their higher levels of productivity to reduce prices and increase profit margins rather than passing most of it on to their workforce in higher wages, while the productivity 'laggards' have limited scope to pay higher wages. If employment growth is much less dispersed than productivity growth across firms, as overseas evidence suggests is the case, these observations may help to explain not just declining labour shares of national income but also low average productivity growth and subdued nominal wages growth. The paper sets out some research proposals designed to further explore these linkages.

Given the broadening application across industries of new information and communication technology, if the above forces are indeed at play they may prove pervasive and long lasting, with important implications for monetary policy over the cycle.

JEL Classification Numbers: D33, E24, E25, J3

Keywords: labour share, wage growth, superstar firm hypothesis, digital technology

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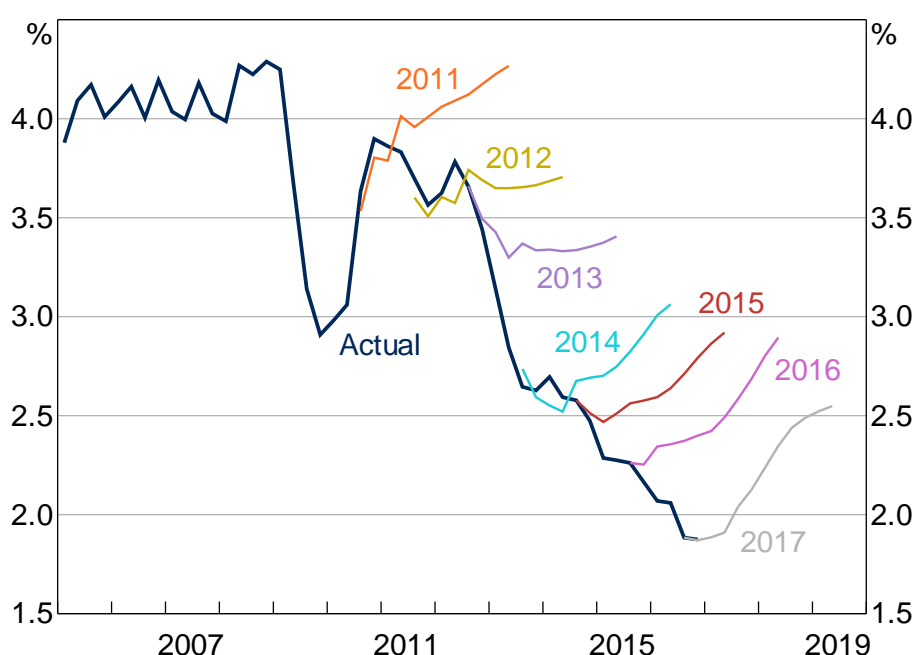
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## 1. Introduction: Short-run and Long-run Wage Puzzles

For at least the last six years, and in periods of both rising and falling unemployment, nominal wages growth in Australia has surprised on the downside (Figure 1). A 2015 RBA *Bulletin* article examined why the decline in wages growth since late 2012 had been so large by historical standards relative to the high and rising unemployment rate: that is, why the Phillips curve appeared to have steepened (Jacobs and Rush (2015); see also Kent (2015)). Two years later, the focus of RBA research was on explaining why, in the face of low and falling rates of unemployment, wages growth was again surprising on the downside: that is, why the Phillips curve appeared to be flattening (e.g. Bishop and Cassidy 2017; Lowe 2017a).

**Figure 1: RBA Wage Growth Surprises**  
Wage price index forecasts, year-ended



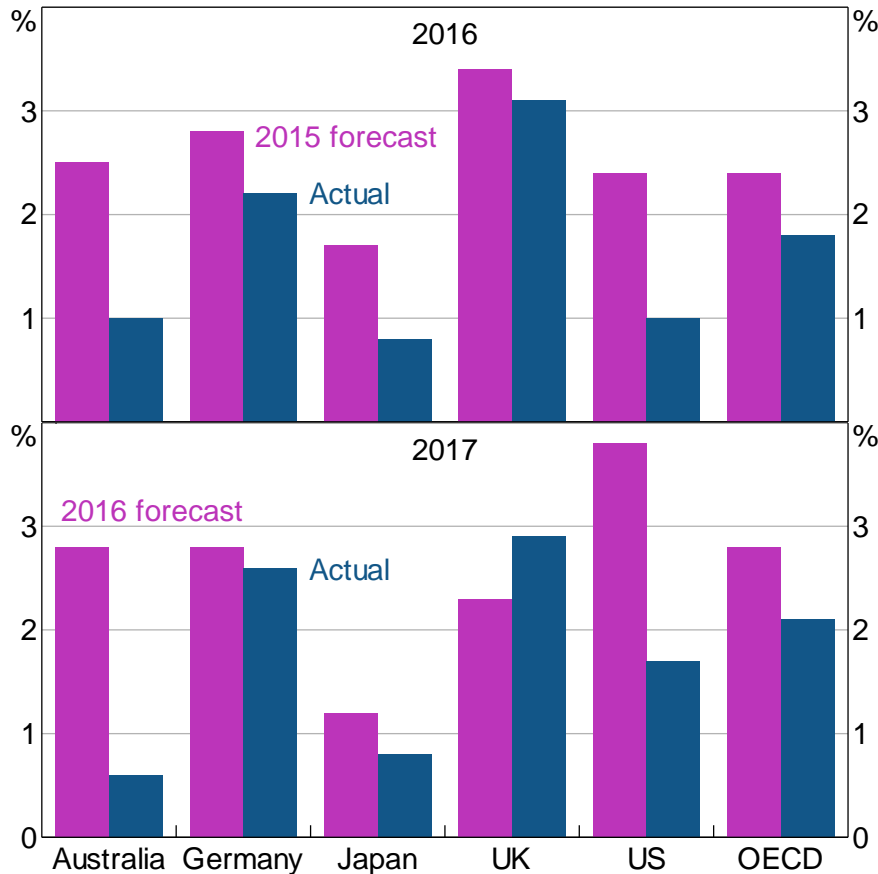
Note: February *Statement on Monetary Policy* forecasts  
Source: Bishop and Cassidy (2017)

Such observations raise questions about the stability of the Phillips curve and its suitability as a framework for examining what is driving low wage outcomes: a key issue for many central banks. In a late 2017 speech, RBA Governor Philip Lowe stated that understanding why wages growth was so low was a 'major priority' for the RBA (Lowe 2017b).

During periods of weak economic growth and rising unemployment, slow growth in nominal wages is to be expected. But the persistence of surprisingly weak nominal wages growth in the context of low and falling levels of unemployment, which has been observed across a number of countries (Figure 2), has been both unexpected and unwelcome. It has led a number of central banks to look

for possible structural explanations, with a variety of common causal variables operating across different countries (e.g. Arsov and Evans 2018).<sup>1</sup>

**Figure 2: International Wage Growth Surprises**  
Compensation per employee forecasts, year-ended



Source: OECD, *Economic Outlook*

While this research work has to date raised almost as many questions as it has provided answers, implicit in the *behaviour* of a number of central banks is the view that longer-lasting structural factors may be at least part of the explanation: that is, the current period of low wages growth may be more than just a cyclical phenomenon. This has been reflected in their willingness to maintain highly accommodative monetary policy settings for longer than would normally be the case, encouraging even lower levels of unemployment. Should this view prove wrong and higher levels of inflation result, they may be costly to reduce. On the other side of the equation, if ongoing structural developments are in fact an important part of the explanation for subdued wages growth, the risk may be one of normalising interest rates too rapidly.

One reason for suspecting that longer-run structural factors may be at play is the observation that wages growth has, in a broader sense, surprised on the downside for decades, across many countries. A standing assumption in the economics profession, at least until relatively recently, was

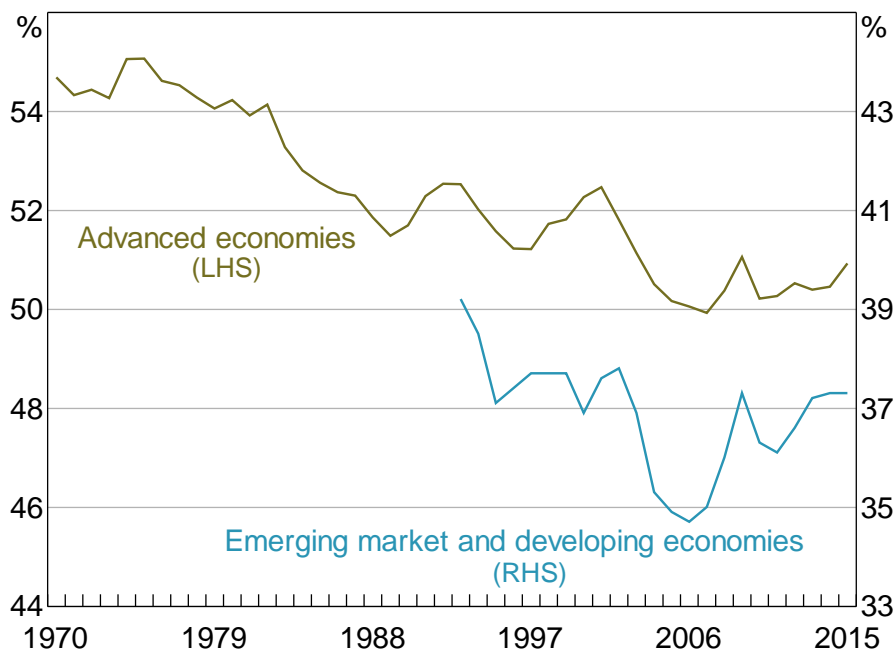
<sup>1</sup> These have included: declining levels of union membership; rising job insecurity; structurally weaker productivity growth; globalisation; automation; hysteresis; more permanently anchored price expectations flowing from the move in the 1980s to more explicit inflation targeting by central banks; and increasing 'casualisation' or divisibility of the workforce. For some references see OECD (2017) and Arsov and Evans (2018).



that, over the long run in industrialised economies, nominal wages growth would roughly equal producer price inflation plus labour productivity growth: that is, the wages share of GDP would remain reasonably stable. Indeed, a good deal of modern macroeconomic analysis, along with development economics, was based on this 'stylised fact'. Keynes himself subscribed to it in 1939, describing it as 'one of the best-established regularities in all of economic science'.<sup>2</sup> It was taken a step further by Simon Kuznets in his 1954 Presidential address to the American Economic Association (Kuznets 1955), in which he put forward his famous 'Kuznets curve' theory: labour's share of national income, he alleged, at first falls during early stages of industrialisation, then rises, and finally levels out and stabilises as economies move into more advanced stages of industrial development and rising labour productivity is increasingly passed through to the workforce via higher real wages.<sup>3</sup> This view was seemingly supported by data suggesting that, for most of the twentieth century, the wages share in many western economies did in fact rise as those economies became more industrialised, before levelling out.

However, this cosy view of workers fully benefiting from the fruits of economic growth has been challenged by more recent data. A 2011 International Labour Organization report found that the labour share of national income had fallen significantly in three-quarters of 69 countries for which data exist from the early 1970s to late 2000s (Charpe 2011, pp 55–56). These findings have been confirmed in a number of more recent studies (Figure 3), although the commencement dates for the declining labour share at times differ slightly (e.g. Karabarbounis and Neiman 2013, 2017; Dao *et al* 2017; IMF 2017b).

**Figure 3: Labour Share of National Income**



Source: IMF (2017b)

<sup>2</sup> As quoted in Piketty (2014, p 220).

<sup>3</sup> For an interesting and broader examination of the apparent breakdown of some of Kaldor's famous 'stylised facts', including constant factor shares, see Eggertsson, Robbins and Getz Wold (2018).

A considerable amount of research has been conducted on what has been driving the trend decline in the labour share. This is hardly surprising given its ramifications. The falling labour share is contributing to rising income inequality because, in most if not all western economies, the distribution of income from capital is more concentrated than for income from labour, and hence a shift in factor income shares in favour of profits, other things equal, leads to rising income inequality (e.g. Jacobson and Occhino 2012; Piketty 2014; IMF 2017b). While still somewhat contentious, there is also some evidence of adverse effects of rising income inequality on economic growth (e.g. Mo 2000; OECD 2015; Ostry, Berg and Tsangarides 2014; Brueckner and Lederman 2015).

The importance of understanding what is driving factor share trends, moreover, extends well beyond economics. Downward trends in the wages share of GDP and associated rising income inequality have been widely cited as critical factors in explaining observed disillusionment with mainstream political parties, free trade and globalisation. Indeed, trend increases in inequality have long been seen by some as incompatible with well-functioning democracies.<sup>4</sup>

While the question of what is driving changes in factor shares has received considerable attention from both academics and bodies such as the OECD and IMF, it has received less attention from central banks. This paper suggests that it warrants closer attention. The factor share puzzle can be seen as either a real wage puzzle – why have real wages been increasing slower than labour productivity – or a long-run nominal wage puzzle – why has nominal wages growth been lower than producer price inflation plus labour productivity growth? Understanding what is driving this may well be important for the conduct of monetary policy. If real producer wages<sup>5</sup> are increasing less than labour productivity, the difference between the two is being reflected in either higher profit mark-ups or lower output prices, or some combination of the two. Understanding which it is, why and whether the split is changing over time is important for inflation forecasting.

More broadly, both short- and long-run wage puzzles ultimately reflect structural shifts in bargaining power between labour and capital over the distribution of value added. Analysing such structural changes requires models that allow for product and/or labour markets that are not fully competitive and can accommodate changes over time in mark-ups. While to some extent this can be done within a Phillips curve framework, such a reduced form approach is arguably not the best way in which to disentangle and examine slow-moving structural forces that are at play.

Reinforcing the potential importance of central banks understanding what is driving the long-run wage puzzle is its longevity and the fact that it is occurring across so many countries. Both of these features suggest its causes are likely to be structural rather than cyclical. If these causal factors are also relevant to helping explain more recent nominal wage behaviour then, to the extent that they are likely to remain in play or indeed strengthen going forward, central banks can have more confidence in keeping interest rates lower for longer.

A fair amount of work has been done on how the growing take-up of information and communications technology (ICT) and its embodiment in new areas of investment may be affecting nominal wages growth through its impact on bargaining power, job security and product market

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4 US Supreme Court Justice Louis Brandeis, speaking early in the twentieth century, is alleged to have stated: 'We may have democracy, or we may have wealth concentrated in the hands of a few, but we can't have both'.

5 That is, nominal wages deflated by an output price deflator, as against the real consumer wage where the deflator is a consumer price deflator.

competition. The RBA has itself done a good deal of research in this area. Most of the empirical results, however, are either inconclusive or help explain only a small part of the slow nominal wage growth 'surprise'.

Recent academic work that focuses on the broadening but very uneven take-up across firms of the benefits of new technology, in particular ICT (Brynjolfsson and McAfee 2014), may well provide more fertile ground for examining links between new technology and nominal wages growth. A pioneering study by the OECD in 2015 on the diffusion of technology across firms and countries found that, while productivity growth for 'frontier' firms remained robust, the productivity gap between frontier and 'laggard' firms was increasing across many industries and countries (Andrews, Criscuolo and Gal 2015). Building on these findings, Autor *et al* (2017) put forward the hypothesis that uneven technology take-up is resulting in technological leaders ('superstars') across many industries that have high profit mark-ups and low labour shares of value added, and that this can explain the macro-level decline in labour's share. Empirical tests have confirmed a range of implications that flow from their 'superstar' hypothesis, for both the United States and a number of European countries.

This research work linking declining wage shares to the uneven take-up of new technology and different levels of productivity growth across firms may also have important implications for nominal wages growth, on a number of fronts. Firstly, analysis by the Bank of England suggests that the growing gap between productivity frontier and laggard firms across many industries helps explain the slowdown in average productivity growth observed in many countries in recent decades (Haldane 2017a). Low productivity growth has in turn been identified as helping to explain low nominal wages growth across a number of countries (e.g. Brouillette *et al* 2017; Arsov and Evans 2018). If low productivity growth continues, the capacity for *future* growth in real wages and living standards will also be increasingly constrained.

Secondly, there is some evidence, both overseas and in Australia, that the larger and more productive firms are increasing their industry market shares as measured in terms of sales or value added, but much less so, if at all, in terms of employment. They are primarily using their market and bargaining power to absorb most of their firm-specific productivity gains into higher profits and lower output prices, rather than into higher wages (e.g. Australian Treasury 2017; Haldane 2017a; Kehrig and Vincent 2017); while at the bottom end of the scale the productivity laggards do not have the capacity to offer anything other than low wage increases in order to remain in business. In short, both the distribution of wage increases and the distribution of employment appear to be much less dispersed than the distribution of productivity growth across firms. *The central hypothesis of this paper is that these firm level observations may be key factors behind not just the declining labour share and low productivity growth but also downward pressure on average nominal wages growth.*

Such links, moreover, may well be increasing in importance. As the take-up of digital technology spreads – albeit unevenly – across more firms, industries and activities, so will its likely impact on product and factor markets and on bargaining relationships.

Reflecting the above observations, the remainder of this paper is organised as follows. Section 2 looks briefly at the nature of the ICT revolution and associated new globalisation and some of its potential effects on product and labour markets and bargaining power. It then looks at recent RBA research work quantifying the effect of these factors on nominal wages growth, with a more detailed

examination in Appendix A. Section 3 evaluates some of the key overseas studies on declining labour shares, in particular recent studies linking it to uneven take-up of new technology and productivity across firms. It also discusses the possible relevance of this framework for Australia.

Section 4 sets out some research proposals designed to further explore these possible links between factor share analysis and the nominal wage puzzle in Australia.

## **2. Technology, Bargaining Power and Nominal Wages Growth**

This section looks at some of the ways in which new technology, in particular ICT, may be impacting on the relative bargaining power of employers and employees across a broadening range of industries, and hence on wages growth. It then examines recent RBA research work in this area.

### **2.1 New Technology, Product Markets and Labour Markets: Some General Observations**

Two closely related developments that have had a major impact on both labour and product markets in many countries in recent decades are the application of digital technology (e.g. Brynjolfsson and McAfee 2014) and the associated 'new' globalisation.<sup>6</sup> Digitisation – the representation of information in bits – has dramatically reduced the cost of storing, transmitting and manipulating data. Complementing and magnifying the digital revolution have been three important technological developments: the internet and the development of high-speed networks and search engines; the widespread dissemination of platform devices – mobile telephones, tablets, etc – that provide consumers, workers and service providers with both connectivity and access to data and information in most places at all times; and the use of digital technology and platforms to collect and merge masses of exploitable commercial, personal and geographic data: so-called big data.

Reference is often made to increased consumer price awareness and sensitivity across many sectors due to growing access to online price comparisons, putting greater pressure on companies to reduce costs – including labour costs (e.g. Akerman, Leuven and Mogstad 2017). But the take-up of ICT is also having a more pervasive impact on many other aspects of business, including marketing, distribution, just-in-time inventory control, automation and the spread of web-based service providers. It has also made it easier and cheaper to coordinate complex activities across different locations, allowing firms to take greater advantage of geographical differences in wages and other costs by 'unbundling' production processes through the creation of global supply chains: the new globalisation. A number of studies both in Australia and overseas have highlighted the lengthening of global supply chains.<sup>7</sup>

The ICT revolution and associated new globalisation have enabled and encouraged major changes in work and management practices across many industries, in particular by making both production processes and labour input increasingly 'divisible' across countries and firms and within firms. Digital

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6 Baldwin (2016) differentiates the 'old' globalisation, associated with invention of the steam engine and the major decline in the cost of transporting goods across countries, from the 'new' globalisation associated with the ICT revolution and the dramatic fall in the cost of transferring information across countries. Whereas old globalisation was focused on separation of production and consumption, new globalisation is focused on unbundling production processes via supply chains.

7 See, for example, Timmer *et al* (2014) and Francois, Manchin and Tomberger (2015). For Australian studies, see Kelly and La Cava (2014) and Heath (2017).

technologies make it easier and cheaper for firms to keep in touch with and monitor employees, whether they are in the office, at home, in different offices within the same country or in different countries. This has enabled firms wanting to increase flexibility and reduce costs to use cheaper overseas workers in parts of their production process and/or non-standard forms of employment domestically, such as self-employed, contract and casual work. While in many cases this has been beneficial for employees looking for more flexible working arrangements that meet their specific circumstances, a number of studies suggest it has also been an important factor behind declining union membership and employee bargaining power and – especially in sectors and occupations where digitisation is extending to automation – falling job security and lower wages.<sup>8</sup>

The question of whether the ICT revolution and associated new globalisation will continue to have a substantial impact on product and labour markets has been at the centre of a lively academic debate in recent years. ‘Techno-pessimists’ such as Gordon (2016) argue that the effect of the ICT revolution is overstated (see also Cowen (2011) and Fernald (2015)). In a major study looking at the rise and fall of productivity growth in the United States, he argues that the impact of the ICT revolution was short-lived and less significant than what he calls the first (steam engine, railroads) and second (electrification, plumbing) industrial revolutions. In his view, the temporary nature of the third (ICT) industrial revolution explains why US productivity growth rose from around the mid 1990s but then fell away after the mid 2000s. As a challenge to those who argue to the contrary, he raises a pertinent question: if the effect of the ICT revolution is really so substantial and ongoing, why is it no longer showing up in faster productivity growth?

On the other side of the argument, so-called ‘techno-optimists’ such as Brynjolfsson and McAfee (2014) see ICT as a ‘general purpose’ technology: pervasive (in the sense of being a potentially important input across many sectors of the economy); subject to continual improvement; and spawning ongoing innovations in many areas. They argue that we are now at an inflexion point, with the impact of this third industrial revolution (or what they call the second machine age) set to become much more widespread as computing power continues to increase exponentially,<sup>9</sup> as more and more activities and devices become digitised and as ongoing innovations such as artificial intelligence, 3D printers and the internet of things are spawned by digitisation.

Increasingly, the evidence seems to suggest that both camps are partially correct. A number of studies have found not only extremely uneven patterns of take-up and utilisation of new technology across countries and within sectors of an economy but also a growing gap between high productivity firms that are at the forefront of adapting and using new technology and laggard firms within the same sector. With reference to a seminal OECD study in this area (Andrews, Criscuolo and Gal 2015), Haldane (2017a, p 3) states the following:

This empirical evidence suggests a long tail of countries and companies with low, slow productivity growth. These productivity laggards have been unable to keep-up, much less catch-up, with frontier countries and companies. At the same time, an upper tail of companies and countries has maintained

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8 See, for example, Campbell *et al* (2007); Flecker (2010); Hübler and Hübler (2010); Degryse (2016); Goldschmidt and Schneider (2017); Haldane (2017b); and Hudson-Sharp and Runge (2017). For some Australian studies, see Lass and Wooden (2017) and Mooi-Reci and Wooden (2017). For studies specifically on the impact of automation on wages growth and wage inequality, see references in Autor and Salomons (2018).

9 This point is disputed by Gordon (2016, pp 444–448).

high and rising levels of productivity. These productivity leaders are pulling ever-further away from the lower tail ...

This empirical pattern ... helps explain why we might see the *co-existence* of secular innovation (among leaders) and stagnation (among laggards). It helps account for the fall in productivity growth rates – namely, slower rates of diffusion of new innovation to the long lower tail of companies.

Many of the potential benefits of the ICT revolution to a firm – more detailed information on potential clients, easier marketing, greater flexibility with respect to labour input, greater economies of scale and lower costs through outsourcing and global supply chains – are largely ‘non-rival’ in nature, in the sense that one firm taking advantage of the benefits does not prevent a competitor from doing the same. Nonetheless, the reality is that doing so successfully and over a sustained period of time requires considerable management skill, information and capacity to fund new investment. These requirements are far from uniformly spread across countries or firms. By way of example, a recent study of law firms in Australia found, amongst other things, that all higher profitability firms in the survey are ‘harnessing new technologies’; and that cost and lack of knowledge are key factors inhibiting smaller firms from taking up new technologies (Macquarie Bank 2017).<sup>10</sup> All firms in the survey saw low cost ‘virtual firms’ and outsourced lawyers as the main threats to their business, as clients bypass them as the traditional service providers.

While the take-up of digital technology has been very uneven across firms within a given sector or industry, the evidence suggests that its effects are spreading as it is applied by some firms across more and more sectors, industries and professions (e.g. Weil 2014; McTernan and Reed 2015; Degryse 2016; Katz and Krueger 2016; Goldschmidt and Schmieder 2017). While this is happening faster in the United States than in most other countries, anecdotally the indications are that its impact and application in Australia are also continuing to widen (Department of Industry, Innovation and Science 2016; Productivity Commission 2016). This has been identified clearly in the RBA business liaison program. Lai *et al* (2018) note the following:

Information from the Bank’s liaison program and other survey evidence suggests firms have been more willing to spend on IT than most other forms of capital in recent years. The desire to increase efficiency, lower the cost of doing business, and improve service quality have been important drivers of the adoption of technology across the economy.

The authors also note that the take-up of ICT across firms within a given industry is very uneven, consistent with overseas studies referred to earlier.

While the application of ICT is spreading to more sectors and industries, there is still a good deal of uncertainty as to just which activities, industries and stages of production can or cannot be digitised, automated, unbundled and/or offshored; and with respect to the pace at which new ICT innovations may occur and be taken up. This uncertainty or ‘fear of the unknown’ may itself be having an important impact on labour market behaviour.

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<sup>10</sup> This finding on key factors inhibiting take-up of new technology in the legal industry is consistent with much broader feedback across many sectors of the Australian economy from the RBA’s business liaison program; see Lai, Poole and Rosewall (2018).

## 2.2 RBA Empirical Work on Technology, Bargaining Power and Nominal Wages Growth

### 2.2.1 *Technology and product markets*

Many consequences of the ICT revolution discussed above could in principle help explain why nominal wages growth has been sluggish across most countries, including Australia. Increasing divisibility of labour, falling union membership, outsourcing and increased job insecurity may be shifting bargaining power away from employees and having an important impact on nominal wages growth.

Similarly, greater competition in product markets may have stiffened employer resistance to higher wages and increased employer focus on cutting costs. In a speech in 1996, the then RBA Deputy Governor, Ian Macfarlane, reminded his audience that 'we now live, work and aim to sell our output in a world ... characterised by ... low pricing power by business and labour'. He went on to suggest that one of the two most important reasons for low inflation was likely 'increased competitive pressures as economies have become more open and as domestic competition has intensified' (Macfarlane 1996, p 18).

While initially increased domestic competition in Australia was typically attributed to market liberalisation measures in the 1980s and 1990s (e.g. Dwyer and Leong 2001), more recently the focus has been on global factors – including globalisation and the use of global supply chains to reduce costs. In a recent speech focused on why nominal wage growth was so low, RBA Governor Lowe suggested that 'foremost' among the structural factors at work were perceptions of increased competition:

Many workers feel there is more competition out there, sometimes from workers overseas and sometimes because of advances in technology ... [As a consequence] many workers feel like they have less bargaining power than they once did.

Lowe went on to suggest this was not the full story:

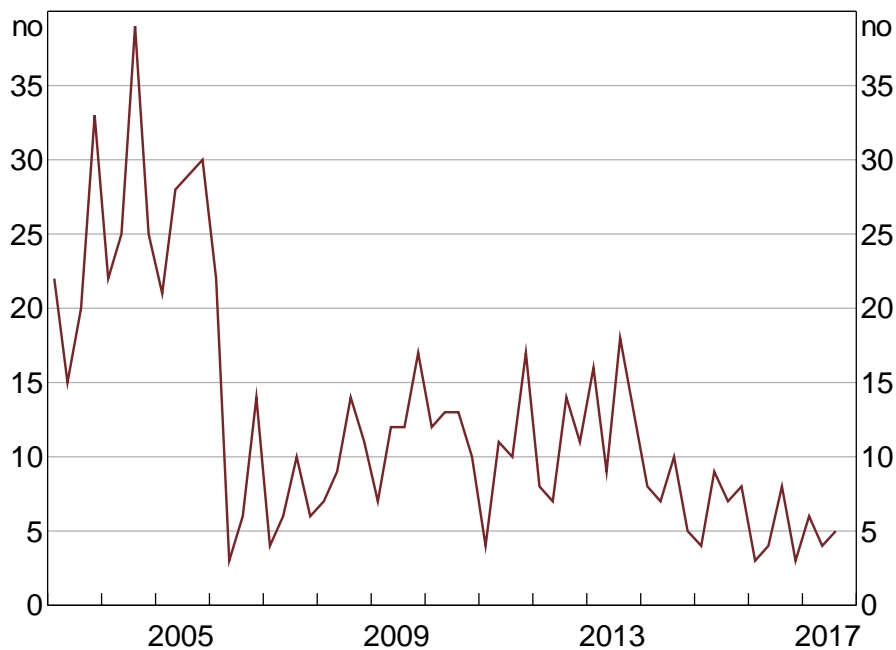
It is likely that there is also something happening on the firms' side as well ... Businesses are not bidding up wages in the way they might once have. This is partly because business, too, feels the pressure of increased competition.

One response to this competitive pressure is to have a laser-like focus on containing costs ... Paying higher wages can sit at odds with that mindset. (Lowe 2017b)

The increasing impact of digital technology is certainly not the only factor that may be leading to increased competition in product markets and greater employer resistance to cost – including wage cost – pressures, but the anecdotal evidence suggests it is an important and growing one. A key rationale for introducing digital technology is to reduce costs. As it is disseminated across more firms and industries, other things equal, competitive pressures increase, including increased competitive pressure on technology laggards from the technology leaders in their sector or industry.

Nonetheless, finding evidence that increased product market competition and greater employer resistance to cost increases are important factors in explaining the short-run wage puzzle is challenging. A key reason for this is the difficulty of finding suitable proxy variables and rich enough data sources to isolate and robustly test the hypothesis when there are so many moving variables. If employer resistance to wage increases was rising then, *other things equal*, this should be reflected in rising numbers of wage-related industrial disputes, which is not the case (Figure 4). However, other things are not equal: the hypothesis outlined by RBA Governor Lowe in the earlier quotations is that both employer resistance and union bargaining power are being impacted by new technology and putting downward pressure on wages growth. This is more consistent with the industrial disputes data.

**Figure 4: Wage-related Industrial Disputes – Australia**



Source: ABS

One possible data source that might shed more light on this issue is survey data. Ballantyne and Langcake (2016) used information from the Reserve Bank's business liaison program to look for explanations of a structural break in retail goods inflation around 2010. Amongst their findings were that an intensification of competition and firms' increased efforts to reduce costs along their supply chain were likely contributing factors. In both cases, they suggest, digital technology appeared to have played an important role, both by way of increased consumer awareness of prices via online shopping and increased supply of retailers due to competition from foreign online companies.

It will be argued in Section 4 that the growing divergence in productivity levels between firms in the same industry may well be a key factor behind increasing product market competition, and that a firm-level framework that allows for heterogeneous productivity performance provides a richer framework and database for testing hypotheses in this area.



### 2.2.2 Technology and labour markets

Most of the RBA research looking to explain surprisingly low nominal wages growth has been done within the framework of a conventional wage Phillips curve relationship:

$$w_t = \alpha + \beta(ue_{t-1} - ue_{t-1}^* / ue_{t-1}) + \gamma(\mathbf{z}_t) + \varepsilon_t \quad (1)$$

where  $w$  is nominal wages growth,  $ue$  the unemployment rate,  $ue^*$  the NAIRU (the non-accelerating inflation rate of unemployment),  $\mathbf{z}$  a vector of other exogenous cyclical factors that may affect wages growth and  $\varepsilon$  the error term. In the RBA's preferred formulation, the vector  $\mathbf{z}$  includes inflation expectations, actual inflation, trend growth in labour productivity and the change in the unemployment rate.

A recent RBA study (Arsov and Evans 2018), using the formulation in Equation (1), examined why wages growth across a number of advanced economies, including Australia, had surprised on the downside in recent years, despite tight labour markets. It reached the following conclusions. Firstly, Phillips curves would not appear to have flattened over the 2000s: that is, recent low wages growth does not appear to reflect a weaker relationship with unemployment. Secondly, lower inflation expectations and lower productivity growth help explain low wages growth, but only partly, such that 'over the past two years wages have been persistently weaker than estimated by the models'. The study also noted that this recent period of downward surprises in wages growth is not the first – similar outcomes were seen in the early 2000s.

The above finding – that, even when additional explanatory variables such as low inflation expectations or weak productivity growth are included, conventional Phillips curves cannot fully explain the weakness in wages growth in recent years – has been a consistent theme in recent speeches and in research by the RBA focused on Australian wages growth. It has led the Bank to examine structural as against cyclical factors that may help explain the nominal wage growth surprise. This work is examined in Appendix A.

Three broad observations may be made regarding this RBA research. Firstly, because recent wage growth 'surprises' have been surprises relative to what has been forecast by traditional Phillips curve augmented wage equations, it is not surprising that most of the analysis by the RBA and other central banks of possible structural impacts on wage behaviour has been done within a Phillips curve framework. However, while this framework incorporates cyclical shifts in employee bargaining power over the course of the economic cycle through the unemployment gap term, it is arguably less well suited to examining structural factors that may be having a slow-building impact on employee bargaining power over a longer time period. In part, this is because such structural factors are often hard to measure, providing fewer observations and hence making their impact harder to assess within a cyclical Phillips curve framework (Arsov and Evans 2018). More broadly, there is increasing evidence – at least in the United States – of a trend rise in profit mark-ups over recent decades (e.g. Barkai 2016; Bessen 2017; De Loecker and Eckhout 2017; Eggertsson *et al* 2018). If similar trends are evident in Australia, fully analysing what is going on and incorporating it into both wage and price equations may require more radical surgery. Cockerell and Russell (1995, p 4) noted the following:

Modelling the Australian economy using a price taking model is inconsistent with the observation that firms appear to set prices and that labour market outcomes are the result of collective bargaining between labour and firms (or possibly labour, the government and firms). It may be more appropriate, therefore, to model Australian wage and price inflation within an imperfect competition model.

This point is returned to in Section 4.

The second observation concerns the nature of the structural factors that may be dampening wages growth and that the RBA has examined in its research. They are as follows:<sup>11</sup>

- increased import competition, globalisation and job insecurity;
- declining unionisation;
- casualisation of the labour force; and
- gradual unwinding of a real wage overhang built up in earlier years.

All of the above factors except the last one seem likely, *a priori*, to be in part related to the impact of new technology. Moreover, for reasons set out in Appendix A, the gradual unwinding of a real wage overhang seems unconvincing as an explanator of ongoing nominal wage growth surprises.

A third observation relates to the possible link between some of the above factors and the uneven take-up of new technology. The Autor *et al* (2017) paper notes that superstar firms appear to be 'increasingly using domestic outsourcing to contracting firms, temporary help agencies, and independent contractors and freelancers for a wider range of activities previously done in-house' and references some other studies on this point (Weil 2014; Katz and Krueger 2016). The authors go on to state the following:

This fissuring of the workplace can directly reduce the labor share by saving on the wage premia (firm effects) typically paid by large high-wage employers to ordinary workers and by reducing the bargaining power of both in-house and outsourced workers in occupations subject to outsourcing threats and increased labor market competition ... (Autor *et al* 2017, p 26)

A reasonable summary of RBA work examining structural factors that may be reducing employee bargaining power and contributing to lower wages growth is that, while the empirical results help explain some of the weakness, the overall impact is not large and still leaves an unexplained element. This was also the finding of Arsov and Evans (2018) in their examination of the effect of shifts in bargaining power (amongst other factors) in explaining weak wages growth across a number of countries, in which they concluded that:

Structural changes in the labour market, including declines in unionisation rates and employee protections also seem to be factors behind the weaker wage growth. However, all of these factors are

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11 Another factor examined in RBA research is the frequency, average size and dispersion of wage increases. Bishop and Cassidy (2017) found that all three had declined in recent years. However, this is more a description of what is going on behind the aggregate numbers rather than an explanation of what is driving surprisingly low nominal wages growth.

only part of the story and, over the past two years, there appears to have been some other common factor weighing on wage growth across advanced economies.

As noted earlier, part of the reason for the limited findings from RBA research in this area may be the absence until recently of a large and rich enough Australian database that, amongst other things, allows for the impact of the explanatory variables being examined to be isolated from other potentially correlated variables. More broadly, finding enough data points (and variations in the data) to be able to robustly test the impact of potential explanatory variables is a common problem across many areas of economic research, and has led some researchers to look for richer, micro-level data sources to formulate and test their hypotheses.

Recently available firm-level data sources in Australia may well overcome these problems and facilitate stronger econometric testing and more robust results with respect to structural factors that may be influencing wages growth. These data sources may also allow for future work in this area to be centred around an underlying theoretical framework that allows for heterogeneous productivity growth across firms and associated changes over time in industry concentration and profit mark-ups which generates a set of testable hypotheses. In the context of the central focus of this paper, these data sources allow work to be undertaken on whether one of the key findings with respect to new technology – namely, its very uneven take-up across firms – is an important part of the explanation for low average nominal wages growth.

A shift to a more micro-level framework that generates a set of testable hypotheses can be seen in the overseas work linking this uneven take-up across firms of new technology to the widely observed trend decline in labour's share of national income. These studies are examined in Section 3 below. Section 4 sets out some *a priori* reasons why some aspects of the theoretical framework used in these studies of factor income share movements may have relevance to explaining why nominal wages growth has been so low in many countries, and sets out some suggested areas for further research on this front.

### **3. Technology and Labour's Declining Share**

As noted earlier, labour's share of national income has been falling in most developed countries since around the mid 1980s. Not surprisingly given its significance both economically and politically, considerable research work has been undertaken trying to explain this observed phenomenon. Some of that research has focused on measurement issues, suggesting that the decline can be partly or largely explained by the treatment of capital depreciation, income from housing, income of the self-employed, or intangible capital.<sup>12</sup> However, while such 'explanations' may have some validity for some countries at certain historical periods, the continuation of the declining trend across so many countries has led to a general consensus that, data queries aside, the fall in labour share is real and significant and requires more fundamental explanations (Autor *et al* 2017, p 3). In addition, such 'measurement issue' explanations do not fit easily with the now widely accepted fact, further

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12 See, for example, on the treatment of capital depreciation Bridgman (2015) or Cho, Hwang and Schreyer (2017); on housing income Rognlie (2015); and on intangible capital Elsby, Hobjin and Şahin (2013). For a recent Australian study that attributes the apparent long-run decline in labour's share to the treatment of housing income and depreciation, see Trott and Vance (2018).

discussed below, that within-industry rather than between-industry changes account for the vast bulk of the shift in labour's share.

As was the case in relation to work on structural explanations of low nominal wages growth in recent years, many – indeed, most – of the causal factors examined in explaining the decline in labour's share relate, directly or indirectly, to technology and its effects. Indeed, there is a close overlap in the structural factors examined with respect to short- and long-run wage puzzles, which is not surprising given the importance in both cases of shifts in bargaining power. However, a notable exception is the most recent work linking labour's declining share to the uneven take-up of technology and the resultant growing productivity gaps between firms in the same industry. Little if any work appears to have been done examining whether this framework can also help explain the more recent puzzle of very low nominal wages growth: the focus of Section 4 below.

In examining and evaluating the many and varied explanations for the trend decline in labour's share, a number of useful filters can be used. The primary ones are as follows.

Firstly, a growing number of shift/share studies have shown that the decline in labour shares in the United States and in most other countries is primarily a within-industry phenomenon, not a between-industry one (e.g. OECD 2012; Elsby *et al*/2013; Karabarbounis and Neiman 2013; IMF 2017b). More recently, Autor *et al* (2017) have taken this analysis one step further and found that in the United States and (at least within the manufacturing sector) other countries examined, the fall in labour's share is driven primarily by between-firm reallocation within an industry, rather than by the within-firm component.<sup>13</sup> Taking these two sets of findings together, explanations of declining labour shares that focus on shifts in activity between labour and capital intensive industries, or on factors such as trade exposure or outsourcing that should impact equally across all or most firms within an industry, are unlikely to identify the key drivers, at least for most countries.<sup>14</sup>

Secondly, most empirical studies suggest that the elasticity of substitution of capital for labour is less than one.<sup>15</sup> Consequently, explanations of factor share shifts that focus on the decline in the cost of capital relative to labour at an aggregate level are also questionable, although it is worth noting that automation and artificial intelligence may over time raise the elasticity of substitution in at least some industries and for some workers.

Thirdly, given that the declining labour share has been observed across many countries, developed and developing, typically since around the 1980s, causal factors that are specific to only a few countries, or cover a shorter or quite different time period, are unlikely to provide a convincing explanation.

Fourthly, and as noted earlier, explanations for significant changes in factor shares must ultimately relate, directly or indirectly, to factors influencing the relative bargaining power of labour and capital

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13 In the Autor *et al* study, labour's share fell in the United States for four of six sectors over the period examined; namely manufacturing, services, utilities and transportation, and retail trade. It rose in finance; and rose sharply then fell almost as sharply in wholesale trade. In each sector, except 'services' where the firm entry effect dominated, the between-firm effect was the largest negative contributor to the change in labour's share.

14 Australia may be a partial exception to this general point. This point is returned to below.

15 See, for example, Oberfield and Raval (2014), Summers (2014) and Lawrence (2015). For reviews of the literature on estimating the elasticity of substitution, see Antràs (2004), Chirinko (2008) or León-Ledesma, McAdam and Willman (2010).

over the distribution of productivity gains. Given that a declining labour share has been observed in many countries since around the 1980s, it seems reasonable to conclude that a key part of the explanation revolves around ongoing structural changes in labour and product markets that are impacting on the bargaining power relationship between management and labour within many firms and industries over roughly this same period.

The following literature survey of overseas studies linking labour's declining share to technology-related factors is far from comprehensive, aiming instead to briefly evaluate the most widely cited technology-related studies in order to put the more recent productivity divergence explanations that are of primary interest into a broader context.<sup>16</sup>

### **3.1 Globalisation: Supply of Cheap Labour, Increased Import Competition and Outsourcing**

While the digital revolution has greatly facilitated globalisation and the increased integration of both labour and product markets, it is but one of many factors that have facilitated globalisation more broadly. The integration of China into the global economy since the fundamental reforms that began in the late 1970s and the dismantling of many barriers to both trade and capital flows in recent decades have, by way of example, also been major factors behind increased globalisation.

A number of studies have examined the impact of increased supply of low-wage labour, increased international competition, trade exposure and outsourcing on labour's share. Phelps (cited in Ellis and Smith (2007)) suggested that the entry of China and eastern Europe into the global economy has increased the supply of low-wage, low-skilled labour without an equivalent increase in the capital stock, thereby reducing the relative price of labour. If the elasticity of substitution is less than one – which most of the empirical literature suggests is the case – this would lower the labour share of national income. Closely related to this argument are studies suggesting that increased import competition (e.g. Harrison 2002; IMF 2007; OECD 2012, p 130) and offshoring (e.g. Jaumotte and Tytell 2007; OECD 2012; Elsby *et al* 2013; Autor *et al* 2017, p 2) can explain some or most of the fall in labour's share. By way of example, Abdih and Danninger (2017), in following up on an earlier IMF (2017b) study and using industry-level data for the United States for 2001 to 2014, found that, across a number of different model specifications and different proxy measures of the explanatory variables, import competition and the use of foreign inputs jointly explained between 41 and 51 per cent of the decline in labour's share.<sup>17</sup>

Looked at in a bargaining context, outsourcing, supply chains and rising import competition have all had a significant impact on both product and labour markets. However, while there is certainly evidence that outsourcing, supply chains and import competition have lowered both perceived job security and union bargaining power and raised the elasticity of labour demand with respect to labour costs (e.g. Rodrik 1997; Dumont, Rayp and Willemé 2006; Abraham, Konings and Vanormelingen 2009; Bloom, Draca and Van Reenen 2011; Boulhol, Dobbelaere and Maioli 2011; Goldschmidt and Schmieder 2017; OECD 2017), it should also have affected profit margins. Whether

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16 One area of explanation not covered and which is not closely linked to technology is that of 'financialisation'; that is, the increase in size and importance of a country's financial sector. For a literature survey and summary of the different channels whereby financialisation may impact on labour's share, see Guschanski and Onaran (2018).

17 However, similar to the IMF (2017b) study on which this analysis is built, the study also found that technology – as measured by the intensity of 'routinisation' of job tasks – was a more powerful explanatory variable.

on balance this is likely to have raised or lowered labour's share of national income is thus unclear *a priori* and is an empirical matter.

At a conceptual level, it is difficult to reconcile explanations centred on trade exposure or outsourcing with the finding referred to earlier that most of the 'action' on falling labour shares is happening between firms in a given industry, rather than across all or most firms in an industry. It is not at all obvious why different firms in the same industry should face quite different levels of import competition or have very different opportunities to outsource. Thus it is perhaps not surprising that more detailed studies using micro-level data sources have failed to find a significant relationship between industries or firms with greater exposure to trade shocks, import competition and outsourcing on the one hand and the extent of the decline in labour's share on the other.<sup>18</sup>

In addition, most of these 'globalisation' explanations are not easy to square with the observation that labour-abundant countries, including China, India and Mexico, have also experienced significant declines in their labour shares (Karabarbounis and Neiman 2013, fn 1).

Finally, Ellis and Smith (2007) have pointed out that, if the explanation for the declining labour share centred on increased global competition and expansion of the global, low-wage labour supply, one might have expected the relative price of investment goods to have risen, whereas in fact the opposite has been the case.

### **3.2 Bargaining Power: Union Membership and Market Deregulation**

Links between globalisation and increased global competition and reductions in workers' bargaining power are likely to exist regardless of the particular type or level of union coverage, bargaining arrangements or institutions in place. This section looks more specifically at research on whether changes in institutional arrangements in labour markets, and differences across countries, may be an important independent factor behind the declining labour share. Once again, while technological change has undoubtedly been an important factor behind some of these institutional changes, it is but one of many factors involved.

Studies in this area have often been more qualitative than quantitative, reflecting the difficulty of finding adequate proxy variables for measuring differences in bargaining arrangements and their impact on employee bargaining power.

An early study by Blanchard and Giavazzi (2003) focused on deregulation in product and labour markets and associated shifts in bargaining power in Europe in the 1980s. Similarly, Giammarioli *et al* (2002) linked the decline in labour's share in Europe to labour market deregulation and declining union membership. However, these studies fail to explain the pervasiveness across economies, geographical regions and time of declining labour shares. They also sit uncomfortably with more recent findings that most of the action with respect to the falling labour share is occurring between firms in a given industry.

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18 For an international industry-level analysis and more references see OECD (2012), which found that offshoring plus increased import competition accounted for around 10 per cent of the decline in labour's share across the countries examined. For a US manufacturing sector study see Autor *et al* (2017).

Declining union membership and labour market deregulation are common features across many western economies over recent decades. The OECD (2012) provides a useful summary of some of the main factors that have been driving this trend, including the increasing use of ICT and associated 'casualisation' of the labour force discussed earlier. While some studies have found evidence of some relationship between union density and factor income shares (e.g. Charpe 2011; Stockhammer 2017), the evidence is at best mixed. This is not surprising: as the OECD 2012 study notes, there is no close relationship between the evolution of union coverage across countries and the extent of collective bargaining coverage, because many factors beyond level of trade union membership can affect collective bargaining coverage.<sup>19</sup> Nor does shifting attention to collective bargaining coverage itself help much. Noting the highly divergent trends in collective bargaining coverage across countries, the OECD finds no clear correlation between bargaining coverage and shifts in labour's share in the business sector. Indeed, they note that:

... some of the largest decreases in the business-sector labour share occurred in countries where collective bargaining coverage increased or decreased only slightly, such as Finland, Sweden and Italy. (OECD 2012, p 138)

With respect to Australia, the study found that, while institutional changes over the period examined (1990 to 2007) resulted in by far the largest drop in collective bargaining coverage of the countries examined, the decline in labour's share was around average.

Increasingly, across many OECD countries, collective bargaining has become more decentralised, occurring more at the firm/establishment level rather than the industry level (OECD 2012, p 139). While a number of studies have found that this has increased the link between wages and local performance, there is little if any evidence of a significant link between decentralisation of bargaining and shifts in the labour share (OECD 2012, p 142).

Finally, these institutional explanations are also difficult to reconcile with the observation that changes between firms, rather than across whole industries or resulting from intra-industry shifts in activity, are at the heart of the decline in labour's share.

In summary, the common experience of a declining labour share across a wide range of countries with differing bargaining institutions and degrees of collective bargaining and union membership suggest this is not fertile ground for further exploration. Rather, the factors ultimately driving shifts in bargaining power would appear to be pervasive and operating regardless of differences or changes in institutional bargaining arrangements across time and countries.

### **3.3 Capital Accumulation, Technical Change, Relative Factor Prices and ICT: Earlier Studies**

From early in the piece, a number of studies looking at reasons for labour's declining share focused on issues relating to capital accumulation, technical change and the relative price of capital and labour. Acemoglu (2003) and Bentolila and Saint-Paul (2003) examine factors which could lead to deviations from standard growth model stable paths in which labour is paid its marginal product and

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19 These include the importance of multi-employer bargaining and the role the state plays in a number of countries in extending collective bargaining arrangements to parties not directly affiliated with the bargaining parties (see OECD (2012, p 135)).

either technical change is labour augmenting and does not impact on factor shares, or the production function is Cobb-Douglas (elasticity of substitution of one) and neither capital nor labour-augmenting technical change affects factor shares. Relaxing these conditions to allow for deviations from stable growth paths, an increase in capital intensity results in an increase in both the capital-to-labour ratio and the marginal product of labour. If capital and labour are complementary – that is, the elasticity of substitution is less than one – the increase in real wages will more than offset the decline in labour intensity, and labour's share will rise. But if labour and capital are substitutes – the elasticity of substitution is greater than one – labour's share will fall.

Within this framework, the impact of capital-augmenting technical change is the same as rising capital intensity. Using a measure of total factor productivity (TFP) as a proxy for technical change – a rough proxy at best – Bentolila and Saint-Paul (2003) find that growth in capital intensity and TFP more than account for the fall in labour's share in OECD countries between 1972 and 1993. Follow-up analysis by the OECD (2012) using a similar framework reached roughly similar results, but importantly they used firm-level data rather than macro data to confirm the earlier finding holds on a within-industry basis.

Similarly, in a more recent and widely cited article, Karabarbounis and Neiman (2013) argue that the rapid decline in quality-adjusted equipment prices, in particular due to the spread of ICT, has driven a decline in the cost of capital relative to labour and a rise in the capital-to-labour ratio.<sup>20</sup> If the elasticity of substitution is greater than one, as their cross-country estimations suggest is the case, this would lead to a decline in the labour share.

How do these explanations fit with the view expressed earlier that, ultimately, significant and lasting changes in factor shares must reflect, directly or indirectly, changes in bargaining power? Many of the earlier technology studies do not even mention bargaining power, and seem to view technology and technical change as somehow independent of it. Ultimately, however, any impact must reflect the fact that labour has not benefited as much as capital from the particular nature of technological change in the production process, due to declining employee bargaining power. In short: 'Technology must be interpreted as a factor influencing bargaining positions rather than a mechanical process determining distribution outcomes' (Guschanski and Onaran 2018, p 6).<sup>21</sup>

On the surface at least, a fundamental problem with many of the studies focused on the declining cost of capital and rising capital-to-labour ratios is that, as noted above, the bulk of the empirical evidence at the *macro* level suggests that the elasticity of substitution is less than one. In addition, for a decline in the relative price of investment goods to lead to an *ongoing* trend decline in labour's share, an elasticity of substitution greater than one is a necessary but not sufficient condition: it is also necessary for the capital-to-labour ratio to *continue* trending upwards over the period observed, which in the case of the declining labour share is the period since the 1980s. Such a requirement does not *a priori* seem consistent with the substantial slowdown in labour productivity growth since the 1990s observed across many economies.

It is possible that more detailed firm-level examination of the role played by ICT may help explain the apparent inconsistency between the above empirical results and the filters outlined earlier. The ongoing take-up of ICT may have resulted in technical change in recent decades being capital

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20 See also Acemoglu (2003) and Bentolila and Saint-Paul (2003).

21 See also on this point, Bhaduri (2006) and Hein (2014).



augmenting, as some studies have indeed found (e.g. Arpaia, Pérez and Pichelmann 2009; Tyers and Zhou 2017). In addition, ongoing technological progress with respect to robotics and artificial intelligence may over time raise the substitutability of capital for labour in some firms and industries and for some employees, in particular lower-skilled non-manual workers.<sup>22, 23</sup> If, as more recent work examined below suggests is the case, these changes in technology are occurring very unevenly across firms, with the ICT take-up leading to increased capital/labour substitutability in the high productivity firms but not in the majority of technologically laggard firms, it may be possible to reconcile the results of these studies with the observation that, at a *macro* level, most estimates find the elasticity of substitution is less than one; and also with the observation that, despite the increased take-up of ICT, productivity growth at the *macro* level has slowed in recent decades across many countries.

The key to whether these observations can be reconciled thus lies in further studies at the firm level into the uneven impact of ICT on capital intensity, technical change, productivity growth and elasticities of substitution.

An interesting early study that did not suffer from these limitations and that placed technological change directly in the context of shifts in bargaining power was Ellis and Smith (2007). Hornstein, Krusell and Violante (2002), using a putty/clay model of capital accumulation made famous by Solow (1962), argue that higher innovation rates will result not only in faster rates of capital obsolescence and turnover but also faster churn in the labour market. This shifts bargaining power towards capital and away from labour, with the shift further exacerbated by any labour market rigidities that increase frictional unemployment and by any product market regulation that reduces competition. Building on this analysis, Ellis and Smith suggest that the increased use of ICT, and the incorporation of ICT into a wider range of capital goods, may have been a primary and ongoing factor driving the above process. While the data available to them precluded a direct test of their hypothesis, they note that it fits well with cross-country variations in factor shares: the decline in labour's share, they find, was greatest in countries with greater labour market rigidity and more product market regulation. They also show that, after controlling for other common explanations of labour's declining share – in particular, expansion of the global labour supply, changes in relative factor prices and exogenous shifts in bargaining power – there is still a significant trend decline in labour's share to be explained.

While not directly tested at either a micro or macro level, the Ellis and Smith (2007) hypothesis is consistent with the findings of more recent micro-level studies on what is driving factor shares, which are examined below.

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22 In the case of tasks that can be fully automated, labour and capital become perfect substitutes. For studies focused specifically on the role of automation in explaining labour's declining share, see Acemoglu and Restrepo (2016, 2018) and Autor and Salomons (2018).

23 On differences in elasticities of substitution between higher- versus lower-skilled labour, see Krusell *et al* (2000) and IMF (2017b). For analysis of the types of work most susceptible to automation, see Autor (2015) and OECD (2018).

### 3.4 ICT and Micro-level Evidence: Recent Studies

A number of promising studies of what is driving factor share shifts have been sparked by some seminal OECD research that looked at the diffusion of new technology across firms in 23 OECD countries (Andrews, Criscuolo and Gal 2015).<sup>24</sup>

Using a harmonised, cross-country firm-level database for 23 countries, the study concentrates on the relative productivity performance of global frontier firms (i.e. the most productive globally in terms of both labour and multifactor productivity), national frontier firms and laggards. Their main findings were:

- despite the aggregate level slowdown in productivity growth in the 2000s, productivity growth at the global frontier level remained robust;
- the gap between the high productivity firms and the rest has been rising over time;<sup>25</sup> and
- global frontier firms are not only more productive than laggard firms but also more capital intensive, more patent intensive, have larger sales and are more profitable. However – and importantly both in terms of explaining the aggregate productivity growth slowdown and thinking about implications for average wage growth – they are not significantly larger than the laggards in terms of employment. Consistent with this last point, in their examination of two potentially key sources of productivity gaps across countries – namely, gaps originating from differences in the productivity levels of global versus national frontier firms and those originating from differences in size measured in terms of employment – the first was found to be generally much more significant.

These findings are significant on many fronts. In the context of this paper, two in particular stand out. First, the growing gap between frontier firms and laggards in terms of productivity may help resolve the debate between the technology optimists and pessimists with respect to the ongoing importance or otherwise of the ICT ‘revolution’. New technology is still having a positive impact on productivity growth, but primarily amongst frontier firms; while the growing gap between them and the laggards, along with the fact that the frontier firms are not significantly larger in terms of employment, may explain why aggregate productivity growth has been slowing down (Haldane 2017a).

The second potentially interesting implication is that frontier firms are not only more productive but also more profitable and have larger sales than laggards. This suggests that much of the additional productivity gain is being absorbed by a combination of lower prices (encouraging higher sales) and higher profits, as against higher real wages. If frontier firms are not increasing real wages in line with labour productivity growth and laggard firms simply don’t have the capacity to do so as they are under increasing pressure to maintain their market share and survive, this may help explain the

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<sup>24</sup> While a number of earlier studies such as Syverson (2004) and Hsieh and Klenow (2009) had also identified significant productivity dispersion within sectors, none of them were based on such a comprehensive firm-level data source.

<sup>25</sup> A more recent study suggests this increasing productivity divergence has continued (see Berlingieri, Blanchenay and Criscuolo (2017)).

short-run low nominal wage growth puzzle in a low inflation environment. This implication is returned to below.

The findings of this path-breaking OECD research have, not surprisingly, spawned further research work looking at whether the uneven technology take-up can help explain the decline in labour's share across many countries. The most important and widely quoted study is that of Autor *et al* (2017). They develop a 'superstar firm' model based on the idea that '... industries are increasingly characterized by a "winner takes most" feature where a small number of firms gain a very large share of the market' (p 2). Their model, which is set out in more detail in Section 4, assumes competitive factor markets but allows for imperfect competition in product markets. Specifically, and consistent with growing evidence, including the OECD paper just discussed, the model allows for heterogeneous productivity performance in which more productive firms have a higher level of factor inputs and sales. They also assume that some labour input is fixed and some is variable, such that firms will have a lower labour share of value added if they are larger and/or if they have a higher mark-up. For both these reasons, superstar firms are seen as likely to have lower labour shares of value added.

Their model generates a number of testable hypotheses:

1. If technological change advantages the most productive firms in each industry, product market concentration will rise as industries become increasingly dominated by superstar firms.
2. Industries where concentration rises the most will have the largest decline in labour's share in value added.
3. The fall in labour's share will be driven largely by between-firm reallocation rather than by a fall in the mean unweighted labour share within firms.
4. The between-firm reallocation component of the fall in labour's share will be greatest in sectors with the largest increase in market concentration.
5. The above patterns should be observed not just in the United States but also internationally.

Using firm- and industry-level data, they find statistical support for each of these hypotheses for the United States. Due to data limitations only the second and fourth hypotheses were tested for a number of European countries. They were both confirmed for most of the countries examined.

Whilst the authors see the 'superstar firm' model and associated rising industry concentration as most obviously applicable to high-tech industries, it could be a reflection of other factors, such as barriers to entry. In order to test whether rising concentration is most prevalent in dynamic industries exhibiting rapid technological change, they map it against two proxy measures of technical change, namely patent intensity and TFP. They find significant positive correlations in both cases.

In contrast to the explanations considered, the 'superstar' explanation of labour's declining share meets the requirements of all the filters outlined earlier. It is consistent with the shift/share analyses showing that the action on declining shares is concentrated within as against between industries, and at the industry level is occurring mainly between firms rather than evenly across all firms. It

does not rely on an aggregate level elasticity of substitution greater than one, although the model does tend to imply that, for the technological frontier firms, more successful adoption of new technology is likely to have increased the substitutability of capital for labour – at the extreme, by way of automation of some jobs and tasks.

The analysis also fits the time profile for a declining wage share well. Most studies on the so-called ICT revolution see it as commencing around the 1980s, and as having a significant and ongoing impact on both labour and product markets in many developing as well as developed economies.

Finally, while the superstar firm model is not couched directly in terms of relative bargaining power of labour versus capital, it has a number of important links to that framework. While there is some evidence that employee/union bargaining power is greater in larger firms<sup>26</sup>, the Autor *et al* (2017) study suggests that the increased market power of leading technology firms allows them to use most of their higher productivity gains partly to lower prices and partly to increase their profit margins, rather than passing most of it through to their employees.<sup>27</sup> If at the same time the technological laggards are struggling to maintain their market share, they will simply not have the capacity to pay higher wages; while perceived lower job security in such firms is likely to reduce union/employee bargaining power.

The Autor *et al* analysis is consistent with some earlier but less comprehensive US studies. Peltzman (2014) found that US industries that experienced the largest increase in concentration also experienced the strongest increases in output prices, suggesting increased mark-ups and a lower within-firm labour share. Barkai (2016), noting increasing levels of industry concentration in the United States, found a relationship between the decline in labour's share and increased profit mark-ups, but does not examine whether the latter is occurring across most firms or primarily among larger superstar firms.

Since the Autor *et al* (2017) paper, a number of follow-up papers have been written that, for the most part, confirm and build on their work. A few, however, have questioned their results.

De Loecker and Eckhout (2017) document trends in firm-level mark-ups in the United States for the period since 1950, and find that, after a period of relative stability, they started to trend upwards from around 1980: roughly when the labour share started to fall. They also find a close negative correlation between the aggregate labour share in the United States and an aggregated measure of firm mark-ups, although they make no attempt to control for other variables.

Benmelech, Bergman and Kim (2018), noting that US labour market mobility has declined significantly in recent decades, examine the impact of local-level employer concentration on wages in the US manufacturing sector. Using employment as their measure of local-level industry concentration, they find a significant negative relationship between it and wages that is more pronounced at high levels of concentration and has increased over the period examined (1977 to 2009). Their results are robust after controlling for other factors such as establishment-level labour productivity and local labour market size. They also find that this negative relationship is stronger

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<sup>26</sup> See, for example, Söderbom, Teal and Wambugu (2002). For an Australian study, see Peetz and Preston (2009).

<sup>27</sup> This is also the finding of Adrjan (2018), which is returned to below.

when unionisation rates are low; and that the link between productivity growth and wages growth is stronger when labour markets are less concentrated.

A recent OECD (2018) study uses a firm-level database to confirm the 'superstar' hypothesis for the eight countries they examine in which labour's share fell over the period 2001–13. Interestingly, their results suggest that the decline in labour's share at the technological frontier is largely driven by the entry of new firms with higher mark-ups and/or higher capital intensity, rather than increasing mark-ups or capital intensity in firms remaining at the technological frontier.

A weakness of the superstar firm model is that it assumes an elasticity of substitution of one, thereby excluding any possible role for capital intensity in their explanation of shifts in labour's share. Adrjan (2018), in a longitudinal study using UK firm-level data, uses a model of the firm in which the labour market is perfectly competitive and product markets are not but, unlike Autor *et al* (2017), the elasticity of substitution is not constrained to one. Market power can affect labour's share because it allows a firm to set a higher profit mark-up over cost. But capital intensity can affect labour's share in a firm as well, depending on the elasticity of substitution. His empirical analysis finds that both market share of a firm and its capital intensity are highly significant as explanators of labour's share, with market share being statistically more significant than capital intensity. These results are found to be highly robust to alternative econometric methods, data definitions and sample periods.

Adrjan also examines variations in elasticities of substitution across firms. Using average firm wage levels as a proxy for average skill levels, he finds that the negative impact of capital intensity on labour share is driven by low-wage firms, which he interprets as implying that low-skilled labour is more substitutable with capital. Alvarez-Cuadrado, Van Long and Poschke (2018) show that a model allowing for cross-sectoral differences in productivity growth and in the degree of capital/labour substitution can explain the movement in labour's share in the United States.

These studies help to integrate the 'superstar' analysis with some of the earlier studies on the impact of capital-augmenting technical change and capital-to-labour ratios on labour's share.

A few papers that have followed on from Autor *et al* (2017) have questioned some of their findings. A key testable hypothesis flowing from the superstar firm model is that, over the periods of declining labour share, industry concentration measures should be rising. Bessen (2017) confirms the Autor *et al* finding that this is indeed the case in the United States: on his estimates, both industry concentration and firm operating margins have been rising since 1980.<sup>28</sup> However, the Autor *et al* paper, while finding that the decline in the labour share is closely correlated with the change in concentration ratios across 12 of the 14 non-US countries examined, did not directly examine changes in industry concentration ratios for any countries other than the United States. Some other studies have questioned whether European industry concentration has in fact been on a clear upward trend over the relevant period. Weche and Wambach (2018), using estimates of firm-level mark-up, find that 'market power' of European firms showed a sharp decline during the global financial crisis (GFC) followed by a post-crisis increase that has not yet reached pre-GFC levels, and contrasts this with findings for the United States where concentration ratios are already back above pre-GFC highs. Guschanski and Onaran (2018) go further: using a measure of concentration which – unlike that used by Autor *et al* (2017) – includes a firm's international sales but only covers publicly listed firms,

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28 See also Ganapati (2018).

they find that concentration in the EU-15 group of countries declined between 1995 and 2015. In addition, in contrast to the findings of Autor *et al*, they find little relationship in their European data between concentration and the extent of decline in labour shares; and that declines in labour shares are mainly driven by declines within firms, rather than between firms. This study is very recent and at this stage it is difficult to know whether it is the more limited dataset used, methodological differences or other factors that are driving the differences in results.

As has been mentioned, these micro-level studies of what is driving factor income share changes may provide an important framework for analysing what is driving the short-run, low nominal wage growth puzzle, both in Australia and in many other countries. This issue is examined below in Section 4.

### 3.5 Relevance of Productivity Dispersion Model to Australia

How relevant, if at all, is the superstar firm model for explaining factor share shifts in Australia? One of the data challenges in measuring factor income shares is how to divide up the income accruing to proprietors of unincorporated businesses (gross mixed income or GMI), which is a mixture of labour income (reflecting the value of the time the owner puts into the business) and capital income (reflecting a return on capital and entrepreneurialism). The Australian System of National Accounts selected analytical series reports the wage and profit shares of total factor income excluding the GMI component, which means these shares do not add up to one. In addition, for the general government sector of the national accounts – which is primarily in the non-market sector – the net operating surplus is by convention assumed to be zero. For these reasons, factor income shares derived directly from economy-wide national accounts data need to be interpreted with caution.

The ABS productivity statistics (ABS 2018) attempt to overcome these limitations by focusing on just the market sector of the economy and by allocating GMI to the labour and capital income shares. For the labour share of GMI, the labour income of proprietors of unincorporated businesses is imputed based on the hours they work and assuming the average hourly wage of wage and salary employees in that industry. For the capital share of GMI, the rental price of unincorporated productive capital stock is imputed assuming the rental prices of the incorporated businesses and the incorporated rate of return on capital. The sum of these two imputations equals imputed GMI, with the difference between actual and imputed GMI allocated proportionally.<sup>29</sup>

The longest current data series using the above approach commences in 1973/74 and covers 12 selected market sector industry aggregates.<sup>30</sup> The trend is clear from Figure 5, where the following pattern can be seen:<sup>31</sup>

- labour's share rose sharply in the 1970s and early 1980s to a peak of just under 65 per cent in 1982/83;

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29 An alternative rule of thumb approach that has been used in some of the literature is to allocate two-thirds of unincorporated business profits to wages, but this implicitly assumes a constant capital-to-labour ratio over time. For a more detailed description of how mixed incomes are decomposed into labour and capital components, see ABS (2016).

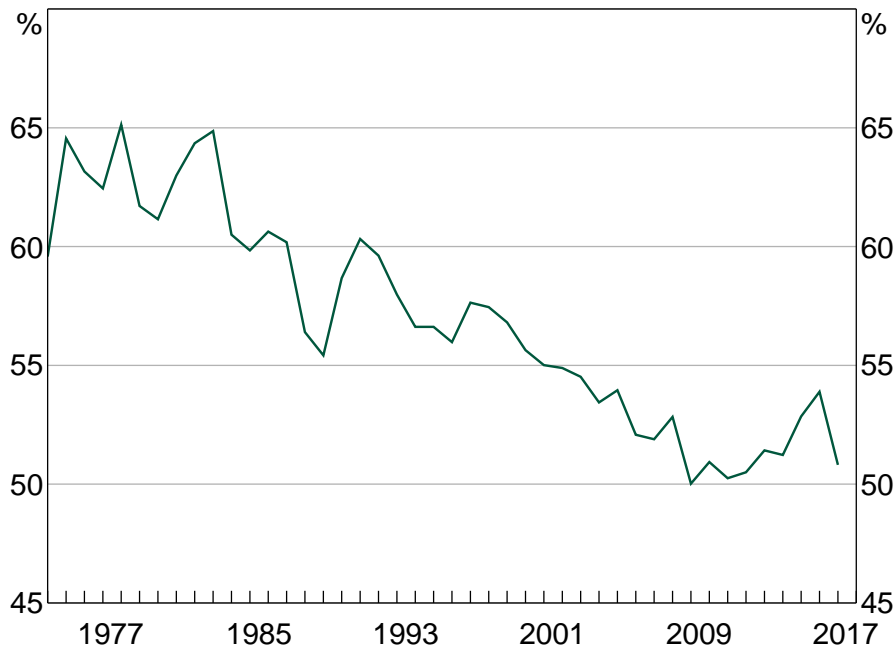
30 While the ABS also publishes 16 market sector industry aggregates, they only go back to 1993/94.

31 The published ABS data are a smoothed series, whilst the data in Figure 5 are unsmoothed and were kindly provided to the author by the ABS.

- it then fell rapidly through to the late 1980s, before rising significantly in 1989/90 and 1990/91;
- it continued to trend lower, albeit gradually, up to 2010/11, rose for a number of years after that, then fell sharply in 2016/17. It is now back close to its lowest point over the data series.

**Figure 5: Labour Share of National Income – Australia**

Aggregate of 12 selected industries



Source: ABS

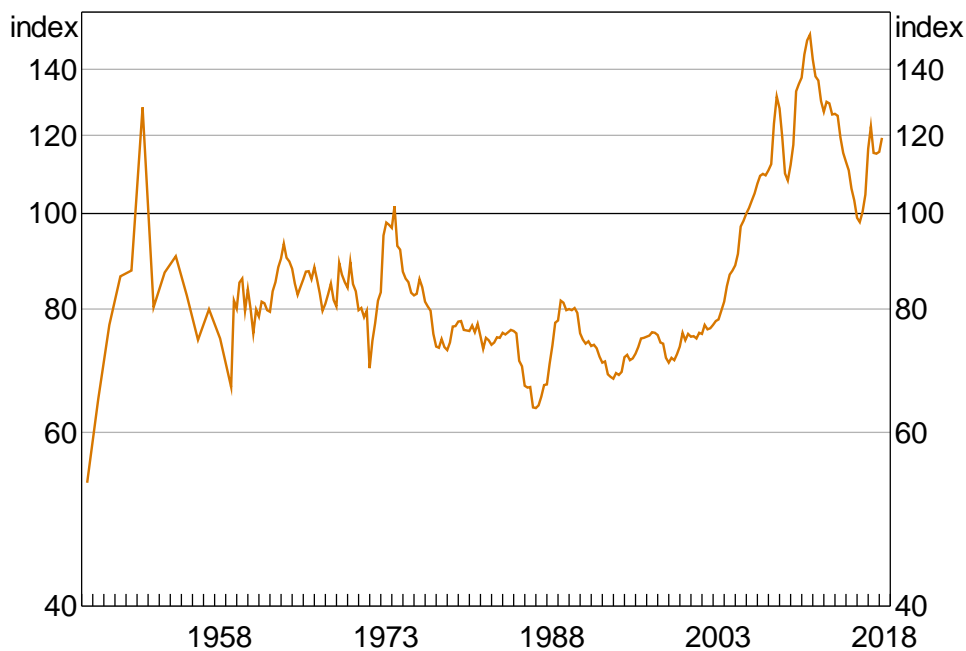
The extent of the trend decline in labour's share shown in Figure 5 is exaggerated by the starting point for the current data series. An earlier market sector series is available for the period 1964/65 to 1995/96 (ABS 1997), but it is based on an older industry classification and excludes improvements to the estimates in subsequent national accounts releases over the last two decades. The earlier series suggests that labour's share rose by 5 percentage points from 1964/65 to 1973/74. However, it then trended down from the mid 1970s to the mid 1990s when the series ended, to a level 2 percentage points lower than at the beginning of the series. The current series shown above suggests a further trend decline since then, by a little over 5 percentage points.

Most Australian studies explain shifts in labour's share primarily in terms of two factors: changes to our wage-bargaining framework in previous decades; and large shifts in our terms of trade. On the first explanation, the sharp rise in labour's share in the 1970s and early 1980s occurred in the context of a highly centralised and heavily unionised wage bargaining process, which contributed to a series of large nominal wage breakouts; while the reversal of this trend from around the mid 1980s occurred in the context of the then Labor Government's series of wage/tax trade-offs negotiated with the trade unions.

These trade-offs were specifically designed to reduce the 'real wage overhang' (historically high labour share), which was seen as impeding investment and employment.<sup>32</sup> The subsequent move to a more decentralised wage-bargaining model is often cited as helping to maintain wage moderation and avoid a repeat of the 1970s real wage overhang.

Terms of trade shifts and the associated movement of resources into and out of Australia's heavily capital-intensive mining sector are often cited as the other critical factor explaining shifts in Australia's factor income shares. Parham (2013) found that the unprecedented rise in Australia's terms of trade and associated mining investment boom in the first decade of this century (Figure 6) accounted for all of the 4 percentage points or more fall in labour's share during that period. However, when looked at on a shift/share basis, the fall in labour shares *within* industries over the 2000s actually accounted for more of the drop in labour's share than *between* industry shifts.

**Figure 6: Terms of Trade – Australia**  
2015/16 average = 100, log scale



Note: Annual data are used prior to 1960  
Sources: ABS; RBA

Shift/share analysis can at times disguise some of the underlying factors at work, because it is done on a net basis. This means, for example, that a shift in resources from one industry to another may have a major impact on factor shares, but it is largely or entirely offset by a shift between two other industries. A recent ABS study (ABS 2018) looking at shifts in labour's share in Australia between the two decades 1997/98 to 2006/07 and 2007/08 to 2016/17, and using similar shift/share analysis, found that 83 per cent of the decline in labour's share was due to within-industry changes as against between-industry shifts. However, this was in large part because the substantial downward impact

<sup>32</sup> For a summary of the discussion and debate at this time on the relationship between the real wage overhang and employment, see Russell and Tease (1988) and Chapman (1998).



on labour's share from expansion of the mining sector was largely offset by growth in a number of labour-intensive service industries.<sup>33</sup>

It is quite possible that, while terms of trade cycles do indeed account for some of the major shifts in factor income shares in Australia, the growth of high productivity firms with low labour income shares may still help explain the underlying *trend* decline in labour's share. James (2017) found that, since the early 1990s, most of the shifts in the profit share can be explained by the economic cycle and the terms of trade, but there is still an unexplained upward trend in the profit share over a longer period. His panel regressions using industry data suggest technological progress may be a key driver.

Furthermore, there are a number of *a priori* reasons for thinking the superstar firm model may help explain the trend decline in labour's share in Australia. Firstly, the 2018 ABS study referred to above showed that within-industry effects dominated net between-industry effects. It also found that, of the 16 industry sectors examined, labour's share fell in 10 non-mining sectors.

Secondly, recent work by the RBA (Hambur and La Cava forthcoming) has found that the average Australian industry is quite concentrated, with a small number of large businesses selling most of the industry's output.<sup>34</sup> While over half of Australian industries have seen some increase in concentration over the last two decades, the overall rise in concentration is primarily due to the retail trade sector. These findings provide some support for the 'superstar' hypothesis, although they are also consistent with other explanations for high and rising industry concentration.

Thirdly, a recent analysis of wages growth by the Australian Treasury (2017) used an important new firm-level data source, the Business Longitudinal Analysis Data Environment (BLADE), to classify firms into high-, mid- and low-productivity groups. While this analysis was done across the whole sample rather than on an industry-by-industry basis, it is still instructive. In particular, they found that:

- although high-productivity businesses pay higher average real wages, they do not pay real wages anywhere near in proportion to their high relative productivity: they were on average 7.1 times as productive as mid-productivity businesses, but only paid 1.6 times as much in average real wages;
- more productive businesses have more capital per worker. For the top five deciles, capital per worker and average real wages increase with productivity, but capital per worker increases much faster than average real wages. This implies that the labour share decreases as productivity increases, at least for the top five deciles; and
- the largest businesses, with more than \$50 million turnover, were also the most productive.

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33 Breaking the series at 2007/08 to reflect the impact of the GFC, the ABS analysis finds that the mining sector contributed around 1.5 percentage points of the 2.3 percentage point decline in labour's share between the earlier and subsequent decade (see ABS (2018)).

34 While Minifie (2017) reached somewhat different conclusions, his dataset was much more limited.

These findings, while not directly testing the superstar firm model, are certainly consistent with the hypothesis that higher productivity firms are using most of their higher levels of productivity to lower prices and gain market share and/or to increase profit margins, rather than to increase wages.

Some preliminary explorations at the RBA suggest that, while the superstar firm model may well explain some of the movements in factor shares in Australia, its relevance may be largely concentrated within a few sectors, in particular retail and wholesale trade. This is an area worthy of detailed study, and is returned to in Section 4.

#### 4. Technology Diffusion and Low Nominal Wages Growth: Some Research Proposals

This section examines how a firm-level framework that allows for heterogeneous productivity growth may also be applied to examining why nominal wages growth has been so low. It outlines a hypothesis linking uneven productivity growth to the nominal wage growth puzzle, and sets out some empirical research proposals for testing the validity of the hypothesis.

##### 4.1 The Heterogeneous Productivity Growth Model

While the short time period for which data are available is a clear limitation, the relatively new BLADE database provides an opportunity for researchers to examine the relevance of a firm-level framework incorporating heterogeneous productivity growth in explaining surprisingly low nominal wages growth in Australia.<sup>35</sup>

The Autor *et al* (2017) study uses an illustrative firm-level model and a production function  $Y_i = A_i V_i^{1-\alpha} K_i^\alpha$  where  $Y_i$  is value added,  $V_i$  is variable labour,  $K_i$  is capital and  $A_i$  is Hicks-neutral efficiency in firm  $i$  and is heterogeneous across firms. Given the way the model is specified, the level of total factor productivity ( $A_i$ ) is in effect exogenous to the firm: it is randomly allocated when a firm starts up. Firms with higher productivity will have higher levels of factor inputs and greater sales. The authors assume a fixed amount of overhead labour ( $F$ ) needed for production, so total labour is given by  $L = V + F$ . The model allows for imperfect competition in the product market. With respect to labour markets, all firms are assumed to pay the same, exogenously set wage. Firms cannot respond to increased competitive pressure by lowering wages.

From their model and the static first-order condition for labour, they derive the share of labour costs ( $wL_i$ ) in nominal value added ( $P_i Y_i$ ) as:

$$S_i = (wL_i / P_i Y_i) = 1 - \alpha / u_i + wF / P_i Y_i \quad (2)$$

where  $u_i = (P_i / c_i)$  is the mark-up, the ratio of product price  $P_i$  to marginal cost  $c_i$ . The firm  $i$  subscripts indicate that for given economy-wide values of  $(\alpha, w, F)$ , a firm will have a lower labour share if its mark-up is higher and/or its share of fixed labour costs in total value added is lower.

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35 BLADE is a firm-level statistical system maintained by the ABS that enables business datasets to be linked up via a common identifier, namely the firm's Australian business number (ABN). By enabling various datasets to be linked up, it increases the usefulness of the asset to researchers undertaking firm-level analysis.

Superstar firms will be larger as they produce more efficiently and capture a higher share of industry output. The model suggests they will also tend to have lower labour shares.

Elements of the above framework – in particular, allowing for heterogeneous productivity performance across firms – are relevant to examining various hypotheses linking uneven technology take-up to wages growth. However, the assumptions of *exogenous* productivity and wages obviously need to be relaxed. Furthermore, while the Autor *et al* (2017) model is specified in terms of heterogeneous *levels* of productivity, allowing also for heterogeneous *growth rates* is both more consistent with the literature (e.g. Andrews, Criscuolo and Gal 2015) and potentially more useful in terms of explaining recent nominal wage growth surprises.

If the assumption of exogenous wages is relaxed, the nominal labour share of value added for firm *i* is:

$$w_i L_i / P_i Y_i = \text{wage bill} / \text{nominal value added}$$

If we are comparing higher and lower productivity firms, there are three ways in which higher productivity firms could lower their nominal labour share/increase their profit share over time compared to lower productivity firms:

- for a given wages bill, by increasing their nominal value added faster than the less productive firms;
- for a given level of value added, by increasing their wages bill slower than lower productivity firms via restrained average wage increases and/or slower growth in employment; or
- by some combination of the above two.

The more higher productivity firms are lowering their labour share of value added by constraining nominal wages growth and employment growth, the stronger the potential relevance to explaining low nominal wages growth. Testing this potential relevance thus requires examining relative growth rates for value added, employment and nominal wages in low-, mid- and high-productivity growth firms.

#### 4.1.1 *The hypothesis*

With perfectly competitive labour and product markets, each employee would be paid their marginal product. The faster the rate of productivity growth, other things equal, the faster the rate of wages growth; and the more employment is skewed towards higher productivity firms, other things equal, the greater the contribution to average wages growth of the more productive firms.

If the assumption of perfect competition in factor and product markets is relaxed, the possibilities broaden. They include the central hypothesis of this paper, which is based on partial evidence available both overseas and in Australia that is outlined below:

*The uneven take-up of new technology is resulting in large and growing gaps in productivity performance across firms in the same industry. High-productivity firms that are adapting new*

*technology most successfully are using their higher productivity levels and growth rates to increase profit mark-ups and/or hold down their output prices so as to further increase their market share, rather than primarily passing them on to their workforce via higher wages. They are also likely to be leading the way with respect to domestic outsourcing and casualisation of the workforce, in the process reducing the bargaining power of their employees. Low productivity growth laggard firms are under increasing competitive pressure and have limited capacity to raise wages. These factors are holding down average wages growth compared to a situation where all employees are paid their marginal product. The extent of their impact will depend on the distribution of employment across high- and low-productivity firms and how it is changing over time. Because high-productivity firms are typically not increasing their employment share in line with their value added, this is further reducing their contribution to average wages growth.*

#### 4.1.2 Some supporting evidence

The above hypothesis incorporates the following testable assumptions:

- (a) The uneven take-up of new technology is resulting in very uneven patterns of productivity growth across firms, with the gap between high and low productivity growth rates increasing.
- (b) For high productivity firms, there is a large gap between productivity growth and wages growth; while the increasing competitive pressures on lower productivity firms significantly constrain their capacity to pay higher wages.
- (c) The employment share of high-productivity firms is increasing much more slowly than their value added share.
- (d) High-productivity firms are using their greater application of new technology to lead the way with respect to such practices as outsourcing and casualisation of their workforces.

A number of overseas and Australian studies contain empirical support for one or more of these assumptions. Andrews, Criscuolo, Gal and Menon (2015) confirmed (a) for a range of OECD countries, namely that *the uneven take-up of new technology is driving very uneven patterns of productivity growth across firms, and the gap is increasing*. In addition, Andrews *et al* found that *frontier firms are significantly larger in terms of sales but not in terms of employment*, lending support to (c). Faggio, Salvanes and Van Reenen (2010) found that industries that experienced the greatest increase in productivity dispersion also experienced the largest rise in IT capital intensity, lending support to (a).

Kehrig and Vincent (2017) use plant-level data for US manufacturing to examine what is driving the fall in labour's share. They begin by noting that, since the mid 1980s, labour compensation in manufacturing has fallen from 67 to 47 per cent of value added. At the same time however, the labour share of most US manufacturing plants actually rose. Their analysis finds that the explanation for this apparent paradox has been a major reallocation of production towards 'hyperproductive' (HP) plants, and a downward adjustment of the labour share of these HP plants over time.

Their paper then examines what is driving the dramatic difference in labour share trends between HP and non-HP plants, and finds that:

... almost all the divergence in the labor share trends between two types of plants is due to value added. According to the coefficient estimates, the typical *HP* plant was able to grow its value added by a staggering 250% more than typical non-*HP* establishment, or about 3.7% per year. This, amazingly, has come with very little divergence in the growth of the wage bill across the two types of plants, either through wages or employment. (Kehrig and Vincent 2017, pp 24–25)

This finding is consistent with (b) and (c).

Further support for (c), the proposition that the employment share of superstar firms is increasing much more slowly than their share of value added, can be found in Ganapati (2018). His study suggests that industry concentration increases in the United States are positively correlated to productivity and real output growth, negatively correlated with labour's share of value added and uncorrelated with employment, with the most productive industries typically maintaining or reducing their workforces.

The Autor *et al* (2017) study of factor income shares is consistent with (b) in that its findings imply that most of the productivity gains for higher productivity firms are being absorbed by a combination of lower prices (encouraging higher sales) and higher profit mark-ups, as against primarily being passed on to their workforce in the form of higher wages. It also provides some support for (c): the authors used sales as their measure of industry concentration, but they noted that, if they replaced this measure with employment, the relationship between concentration and labour share switched signs to become positive though generally statistically insignificant.

A recent OECD (2018) study looking at the decoupling of wages from productivity at the firm level found that wage divergence across the countries examined was much less pronounced than productivity divergence. Of particular interest in the context of the above hypothesis was their finding that not only was there a large divergence between productivity growth and real wages growth for high productivity firms, but for lower productivity firms real wages growth was also below their (lower) labour productivity growth rate. This is consistent with (b) and with the central tenet of the above hypothesis, namely that the competitive pressures on lower productivity firms are severely constraining their capacity to raise the wages of their employees.

Similarly, in an interesting study looking at key factors driving increasing wage inequality, the OECD (Berlingieri *et al*/2017) found that it was largely a result of increasing wage dispersion between firms in the same sector, rather than differences across sectors, and that the between-firm dispersion in turn was linked to differences in productivity across firms. Furthermore, the observed growing wage divergence was driven primarily by firms towards the bottom of the wage distribution in their industry paying increasingly less relative to the median firm, as against firms towards the top paying increasingly higher wages. Indeed, wages and productivity were less correlated at both tails of the productivity distribution. These findings are also consistent with (b).

Autor *et al* (2017) noted that the rise of superstar firms appears to be related to 'changes in the boundaries of large dominant employers' (p 26), with such firms increasingly using domestic outsourcing to contracting firms, casualisation of their workforce and automation, reducing both the

bargaining power of their employees and any wage premia typically paid by larger firms. Goldschmidt and Schmieder (2017), in a study of German firms, made a similar observation, noting that:

Large firms are increasingly relying on nontraditional employment arrangements such as outsourcing, temporary or contingent work, offshoring, and subcontracting. (p 1166)

These findings are consistent with (d).

The evidence to date for Australia is more limited. As mentioned earlier, the Australian Treasury (2017) used the BLADE database to classify firms into high-, mid- and low-productivity groups. Consistent with (b), they found that, *although high-productivity businesses pay higher average real wages than lower productivity firms, the dispersion of real wages is substantially less than the dispersion of productivity*. However, as noted this analysis was based on averages across all firms examined rather than on higher versus lower productivity firms within an industry. The higher average wages for higher productivity firms could thus simply reflect a greater concentration of skilled job classifications in higher productivity firms, as against such firms paying more for the same job classification.

Extending the Treasury analysis to look at these factors *within* each industry and to include employment distribution across high-, mid- and low-productivity firms within each industry could provide a potentially important link between the uneven pattern of productivity growth and the short-run wage puzzle in Australia.

As noted earlier, preliminary explorations at the RBA regarding the proposition that the growing dominance of superstar firms has weighed on labour's share in Australia suggested that, to the extent that the effect is relevant to Australia, it may be concentrated in a few sectors of the economy, in particular retail and wholesale trade. If confirmed by detailed analysis, this may reflect lower levels of competition in many sectors of the Australian economy compared to the US economy. A key aspect of the superstar firm model for explaining factor income share movements is that higher productivity firms are using a fair amount of their higher productivity to hold down their output prices and increase their market share: hence the rise in industry concentration ratios. But with respect to using a similar framework that allows for heterogeneous productivity levels and growth rates across firms to look at why nominal wages growth is surprising on the downside, the key is not whether higher productivity firms are increasing their market share, but rather the pressure they are putting on lower productivity firms. Regardless of whether higher productivity firms are reducing output prices or increasing profit margins, their actions put pressure on lower productivity firms to keep their costs down, including wage costs, because they are either less profitable or losing market share, or both. These pressures may be greater for listed than for unlisted companies, but they are relevant for both.

If Australia is a less competitive economy than the United States and – at least in some sectors of the economy – that is being reflected in higher productivity firms raising their profit margins more than reducing their output prices, this may help explain why Hambur and La Cava (forthcoming) found that industry concentration in Australia had risen substantially in only a limited number of industries. The research proposals set out below should help shed light on whether this possible explanation for differences in results for Australia as against the United States has some validity or not.

In short, a firm-level framework that allows for divergent productivity performance may help shed light on slow nominal wages growth regardless of whether high-productivity firms are primarily reducing their output prices to increase their market share or are raising their profit margins. Either way, if the application of digital technology that is driving much of the growing divergence in productivity performance across firms is, as suggested in Section 2, spreading to more and more sectors and being embedded in more areas of investment, the pressure on lower productivity firms across the economy to reduce their wage costs is likely to increase.

#### 4.1.3 *Timing and sustainability*

One of the filters used earlier for examining research on what is driving the trend decline in labour's share across many countries was timing: it was suggested that causal factors should have been in place for most or all of the period of declining labour shares going back to around the early 1980s. One apparent weakness in suggesting that some of the same factors driving the trend decline in labour shares may help explain recent nominal wage growth surprises is that the latter have only been evident for a much shorter period of time.

In explaining such timing differences, it is necessary to clearly delineate those elements of the superstar factor share model that are central to the hypothesis above regarding nominal wage growth surprises. The Autor *et al* factor share hypothesis assumes disparate *levels* of productivity across firms, not disparate *growth rates*. Firms with a higher level of productivity attract more resources and capture a higher share of industry output over time, by means of the usual allocative efficiency mechanisms (see Andrews, Criscuolo, Gal and Menon (2015)). As they also have lower labour shares, this growth in their market share, it is hypothesised, accounts for the trend decline in labour's share. However, the hypothesis above regarding nominal wage growth surprises relies more on the dispersion of productivity *growth rates* across firms – that is, a *growing* divergence in terms of productivity levels – putting *increasing* pressure on lower productivity firms to reduce cost increases, including wage costs.

The distinction may be important with respect to the timing issue. As noted earlier, recent studies using a firm-level database that commences around 2000 found that the firm-level dispersion of labour productivity has increased significantly since then.<sup>36</sup> Data on firm-level productivity growth rates for Australia are similarly only available for the period since 2002, and also show both high and growing levels of dispersion. Longer-run studies on productivity dispersion across firms are relatively sparse due largely to data constraints (see Faggio *et al* (2010)), but those available show mixed results for periods prior to this century. By way of example, Bartelsman, Haltiwanger and Scarpetta (2009) found that, while the dispersion of firm-level labour productivity was substantial during the 1990s across the eight countries and industries examined, it was also reasonably constant over the decade. However, Faggio *et al* (2010) found that within-industry productivity dispersion in the United Kingdom started trending upwards around the mid 1980s. They attribute growing productivity dispersion primarily to the uneven take-up of new technology: after controlling for a range of other factors, they find a strong positive correlation between ICT capital intensity across industries and the extent of the rise in productivity dispersion.

Uneven take-up of new technology is hardly a new phenomenon. However, among the defining features of digital technology are its pervasiveness and the *ongoing* and rapid technological advances

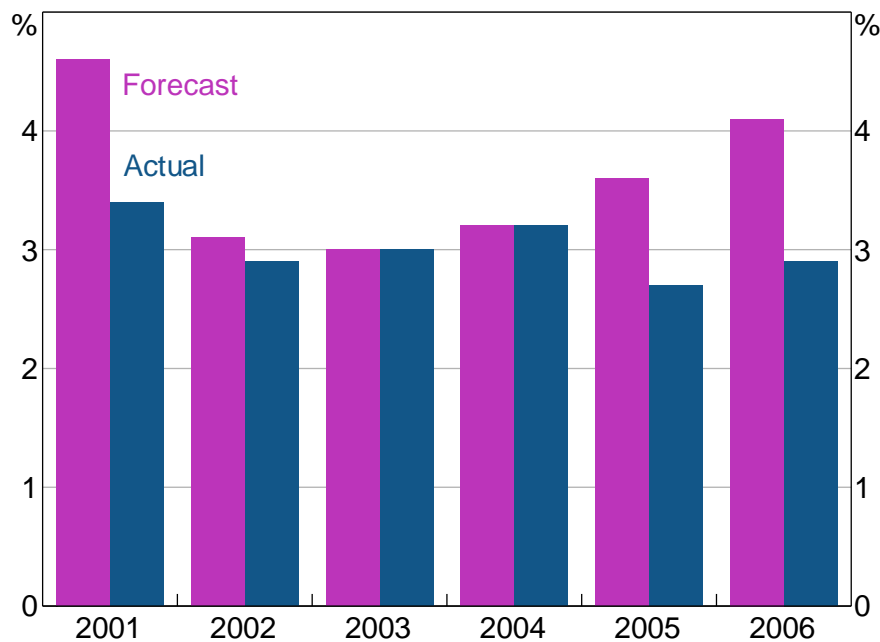
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<sup>36</sup> See, in particular, Andrews, Criscuolo and Gal (2015) and Berlingieri *et al* (2017).

being made in this area. While speculative, this may help explain the *increasing* divergence in productivity performance across firms in recent decades, which this paper suggests has resulted in a gradual but rising pressure on the productivity laggards to control costs.

A related factor of relevance to the issue of timing is that the period of wages growth overestimation appears to be longer than just the past few years. Analysis of OECD wage growth forecasts versus outcomes shows that, in addition to the downward wage growth surprises of the last two years discussed in, for example, Arsov and Evans (2018), wages growth was consistently overestimated in the six years leading up to the GFC (Figure 7). By contrast, during the period of the GFC and its immediate aftermath, the OECD repeatedly *underestimated* inflation, including wage inflation, despite the fact that it consistently *overestimated* GDP growth (Pain *et al* 2014). Given the severity of the GFC-related recession in most OECD countries, it is not surprising that historical relationships between labour market slack and wage/price inflation broke down, so this period is probably best put to one side in thinking about timing issues.

**Figure 7: OECD Wage Growth Forecasts and Outcomes**  
Compensation per employee, total OECD



Source: OECD, *Economic Outlook*

In the case of Australia, the GFC-related downturn in GDP growth and rise in unemployment were much less severe than in other OECD countries and, as noted earlier, wages growth in the aftermath of the GFC was lower than expected and has remained so (Figure 1). There is also some evidence of downward wage growth surprises in Australia in the 2001–06 period shown in Figure 7, at least for some forecasters: OECD wage growth forecasts for Australia exceeded outcomes in four of those six years.

Finally, it is possible that, while the impact of the uneven take-up of technology on the relationship between average *real* wages growth and productivity growth started to occur early in the period of rising ICT investment, the link to *nominal* wages growth strengthened in the wake of the more



recent coincidence of both lower-than-expected productivity growth and very low and stable inflation expectations (see IMF (2013), Jacobs and Rush (2015), and Bishop and Cassidy (2017)).

A closely related issue concerns the *sustainability* of large and – more recently – growing gaps in productivity performance across firms in the same industry. Economic theory suggests that competitive pressures should, over time, see productivity dispersion between firms in the same industry narrow, by way of less-competitive firms adapting the new technology and improving their productivity performance; or else failing to do so and exiting the industry as resources are directed away from them and towards more productive firms.

The persistence of high and growing levels of productivity divergence has led to a number of studies focused on why static and dynamic allocative efficiency mechanisms are not working as might be expected in many countries (see Bartelsman *et al* (2009) and Andrews, Criscuolo, Gal and Menon (2015), including references therein). Factors examined include product market regulations that inadvertently act as barriers to new entry, employment protection legislation that raises the cost of hiring and firing labour, and access to risk capital.

As noted earlier, uneven adaptation of new technology is hardly a new phenomenon, so another way of coming at the issue of why productivity dispersion has remained high and growing in recent decades is to consider whether there is something unique about digital technology that acts as a barrier to new entry. Two key aspects of ICT discussed in Section 2 are the gathering and processing of information to improve a firm's efficiency and expand its client base; and the use of automation to reduce costs. In both cases, successful adaptation of new technology to the particular needs of a firm can be expensive and disruptive. It requires high levels of managerial skill and imagination. It also requires staff with the skills, capacity and willingness to put the new technology in place, use it effectively and adapt to the many changes to workplace practices that it may bring. Because its introduction can be highly disruptive, it also requires specific change management skills on the part of senior managers and boards.

These required skills, imagination and attitudes are far from uniformly spread across countries or firms and, in many countries, may be in short supply. That in itself is a barrier to perfectly functioning markets, and has implications for the education and training of both employees and management.

In addition, there may be industries in which the technological leaders are able to use their leadership position to establish their own barriers to entry. Antitrust lawsuits in the United States and, more so, Europe against leading technology companies in recent decades provide examples.<sup>37</sup>

Looking forward, the pace of technological advance with respect to ICT, and the number of industries in which it has the capacity to be applied, are if anything accelerating, particularly with respect to big data, automation and artificial intelligence. Successful ongoing take-up of the opportunities such technological change provides, either by existing technological leaders or by new entrants, is also likely to operate in the direction of ensuring that the dispersion in the level and growth rates of labour productivity across a growing number of industries remains high for some time.

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<sup>37</sup> For some examples, see Couturier (2016).

#### 4.1.4 *Testing the hypothesis*

The hypothesis set out earlier generates a number of testable propositions for Australia using firm-level data.

##### *(a) Uneven technology take-up and product markets*

**Testable proposition 1:** The uneven take-up of technology is resulting in a large and growing divergence in productivity performance across firms. Technological leaders are appropriating most of their higher productivity gains into either higher profit margins or lower output prices.

##### **Test**

Firm-level output price data are not available, but increases in market share provide a rough proxy for the extent to which high productivity firms are holding down their quality-adjusted output prices relative to their competitors. Use the BLADE database to classify firms in each industry into high-, mid- and low-productivity growth groups to examine whether productivity dispersion has been increasing. Look at changes over time in productivity, profit margins, nominal wages and value added for high-productivity firms within each industry, to test the proposition that they are primarily using their higher productivity growth to increase profit mark-ups and/or increase their market share.

**Testable proposition 2:** To the extent that higher productivity firms are using their higher productivity growth rates to increase profit mark-ups or increase their market share via lower output prices, this is putting increased competitive pressure on lower productivity firms to reduce costs, including by paying below industry-average wages and wage increases for the same occupation.

##### **Test**

The BLADE database includes data on average firm wages, but not wages by job classification. The ABS are currently building a longitudinal employer/employee database which may be linked to BLADE and which would allow a detailed examination of the above proposition, but the full database is not yet available. In the interim, a very partial test would be to look at average wage levels and increases in each industry for low-, mid- and high-productivity firms and compare them to productivity levels and growth rates.

**Testable proposition 3:** Productivity leaders' share of total industry employment is rising more slowly than their share of industry sales or value added, which (in combination with propositions 1 and 2 above) is holding down average industry wages growth.

##### **Test**

Use the BLADE database to look at changing shares of industry employment for each productivity group relative to shares of industry sales or value added.

Look at what would have happened to average industry wages growth if employment to sales or value added ratios for each productivity group had remained constant.

*(b) Uneven technology take-up and labour markets*

Reference was made earlier in this paper to the observation that the rise of superstar firms appears to be related to 'changes in the boundaries of large dominant employers' (Autor *et al* 2017).

The BLADE database may allow at least part of this observation to be tested for Australia.

**Testable proposition 4:** Higher productivity firms are leading the way with respect to domestic outsourcing and casualisation of the workforce, reducing employee bargaining power and any 'large firm' wage premia.

**Test**

The BLADE database includes survey data on working arrangements. It may be possible to use these data sources to examine differences in the degree of labour force casualisation between high-, mid- and low-productivity firms across different industries.

**5. Concluding Comments**

Overseas studies suggest the increasingly uneven take-up of new technology across firms may help explain labour's declining share of income, weak average productivity growth and rising industry concentration in some countries. This paper has suggested that uneven technology take-up may also help explain surprisingly weak nominal wages growth, and has set out some research proposals designed to test the underlying hypothesis. Recently available firm-level data sources in Australia should facilitate stronger econometric testing and more robust results in all of these areas, centred around a theoretical framework that allows for heterogeneous productivity growth across firms.

Given the growing application of ICT-related investment across different industries and activities and the rapid pace of innovation, the effects of its uneven take-up – including on wages growth – seem likely to increase over time. For that reason as well, this is an area that warrants closer examination.

## Appendix A: RBA Research on Structural Factors That May Be Holding Down Nominal Wages Growth

Most of the RBA research looking to explain surprisingly low nominal wages growth has been done within the framework of a conventional wage Phillips curve relationship:

$$w_t = \alpha + \beta \left( ue_{t-1} - ue_{t-1}^* / ue_{t-1} \right) + \gamma(\mathbf{z}_t) + \varepsilon_t \quad (\text{A1})$$

where  $w$  is nominal wages growth,  $ue$  the unemployment rate,  $ue^*$  the NAIRU,  $\mathbf{z}$  a vector of other exogenous cyclical factors that may affect wages growth and  $\varepsilon$  the error term. In the RBA's preferred formulation, the vector  $\mathbf{z}$  includes inflation expectations, actual inflation, trend growth in labour productivity and the change in the unemployment rate (Arsov and Evans 2018, Appendix A).

It is worth noting that  $\beta$ , the coefficient on the unemployment gap, is not only a measure of the strength of the relationship between nominal wages growth and the economic cycle: it is also a measure of real wage flexibility and its inverse, real wage rigidity ( $1/\beta$ ). To quote Coe (1985):<sup>38</sup>

[real wage rigidity is] the degree of non-accommodation, measured in terms of unemployment, which would be necessary to maintain inflation constant in the face of an adverse shock. Thus real wage rigidity will be higher the less responsive are nominal wages to the unemployment rate. (p 115)

Returning to Equation (A1), explanations of the nominal wage growth puzzle that are focused on a falling  $\beta$  – that is, a *flattening* of the Phillips curve – are likely to be of limited use in examining structural declines in labour bargaining power. This is because, if nominal wages growth is less sensitive to labour market conditions over the course of economic cycles, wages growth will be higher than expected when unemployment is high and rising and lower than expected when unemployment is low and falling, with the 'surprises' to some extent at least cancelling out over the course of an economic cycle.

Ongoing falls in  $\beta$  over the course of a cycle – that is, ongoing flattening of the Phillips curve – have been 'observed' both in Australia and overseas in certain periods.<sup>39</sup> However, they are not relevant to wage behaviour in Australia over the course of the most recent cycle, during which nominal wages were initially falling faster than expected during a period of high and rising unemployment, implying that the Phillips curve was steepening or the intercept coefficient was rising (Jacobs and Rush 2015). More broadly, *ongoing* flattening of the Phillips curve over the course of economic cycles would imply a trend decline in real wage flexibility. This seems unlikely in most western countries, where the trend has been in the direction of labour market deregulation. In Australia's case, the decentralisation of wage bargaining that has occurred since the early 1990s is widely perceived as

38 See also on this point Grubb, Jackman and Layard (1983) and Lim, Dixon and Tsiaplias (2009).

39 Overseas research work earlier this decade on the observed flattening of *price* Phillips curves was in fact driven by the observation that price inflation had not fallen as much as expected in response to the sharp rise in unemployment rates to well above estimated NAIRUs coming out of the GFC. For international studies on this see, for example, IMF (2013), Matheson and Stavrev (2013) and Blanchard, Cerutti and Summers (2015). In Australia, Gillitzer and Simon (2015) observed the same flattening, although most of the changed behaviour came from greater anchoring of inflation expectations. For an earlier Australian study on Phillips curve flattening, see Kuttner and Robinson (2008).

having significantly *increased* real wage flexibility and contributed to stabilising both activity and unemployment (e.g. Borland 2011).

Recent RBA research looking at possible structural factors dampening wages growth is discussed below.

### **A.1 Job Insecurity**

If employee objectives were to change in a way that placed less emphasis on securing real wage increases and more on maintaining jobs, this would show up as a fall in  $\alpha$  in Equation (A1): that is, a downward shift in the Phillips curve. While much of the public discussion on the potential adverse effects of automation on employment is undoubtedly exaggerated, the evidence does suggest that it is having a hollowing-out effect on certain types of jobs and workers, forcing many of them to look for work in less well paid and lower-skilled occupations (e.g. Autor 2015; OECD 2017). Similarly, as the use of digital technology enables and encourages the outsourcing of work to lower wage economies, it would be surprising if this were not impacting on job security in the relevant industries (for some references, see Goldschmidt and Schmieder (2017)).

This is, of course, not to imply that the various effects of ICT take-up are the only factors affecting job security. The recent global recession has likely had a longer-lasting impact on job security than earlier recessions given its severity and the slow recovery from it. However, to the extent that ICT is having a significant and separate impact, it is likely to both predate the Great Recession and outlast it, if not increase over time as more and more industries and firms are affected by ICT.

Recent work by the RBA provides some partial support for the above hypotheses. Anecdotal evidence from the RBA's business liaison program suggests that employees are increasingly concerned about losing their jobs to automation or offshoring. Foster and Guttmann (2018) use data from the HILDA Survey to examine the impact of higher trade exposure (globalisation) and automation risk, *inter alia*, on perceived job security, and find a statistically significant relationship. They also find that automation risk and trade exposure contribute significantly to lower wages growth. However, they go on to note that these explanatory variables cannot account for low aggregate wages growth in recent years, because employment growth has been moving away from highly trade-exposed industries and from occupations that are more easily automated. They also note that the fall in perceived job security in recent years has been very broad based across industries and occupations, and is most likely reflecting generalised concerns about job security in the wake of the GFC. While this broad-based deterioration in perceived job security has a statistically significant effect on wages growth over the full period examined, it cannot explain much of the recent decline in average wages growth.

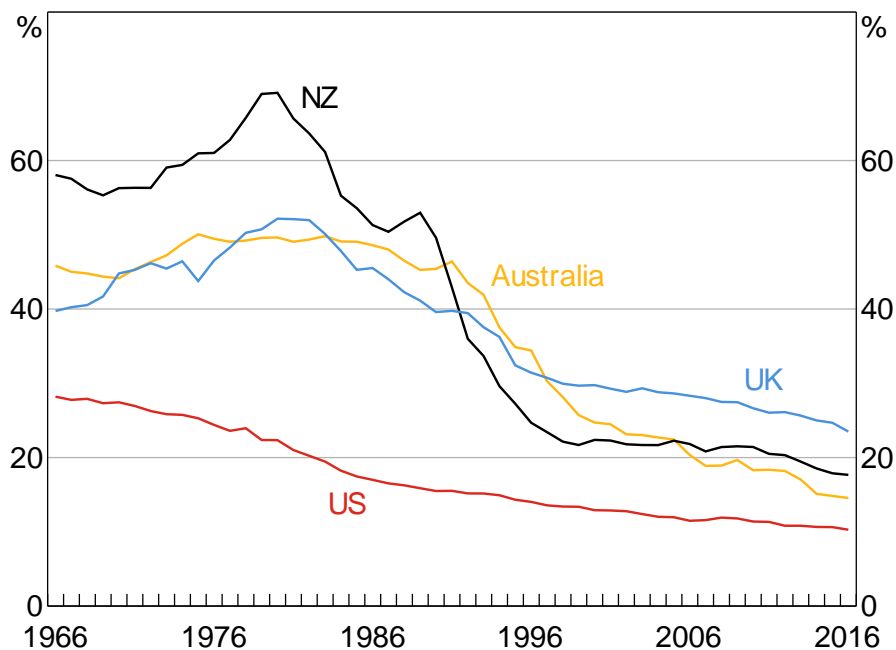
### **A.2 Falling Unionisation**

While job security and bargaining strength are closely intertwined, with lower levels of perceived job security reducing the bargaining power of employees, other institutional factors may also affect bargaining power. The clearest example is falling levels of unionisation. Empirical work in Australia and elsewhere finds a wage premium for trade union membership, including for workers with the

same skills in the same sectors.<sup>40</sup> It seems unlikely that this primarily reflects different perceptions of job security by individual employees: more likely, it mainly reflects the greater bargaining power of a union as against an individual.

Arsov and Evans (2018) note that unionisation rates have been declining across all advanced economies since the 1990s, but the fall has been particularly large in Australia and a few other countries in recent years (Figure A1). Their econometric analysis suggests that, on average across the countries examined – which included Australia – a 1 percentage point decline in unionisation rates reduced wage growth by around one-quarter of a percentage point in the following year.

**Figure A1: Trade Union Membership**  
Per cent of wage and salary earners



Sources: Australian Treasury; OECD

Of course, the spread of new technology and its ramifications is only one of many factors that have led to declining levels of unionisation in Australia and elsewhere, but it is certainly a factor and is likely to have an ongoing effect.

### A.3 Casualisation of the Workforce

In a recent paper examining reasons why wages growth in the United Kingdom has surprised the Bank of England on the downside, Haldane (2017b) looked at the impact on wages growth of what he calls the increasing 'divisibility' of work, which as outlined earlier has been greatly enabled by digital technology. Haldane looked at the effect of not only declining union membership but also, closely associated, the growth in self-employment, in part-time and casual work, and in so-called zero hours contracts. While noting that, for some workers, these changing patterns of work and associated shifts in bargaining power have been forced upon them and may be associated with

<sup>40</sup> See, for example, Blanchflower and Bryson (2002), Bryson (2014) and Haldane (2017b). For Australian studies, see Cai and Liu (2008) and other references therein.

increased job and wage insecurity, for many others this may not be the case: he refers to survey data showing that for some at least the shift to part-time work and self-employment has been welcome, providing greater control and flexibility. He also refers to UK survey data showing a marked increase in the share of temporary workers reporting they do not want a permanent job; and an upward trend in the share of part-time workers reporting they do not want full-time work.

Whether welcome or not, Haldane suggests that these changes in working arrangements are reducing aggregate wages growth. He cites estimates of a union membership wage premium in the United Kingdom of between 10 and 15 per cent; a wage discount for self-employed of around 15 per cent, 5 to 6 per cent for temporary workers and 7 per cent for zero hours contracts. While his back-of-the-envelope estimates suggest that these numbers have probably only directly reduced average annual wages growth since 2000 by a small amount, he argues that their overall impact is likely larger due to spillover effects on other workers. In addition, as digitisation spreads across industries, the impact of these changing work arrangements seems likely to increase over time.

More broadly, an OECD (2015) study found that, across almost all countries for which data were available, there was a marked wage gap between workers on temporary or casual contracts as against standard or 'permanent' contracts.

Looking at labour market casualisation in Australia, Mooi-Reci and Wooden (2017) noted that casual (rather than fixed-term) employment contracts are the most common form of non-standard employment in Australia, accounting for between 22 and 24 per cent of employment at their time of writing. They also noted that industrial laws in Australia require a reasonably substantial hourly wage premium for casual workers to compensate for loss of other benefits such as paid leave. In examining whether casual employment has a lasting effect on wages, they found that it does for male workers – of the order of around 10 per cent – but for women the wage penalty is both smaller and less long-lasting. Lass and Wooden (2017) found that low-paid casual workers experience a significant wage penalty, whereas high-paid casual workers enjoy a wage premium compared to their permanent counterparts. Nonetheless, this premium is, with only a very few exceptions, less than the 20 per cent loading specified in most industrial awards that is supposed to compensate for the loss of other benefits.

If, as has been suggested, the increasing take-up of digital technology is resulting in a growing divisibility or casualisation of the workforce, this might be expected to show up in changing patterns of employment, as Haldane's (2017b) study suggested was the case in the United Kingdom. However, the relationship is often likely to be more complex and to be heavily influenced by differences in labour market regulations and practices across countries (OECD 2012). The UK labour market, for example, is generally regarded as much more flexible and less heavily regulated than the Australian labour market.

Limited analysis of this issue appears to have been done in Australia. Referring to Haldane's UK study, Cassidy and Parsons (2017) suggest there is little evidence in Australia of an increase in the share of workers on temporary contracts or working for labour hire firms. The Australian Treasury (2017) suggest that, while casualisation trends are hard to measure, the share of casual workers rose significantly in the 1990s but has remained reasonably steady since then at around 21 per cent of the workforce. On the other hand, the self-employed share has declined.

These findings may be in part due to inadequacies in the ABS survey questionnaires in terms of picking up changes in the nature of working arrangements. They may also reflect the fact that changes in working arrangements are heavily concentrated amongst the productivity leaders rather than being spread across most firms, and hence are not showing up strongly in the aggregate data.

Some RBA work has been done on the relationship between pay-setting arrangements and wages growth. Bishop and Cassidy (2017) note that wages growth has declined in Australia across all pay-setting arrangements, although it has declined most in industries with a high prevalence of individual agreements. Given there has been an increase in the share of workers on awards in recent years, this does not help explain lower-than-forecast average wages growth. More broadly, the Australian Treasury (2017) notes that reclassifications of groups of workers along with other factors mean that it is difficult to draw any firm links between methods of pay setting and wages growth. Furthermore, in terms of linking this work to the impact of technology, the relationship between casualisation of employment and pay-setting arrangements would not appear to be clear-cut, other than the fact that casual workers are less likely to be unionised.

#### **A.4 Real Wage Overhang**

A possible factor behind nominal wage growth surprises in recent years is that the *level* of nominal wages in earlier years was out of kilter with product prices and productivity, resulting in a real wage overhang that is taking some time to unwind. This possibility was raised by the then US Federal Reserve Chair Janet Yellen (2015), with the suggestion that this overhang may have built up during the GFC-related recession.

This explanation may be more relevant for countries such as the United States that experienced a very sharp recession as a result of the GFC. For many such countries, the surprise during the ensuing steep recession was that wage and price inflation did not fall nearly as far as expected despite the very severe rise in unemployment (e.g. IMF 2013; Blanchard *et al* 2015). For Australia, however, the surprise was, as noted earlier, in the opposite direction: namely, why wages growth fell as far as it did relative to the (much milder) rise in unemployment.

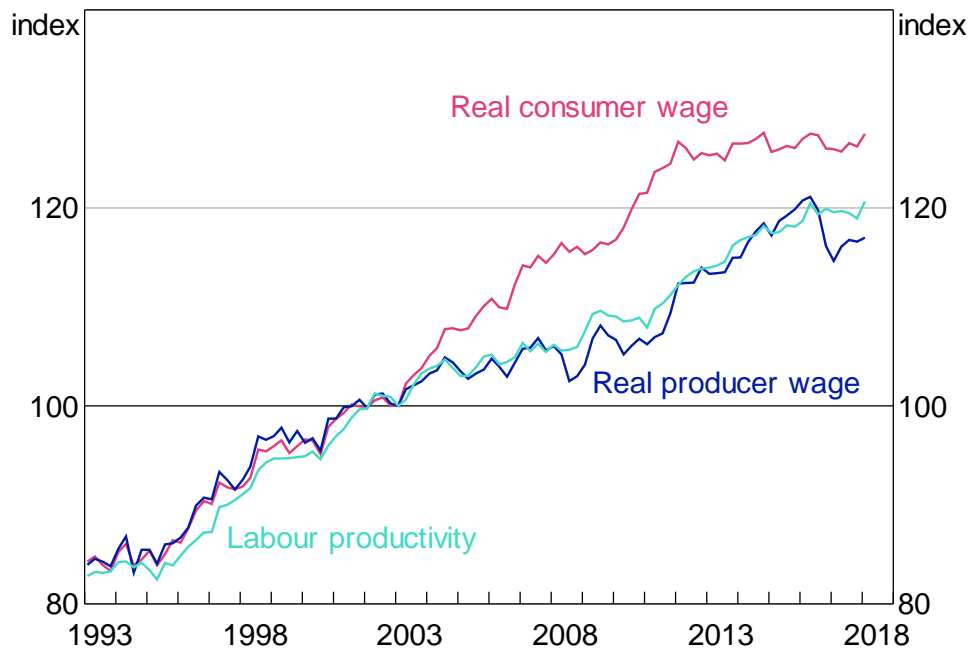
Nonetheless, this proposition has been put forward by both the RBA and Treasury as possibly helping explain recent weak nominal wages growth, and to a limited extent tested for Australia, primarily in the context of the mining boom and its aftermath (Jacobs and Rush 2015; Kent 2015; Davis, McCarthy and Bridges 2016; Australian Treasury 2017; Bishop and Cassidy 2017). The argument runs along the following lines. During the mining boom from 2003/04 to 2011/12, both nominal wages and real consumer wages growth picked up significantly and the exchange rate appreciated. Employers, on average, easily absorbed this rise in nominal wages due to the much faster growth in producer prices than consumer prices – in other words, the real product wage increased substantially less than the real consumer wage (Figure A2).

However, this period resulted in high Australian wage costs in the aftermath of the mining boom, once commodity prices started to fall. The subsequent period of very low nominal and real wages growth can be seen as part of a normal and desirable adjustment process to restoring competitiveness and encouraging employment. Due in part to downward wage rigidity in a period of very low inflation, it is taking a long time for this adjustment to occur (Jacobs and Rush 2015), which may explain ongoing low wages growth in the face of low and falling rates of unemployment.



**Figure A2: Real Consumer and Producer Wages – Australia**

March 2003 = 100



Notes: Real consumer wage is average earnings in the national accounts (AENA) per hour deflated by the household consumption deflator; real producer wage is AENA per hour deflated by the GDP deflator; labour productivity is per hour

Sources: ABS; Australian Treasury

Arsov and Evans (2018) attempted to test this hypothesis of a wage overhang in seven countries (including Australia) plus the core and peripheral bloc of euro area countries by estimating the deviation of the level of wages from their long-run relationship with productivity and output prices. Their results suggest that in most of the countries examined, including Australia, sluggish nominal wages growth in recent years partially reflects deviations of the level of wages from their 'fundamental' value in the aftermath of the GFC, but that this effect has largely ended. However, they suggest that 'a renewed wage overhang may help explain the weakness in nominal wages in 2017 in the United States, Canada and Australia'. They attribute this real wage overhang effect to downward nominal wage rigidities in the context of low inflation.

One difficulty with the argument that slow nominal wages growth in recent years reflects, in part at least, correction of an earlier real wage overhang is that it is hard to reconcile with rapid growth in employment, falling unemployment and a high level of employment to output (low level of labour productivity) in recent years in many of the countries being examined, including Australia. If real wages were significantly out of line with productivity, profits would have been under pressure and so would have been employment, and the employment-to-output ratio would be expected to be falling. However, what we have witnessed is the reverse: which is hardly surprising given that, in fact, wage shares in many countries, including Australia, are at or close to historical lows over recent decades.

It is conceivable that, with the growing integration of countries such as China into the global economy and global supply chains, what we are now witnessing is the slow unwinding of a real wage overhang in more advanced western economies relative to the more successful emerging economies, in the sense that the gap in wage levels between the two groups of economies is much larger than

the gap in labour productivity levels, putting competitive pressure on western economies that requires a 'resetting' of relative real unit labour costs. However, this too should have shown up in rising levels of unemployment in these western economies in recent decades, which – absent the impact of the GFC-related recession – has not been the case.

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