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Skilled Immigration and Wages in Australia^{*}

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ABSTRACT

This paper addresses the implications of the increasing skill intensity of cross-border migration flows for labour market outcomes in host countries. Specifically, we investigate the impact of the relative growth of skilled migrants on domestic wages in Australia over the last quarter century (1980-2006). We use instrumental variable (IV) estimation techniques to deal with the potential endogeneity of immigration. Unlike most of the previous literature, we use macro data to allow for the adjustment of wages and aggregate demand to immigration flows. However, the limited time span of such data raises problems of small sample bias. We address the small sample bias problem by using Jackknife IV estimation. Our basic finding challenges popular presumptions about the adverse wage implications of immigration. However, our examination of the skill composition of migration flows supports the many prevailing empirical findings that immigration need not cause labour market outcomes to deteriorate. Specifically, we do not find any robust evidence that a relative increase in arrivals of skilled immigrants exerts discernible adverse consequences on wages in Australia.

JEL Classification: J61, J31, C31, C59

Key Words: Immigration, wage, endogeneity, instrumental variable.

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SKILLED IMMIGRATION AND WAGES IN AUSTRALIA

1. Introduction

Almost 200 million people are living in a country different from their place of birth. Australia is one of the world's major host nations for immigrants. One out of every four people currently living in Australia was born abroad. These immigrants have made important contributions to the country's economic performance and development. However, supports for immigration, and its appropriate magnitude, are matters of continuing public debate. One prominent issue sustaining the debate is the widespread concern in host countries that immigration harms the labour market prospects of native-born workers. That concern is not restricted to Australia but lies at the heart of the debate about immigration in many countries - including most European nations, the U.S and Canada (Scheve and Slaughter 2001). Accordingly, better understanding of the Australian experience may prove useful in clarifying the issues elsewhere.

The domestic labour market implications of immigration have been investigated intensively. Prominent issues include immigrant assimilation (Baker and Benjamin 1994a; Borjas 1995), labour market participation and unemployment (Altonji and Card 1991; Cobb-Clark 2003), employment and wages (Card 1990, 2001), language and earnings (Chiswick and Miller 1995; Dustmann, and Francesca 2003), welfare participation (Baker and Benjamin 1994b; Hansen and Lofstrom 2003), immigration and economic welfare (Clarke and Ng 1993). The usefulness and explanatory power of such aggregative investigations, i.e., investigations which treat immigrants as a homogeneous factor, are circumscribed by the fact that immigrant flows are intrinsically heterogeneous. Migrants differ by gender, culture and language, education and training, vocational skill and in terms of many other attributes. These characteristics may influence the direction of their entry into the labour market of the host country, their performance in the various submarkets, and also the wage and employment consequences for relevant groups of native workers. In recognition of that heterogeneity, the empirical immigration literature has concentrated increasingly on the composition of immigrant flows and on their differential effects on the host country. For instance, Borjas (2003, 2006) examines the implications of immigrant skill level on the labour market prospects of native workers. The growing interest and applied work in this general area has been heavily oriented towards the U.S. and, more recently, Canada and the European Union.

The main immigrant-receiving countries in the world have continued to record positive net in-migration flows (Figure 1A). While family (re)unification flows constitute a significant component of immigrant flows into the U.S, the immigration programs of Australia and Canada are increasingly focused on migrant skill as reflected in the points system adopted by both countries.¹ The criteria for awarding points steer the skill composition of immigrant flows to accommodate the demand in Australia for particular occupational skills, outsourcing talents or business skills. The skill visa category is also the main avenue by which overseas students gain permanent residence in Australia.

Australia witnessed a large inflow of skilled migrants in recent years. Between 2000 and 2006, the total immigrant intake by Australia was about 140 thousand per year. Skilled migration accounted for approximately 65 percent of the migration visas to Australia granted in 2004-05, with approximately one third of these accruing to foreign students (Productivity Commission 2006). The trend towards increasing skilled immigration is also noticeable in Canada and New Zealand (Table 1A).

While skilled immigration may not erode the overall employment prospects of the native labour force, it may well affect the relative position of skilled workers. Any changes in that relative position, i.e., changes in the wage differential between skilled and unskilled labour, are likely to be dominated by changes in the wages of skilled workers. Unskilled wages are relatively unresponsive to market forces and, hence, to immigration by virtue of the minimum wage setting practice in Australia that relies on union-negotiated increases. Skilled wages are not so restricted, and typically respond to changing labour market situations. Hence, native skilled workers are potentially more exposed to competition from skilled migrants than are native unskilled workers. It follows that skill-oriented immigration policy like Australia's may influence not only domestic wage levels but also the domestic wage structure. Given the relative inertia of unskilled wages, it is plausible to hypothesize that changes in average domestic wages reflect comparable movements in the wages of skilled workers and, hence, in the skilled-unskilled wage differential.

Empirical work on the differential effect of skilled and unskilled migration on domestic wages is quite recent. Investigations of aggregate employment and labour market outcomes for Australian-born workers dispel the popular notion that

¹ For an overview of the skills of immigrants and immigration policy in Australia, Canada and United States see Antecol, Cobb-Clark, and Trejo (2003).

immigration reduces domestic real wages. For instance, Addison and Worswick (2002), examining cross-sectional Australian data for 1982-1996, do not find that disaggregating the native labour force by skill group changes their findings for the aggregate labour force. Chang (2004) shows that immigration cannot explain the variation in the skilled-unskilled wage differential in Australia during the 1990s. Parasnis, Fausten and Smyth (2005) find that an increase in the proportion of immigrants in the domestic workforce has a significant positive effect on labour market outcomes for native workers.

The vast empirical literature for the U.S. suggests, in general, that employment effects of immigration are negligible while there may be some negative wage effects of recent immigrants. Exploring the role of skill in U.S. immigration, Borjas (2003) finds that an immigrant influx that increases the size of a particular skill group by ten percent reduces the wages of native workers in that group by about three to four percent. He corroborates this finding in a subsequent examination of US high-skill labour markets. For example, Borjas (2006) finds that foreign students studying in the US reduce expected earnings on domestic students by 3-4%. Growth of the number of foreign-born students in a particular doctoral field at a particular time had significant and adverse effects on the earnings of doctorates in that field who graduated at roughly the same time. Symmetric labour market outcomes are observed in response to unskilled migration. Card (1990, 2001, 2005), on the other hand, finds no such negative effects. Using data on occupation and metropolitan area to define the relevant labour markets, Card (2001a) observes a slight adverse impact of an immigration-induced supply increase. Card (2005) reviews the recent evidence on U.S immigration and concludes that there is scant overall evidence that immigrants have adversely affected natives' labour market outcomes. He also finds that immigration-induced changes in the skill composition have little effect on wages.

Similarly, Friedberg (2001) observes that immigration has little impact on the wage structure in Israel after correcting for endogeneity of occupational choice. Dustmann, Fabbri, and Preston (2005) find no strong evidence that immigration affects aggregate employment or wage rates in the U.K. The evidence for Germany is mixed. De New and Zimmermann (1994) identify detrimental effects while Pischke and Velling (1997) find no such effect of migration on employment. It appears that empirical evidence of negative effects of immigration is typically generated by aggregate factor proportions analysis or nation-wide approaches (Borjas). Studies based on local labour markets or on "natural experiments" such as political developments in sending countries (Card) find no significant effect of immigration on outcomes for natives. Studies exploiting geographic variation by

correlating immigration with changes in native outcomes across cities or regions find less sizable effects (Altonji and Card 1991) or no effect at all (Pischke and Velling 1997).

Most previous studies of the wage effects of immigration use cross-section data. There is a limited time series literature that examines the co-integration and causality patterns between immigration and unemployment. Some studies explore the short-run and long-run relationship (Islam 2007a) or causality analysis (Withers and Pope 1985) between immigration and job market prospects. A few cross-section studies find mixed evidence on the effect of immigration within skill groups (Card 2001; Friedberg 2001; Borjas 2003). Cohen and Tai-Hsieh (2000) use time series data for Israel and find that immigration-induced changes in wages are reversed eventually. Islam (2007a), also using time series, detects a long-run positive relationship between the immigration rate and real wages in Canada.

Thus, the popular preconception that immigrants threaten the wage and employment prospects of native workers finds no robust support in the empirical literature on aggregate migration flows or on disaggregated flows. But the presumption persists nonetheless. Empirical estimates using a variety of approaches in a variety of settings have mostly shown that the effects of immigration on labour market outcomes are either very small or that they yield conflicting results. This inconclusive state warrants more work. The most interesting time span for analysis is the long run which affords sufficient time for the adjustment of wages and aggregate demand. The weak correlation between wages and immigration suggests that trends in relative wages associated with inflows of migrants should be investigated by time series analysis (Borjas, Freeman and Katz 1996, 1997; Borjas 2003). Accordingly, the present paper employs time series analysis to explore the impact of skilled immigration on wages in Australia. A complete analysis of the trends of the relevant identifying characteristics of the various cohorts of immigrants is beyond the scope of the present paper. At the same time, we provide an empirical strategy that recognizes immigrant heterogeneity but does not require the use of complete aggregate data (see section 3).

A major problem in studying the impact of immigration is that the choice of host country may be endogenous. Immigrants may self-select to join labour markets in those industrial countries which are booming (Friedberg and Hunt 1995). In addition, host countries may base their target immigration rates on a predetermined immigration policy or domestic labour market conditions. We address this potential problem of endogeneity by exploiting the fact that

Australia's immigration policy and previous labour market outcomes may serve as the basis for the immigrants' choice to seek admission to the Australian labour market. Using different variants of the instrumental variable (IV) methods we first estimate the effect of immigration on Australian wages. Because we are using macrodata on immigration flow we also need to deal with possible small sample bias problem due to the limited span of time. So we check the robustness of the IV results with Jackknife Instrumental Variable Estimation (JIVE) (Angrist, Imbens and Krueger 1999; Blomquist and Dahlberg 1999), and validate the choice of instruments by different tests for the validity and specification of the instruments. We use quarterly time series data covering the period 1980-2006. The start of the observation period is fixed by the earliest date for which data for different skill categories of immigrants is available for Australia.² Our fundamental result is that neither skilled nor unskilled immigration exerts discernible adverse effects on wages in the Australian labour market. In fact, our evidence suggests that immigration may exert positive effects on wages.

The rest of the paper is organized as follows: Analytical approaches to modeling the impact of immigration on labour market outcomes are reviewed in the next section. Sections 3 & 4 delineate the empirical strategy and specification of our model, and describe the data, respectively. Section 5 presents the estimation results, followed by robustness checks of the results in section 6. Concluding remarks are given in section 7.

2. Theoretical Considerations

The effects of immigration on labour market outcomes can be examined from alternative analytical perspectives such as area analysis, Heckscher-Ohlin (HO) trade model, production theory approach (PTA) and factor proportion analysis (FPA). Area analysis (e.g., Card 1990; Altonji and Card 1991; Lalonde and Topel 1997) exploits the high concentration of immigrants in gateway cities or states, assuming that labour markets in host countries are geographically segmented. Each local market has its own equilibrium wage structure determined by local labour market conditions. On the other hand, the HO model focuses on trade as an indirect source of supply of particular skills. The factor price adjustments induced by trade flows affect different skill groups and labour market participants differentially, including migrants and indigenous workers. The PTA (Grossman, 1982; Borjas 1987a; Card 2001; Islam 2007b) distinguishes between immigrant and native

² Skilled workers entry into Australia is mainly based on the points system which was introduced in the early 1970s.

workers, and treats both kinds of labour along with other factors of production as separate inputs into the production process. This analytical perspective directs attention to the substitution possibilities between immigrants and other factors of production, including native labour. The FPA (Borjas, Freeman and Katz 1996, 1997, Borjas 2003) emphasises skill groups rather than national origin of labour, considering immigrants an exogenous source of labour supply. This approach focuses on the wage adjustments that are necessitated by immigration-induced labour supply shocks. Given independent information about labour demand elasticities, it determines the wage consequences of immigration.

We adopt a macroeconomic perspective in studying immigration by focusing on the national labour market. However, we also use an analytical framework that combines elements of the production theory approach (PTA) and factor proportions analysis (FPA). We therefore circumvent the problems that arise from inter-city migration of natives as a result of the geographical concentration of immigration flows in certain areas or cities.

An inflow of skilled labour, *χετερισ παριβυσ*, puts downward pressure on wages of skilled workers. But skilled immigration may also cause the labour demand curve to shift out in response to aggregate demand effects. Native workers who are complementary with immigrant labour could experience a rise in wages or employment. Unskilled workers' wages may go up or down depending on the substitution possibilities between the two types of labour and the scale effect of immigration. In the typical textbook case, immigrants and natives are assumed to be perfect substitutes with little or no change in relative demand. The return to owners of capital may increase if, for example, labour and capital are the only two factors of production and labour of the same quality flows into the country. In this case immigrants compete directly with the native-born, exerting downward pressure on wages and raising returns to owners of capital. Lastly, if skilled workers are close substitutes for capital then inflows of skilled immigrants can result in higher national wages by increasing the productivity of unskilled labour. Similarly, assume that capital and either type of labour are complements, while the two types of labour are imperfect substitutes. An increase in skilled labour will then (1) reduce the skilled-unskilled wage differential due to scale effects (outward shift of skilled labour supply); (2) increase the skilled-unskilled wage differential due to substitution effect. The net effect is ambiguous - depending on which effect dominates.

Consider adding dynamics to these comparative-static considerations in the setting of a Solow-type growth model with a constant saving rate, or in a Ramsey-Cass-Koopman-type model with an endogenous saving rate. A permanent inflow

of labour reduces the per capita endowment of capital, increasing the marginal productivity per capita of capital in the host country. In the steady state, where immigrants are endowed with higher levels of embodied human capital compared to the average native, the physical per capita capital stock, output and consumption of the total population may increase.

Now assume that wages of unskilled workers are fixed above the equilibrium level, say by trade unions or for political reasons, for that matter. In that situation, inflows of skilled workers may reduce employment of native skilled workers and depress their wages. The ultimate result depends on wage setting practices. In the most extreme case, employment does not respond at all. Alternatively, employment of skilled workers increases as the inflow if skilled immigrants depress their wages. In this case, employment of native skilled workers may decline depending on their reservation wage level. However, if employers had been paying efficiency wages then it is possible that the adjustment will involve only a decrease in the skilled wage without any change in the aggregate employment level. In these cases welfare of native workers falls since there is an absolute decline in the wage level of skilled workers.

There are, however, scenarios where skilled migrants exert only a small and possibly positive effect on native wages. For instance, if migrants' spending patterns generate an increase in the relative output that utilizes skilled workers relatively intensively, then the immigration-induced change in output mix dissipates the downward pressure on skilled wages. Similarly, if there is an increase in skill-biased technological change in the host country, or if skilled immigrants are not close substitutes for skilled natives, then there is little reason to expect changes in the relative wage among native workers. Since workers with different levels of education perform different tasks and fill different roles in production, the majority of the native born workers can benefit from immigration.

The inflow of workers with a unique array of skills also introduces a new set of opportunities for companies and investors in the host country. A large augmentation of domestic labour supply increases the productivity of the existing capital stock, inducing new investment in response to higher returns. A relatively large inflow of highly skilled immigrants such as scientists, engineers, or medical practitioners also offers potentially significant dynamic gains for creative, innovative and complex professions. Technological and scientific innovation promotes economic growth by enhancing the productivity of workers. The effect of innovation on productivity, however, accrues over time and is fully realized only in the long run. Many skilled immigrants also bring capital to the economy and

engage in setting up firms and promote job creation. They also bring entrepreneurial skill and often create business linkages with their country of origin. These dynamic adjustments are likely to benefit labour. Lastly, from the perspective of the stylized Heckscher-Ohlin model, immigration cannot change relative factor rewards by changing the mix of factor supplies in a small open economy since factor prices depend on the prices of traded goods and not on domestic factor endowments. An influx of labour is completely absorbed by changing the direction and average factor intensity of production (Rybczynski-effect).³ Thus, as long as immigration is not sufficiently large to change the pattern of specialisation or the labour intensity of production, relative wages in the host country will not deteriorate.

Even though they may not affect wage determination immediately it is worth noting that new skilled immigrants are typically relatively young and that they become readily involved in the job market. They contribute to the host economy by paying taxes while claiming relatively little income support from the social security system.⁴ This fact has prompted observers to note that promotion of skilled immigration is emerging as an increasingly prominent element of strategies to protect the solvency of social security systems in potential host countries (Angrist and Kugler 2003).

In short, immigration affects a host country in varied and complex ways.⁵ Comparative static wage adjustments are merely a one-off realignment that may well be dominated by longer-term dynamic adjustments. But even the net effect of immigration on the host country's labour market outcomes is difficult to determine α priori. The relationship between wages, employment and immigration is likely to vary across countries according to regulatory provisions and institutional arrangements such as employment laws, replacement laws, wage-setting, labour market flexibility, industrial structure and business entry costs (Angrist and Kugler 2003). These are matters for empirical investigation and resolution.

³ The direction of production changes to decrease imports of labour intensive goods, reduce exports of capital-intensive goods and shift the output-mix towards labour-intensive goods.

⁴ For example, Baker and Benjamin (1994b) find those immigrants' participation rates in Canada's unemployment insurance and social assistance schemes are lower than the Canadian-born population.

⁵ Immigrants' children, i.e., second generation immigrants, are a growing fraction of the Australian population. They are likely to spend their entire lives in Australia and will pay taxes and receive income support payments. These intergenerational consequences constitute important components of the long-run costs and benefits of immigration. Card (2005) finds that second generation children will catch up with the children of natives. They also have above average levels of educational attainment, even for children whose fathers had much lower schooling than native-born fathers.

Cross-country evidence indicates that the ultimate effects of immigration are strongly influenced by the flexibility of the labour market of the host country. Differences across host countries in the immigrants they receive and in the structure of their labour markets means that the impact of immigration on any particular country, Australia in the present context, must be analysed on the basis of Australian data rather than being inferred from findings obtained for other countries.⁶

3. Empirical Strategy

Assume firm output is produced by two types of workers, immigrants and native born (e.g., Borjas 1987a, Islam 2007b), then we can present a functional form of the production function as:⁷

$$W_t = f(I/P)_t \tag{1}$$

where I is the stock of immigrants in the Australian labour market, P is the entire domestic workforce, and W_t is the wage at time t . $(I/P)_t$ is the immigrant share at time t , and the dependent variable is the average weekly wage of workers. Ideally, we would like to specify the wages of natives as the dependent variable but data limitations restrict us to aggregate wages (representing the composite average wage of immigrants and natives). Similar specifications are used e.g., by Altonji and Card (1991), Butcher and Card (1991), Pischke and Velling (1997) to compare aggregate labour market outcomes with differing immigration rates. Equation (1) can be interpreted as approximating the first-order condition determining the level of wages or as a general reduced-form relationship between the domestic wage level and the immigrant share.

Estimation of equation (1) raises potential omitted variable problems, imparting an upward bias to parameter estimates. One obvious omission is a term depicting the

⁶ According to the Productivity Commission (2006), by 2024-25, annual income per capita would be about 0.6 per cent higher than it would otherwise have been without skilled migration into Australia.

⁷ For example, Borjas (1987a) and Islam (2007b) consider the generalized Leontief production function of the form $f(.) = \sum_j \gamma_j (L_j)^{1/2}$ where the production function $\phi(.)$ is linearly homogenous and possesses the standard neoclassical properties, and L_i is the amount of labour input from the i th category of labour. If firms in the labour market operate in a perfectly competitive industry then we get the following system of labour demand functions: $W_i = \gamma_i + \sum_{j \neq i} \gamma_j (R_j/R_i)^{1/2}$ where W_i is the wage rate and R_i is the proportion of the i th category of worker (such as immigrant) in the total labour force. For more details see Islam (2007b). See also Grossman (1982) and Card (2001a) for similar analyses based on translog and CES-type production functions, respectively.

state of the labour market. The unemployment rate is typically captured by invoking some variant of the Phillips curve, efficiency wage models or bargaining models of wages. Higher unemployment rates weaken the bargaining position of employees and reduce the rate of wage increase. The Phillips curve has been the dominant approach to modelling wage determination as it immediately reflects the influence of the long-run equilibrium rate of unemployment on a fixed growth path. This pins down the equilibrium level of labour utilization in the economy without recourse to any other behavioural equation. We can then estimate the relationship between wages and immigration using the following equation

$$W_t = \alpha_0 + \alpha_1 (I/P)_t + \alpha_2 U_t + \alpha_3 X + \xi_t \quad (2)$$

where we also add vector X which captures the observable time invariant determinants of wages (such as state of residence of immigrants and average age of different cohort of immigrants). U_t is the unemployment rate, ξ_t is the innovation error and α_0 is a fixed effect that captures effects other than those associated directly with the variables in the model. It may include some unobservable policy shift parameters that are not reflected explicitly in the model.

Both theory and empirical evidence suggest a positive association between wages and productivity. In a perfectly competitive market, the wage rate is determined by the productivity of the marginal worker. Hence, an increase in the labour force due to immigration should affect the wage. We need, therefore, to include a variable that can capture the time-varying productivity in the determination of the aggregate trend of wages. Productivity can be defined as output per man-hour at time τ . We don't know exactly what drives productivity. It can be due to workers working harder or to workers becoming more skilled. At the level of the plant or firm, improvements in labour productivity may come from using better quality of cooperating inputs such as raw materials or capital, or they may reflect technological change. Any one of these drivers could cause this increase, and usually more than one factor will be involved. Inclusion of the productivity measure also controls for the capacity of the host country (Australia) to harness her human and physical resources. We, therefore, model productivity (πrod_t is the level of labour productivity at time t) as exogenous in our wage determination system (equation 2a)

$$W_t = \alpha_0 + \alpha_1 (I/P)_t + \alpha_2 U_t + \alpha_3 X + \alpha_4 \times \text{prod}_t + \varepsilon_t \quad (2a)$$

After differencing over successive time periods the estimating equation assumes the form

$$\Delta W_t = \beta_1 \Delta(I/P)_t + \beta_2 \Delta U_t + \beta_3 \times \Delta prod_t + \Delta \varepsilon_t \quad (3)$$

where $\Delta prod_t$ is the growth in labour productivity defined as the change in GDP per hour of labour worked and $\Delta(I/P)$ is the net immigration rate. The differencing has purged the equation of the fixed effects and of any potential biases they may introduce. It also effectively removes all time invariant variables that could possibly be included in vector X .

The estimated value of β_1 in equation (3) measures the impact of immigrant inflows on wage growth and should not reflect any simultaneous causality in the opposite direction. However, immigrants come to a country where their skills are in demand, and hence an important endogeneity problem may be created by the choice of destination country. Furthermore, as noted by Borjas (1987b), immigrants who choose to come to Australia are probably not a random subset of the source countries' workforce. We would expect those who immigrate to have higher expected earnings in Australia than in their country of origin, and vice versa for those who stay. Immigrants are, typically, ambitious, aggressive, and entrepreneurial. They, especially skilled migrants, move across international boundaries from one place of work and residence to another in order to exploit the economic opportunities that are accessible to them. It is also likely that the Australian government bases its immigration policy on past immigration rates.⁸

These considerations imply that the current immigration rate is not exogenous. This endogeneity issue has previously been recognised in studies of local labour markets (Altonji and Card 1991, Friedberg 2001) but not in the context of cross-border migration. These studies typically postulate that immigrants tend to move to cities or occupations where growth in demand for labour can accommodate their supply. Our study is not spatially based, and the endogeneity problems that may arise in the present context are at a greater level of aggregation. In terms of equation (3), if the migrant flow is not independent of $\Delta \varepsilon$, then the conditional correlation between wages growth and immigrant share will confound the two directions of causation, and the estimate of β_1 will be biased. If, for example, immigrants are more skilled, and if they choose high-skilled jobs that have better prospects of high wage growth in Australia, then the estimate of β_1 will be biased upward. Conversely, if immigrants are concentrated in relatively low-paying jobs

⁸ While the immigration policy is generally described as a policy that balances social, economic, humanitarian and environmental objectives, it is ultimately the government that sets the rate – presumably keeping in mind labour market conditions and other considerations relevant to potential migrants.

with little or no prospect of wage growth - possibly due to lack of recognition of foreign qualifications, language barrier, or a dip in the earnings just after arrival - then the estimate of β_1 will be biased downward, leading to underestimation of immigration's effect.

In order to resolve the endogeneity problem, a source of exogenous variation in immigration flows must be found. In the present time series context, such instruments must be correlated with the inflow of immigrants over time, but uncorrelated with the unobserved component of wages growth subsequent to their arrival.⁹ We follow Altonji and Card (1991), Card (2001a), Friedberg (2001) and use the lagged share of immigrants in the labour force as an instrument. The argument here is that the lagged value of the immigration share acts as information to potential immigrants about Australia's policy towards immigration. Accordingly, we assume that the selection process or the immigrants' decision to enter Australia is governed by the following relationship:

$$\Delta(I/P)_t = \gamma\Delta(I/P)_{t-j} + \mu_t \quad (4a)$$

where φ is the lag between the decision to apply to immigrate or setting the immigration policy at time $(t-\varphi)$ and actual entry at time τ .

One problem with our choice of instrument could be that it does not capture the decision of every immigrant and, hence, that it explains only a part of the variation of the proportion of immigrants at time τ . It follows that our instrumental variable should be interpreted as reflecting an estimate of a specific group - viz., those migrants whose behaviour is influenced by the instrument (Imbens and Angrist 1994). "This specificity of estimates is endemic to empirical research. All statistical methods have elements of this limitation when used to analyse phenomena with heterogeneous responses" (Angrist and Krueger 2001, p.78). In the present context, that subset of migrants is likely to be dominated by relatively skilled workers if the acquisition of skill is an indication of a worker's inclination and ability to acquire and process job-relevant information. However, our IV estimates constitute an improvement over simple OLS as we also tackle the potential problem of omitted variables that are correlated with both the migration decision and the determination of wages.¹⁰

The use of time series data at the national level avoids any bias toward zero that would be attributable to factor price equalization and endogenous regional

⁹ The instrumentation is also useful if the error term in equation (3) is correlated over time.

¹⁰ This interpretation of IV is adopted in several prominent studies (Imbens and Angrist, 1994; Angrist, Imbens and Rubin 1996).

choice by migrants. However, it introduces a different bias toward zero: Immigrants tend to come to countries when labour market outcomes are favourable. So we could also look for other potential instruments that can affect the migration decision and that are related to labour market outcomes. The unemployment rate could be particularly relevant for those migrants who are desperately looking for jobs while labour market conditions may capture salient aspects of Australia's immigration policy. Australia is a growing and thriving economy. It has skill shortages in many areas. In order to alleviate the skill shortages the government may select immigrants on the basis of local labour market conditions. Under those conditions the selection process is governed by the following relationship

$$\Delta(I/P)_t = \gamma \omega U_{t-j} + v_t \quad (4b)$$

Y_t is, as before, the unemployment rate and ωU_{t-j} is the weighted average of antecedent unemployment rates (preceding time $t-j$). Since the immigration process from the time of the decision to migrate until the time of arrival takes considerable time, we select $\varphi=6$ in our quarterly data. The weight is taken over the six-quarter period (time $t-\varphi$ is the weighted average of the $t-\varphi-1, t-\varphi-2, \dots, t-\varphi-6$ period). This specification is similar to Pischke and Velling (1997), Dustmann, Fabbri and Preston (2005).

It is possible and, indeed, plausible that the pull of family or of the "diaspora" influences the choice of destination country. Immigrants may apply to Australia because their family and friends already live here or because of the presence of individuals with similar cultural and linguistic background. Therefore, a possible solution to the endogeneity problem is to use measures of historic settlement patterns as instruments for immigration inflows. Our use of the lagged immigrant share as an IV should partly address this concern. As can be seen from Appendix Table 2A and Figure 2A, family and "diaspora" are not prominent drivers of immigration flows to Australia. Rather, the overwhelming impression from the evidence reported there is the considerable change over time in the pattern of immigration by source country and region. Moreover, skilled immigrants enter Australia after satisfying the points system, and they tend to prefer countries that offer better job prospects or more favourable immigration policies and labour market conditions.

Thus we use the past immigration rate and the past unemployment rate as sources of exogenous variation of the current immigration rate. The decision of skilled

immigrants to migrate is based on past Australian immigration policy and on their prospects for success in the Australian labour market. Schematically, the decision path looks as follows:

(Potential) Immigrant → Decision to leave home country → look at unemployment rates and/or stance of immigration policy in potential host country → apply to host country for immigration (→ get visa → arrive in Australia → look for job → earn wage).

The exclusion restriction implied by our instrumental variable regression is that, conditional on the controls included in the regression equation (3), the past unemployment rate and past immigration rate have no effect on today's earnings growth other than through their effects on immigration. One concern with this exclusion restriction is that the historical (past) unemployment rate may have a direct effect on the current wage rate which may attract immigrants to Australia. To capture this effect we should include among the explanatory variables a measure of the effect of the past unemployment rate on the wage level received by immigrants. However, note that we are measuring the growth of wages, as opposed to the level of wages at time τ . We consider it unlikely that the historical unemployment rate exerts a prominent influence on current wage increases. The same considerations apply to the policy variable - the past immigration rate. Therefore, our exclusion restrictions are quite plausible. Since we are dealing with aggregate time series data for Australia we do not need to worry about internal migration by natives in response to immigration inflows and subsequent changes in labour market outcomes. This is usually the case when one is dealing with single cross-section data or local labour market situations (Pischke and Velling 1997, Dustmann, Fabbri and Preston 2005, Halton and Tani 2005, Borjas 2006).¹¹

Figure 1 shows a strong positive relationship between the past (6-quarter lagged) immigration rate and its current level. The visual impression is confirmed by a statistically significant positive coefficient obtained from regressing current on past immigration rates.¹² This strong association corroborates our conjecture that the relationship between wages and the immigration rate is influenced by the antecedent immigration policy and labour market. Without consideration of such

¹¹ One assumption we maintain here is that native skilled workers are not emigrating from Australia in response to the arrival of skilled immigrants. It is, however, possible that the overall gain in skilled workers to Australia from international movement may be obscuring significant losses amongst highly educated workers (especially who are emigrating out) (see also footnote 15).

¹² In the following section we provide multiple justifications of the validity of the instrument.

endogeneity the relationship between wage growth and the immigration rate might be obscured by changes in the immigration policy.

With two instruments for our single endogenous regressor we estimate equation (3) using two stage least squares (2SLS).¹³ It is expected that the 2SLS estimates improve efficiency relative to OLS and provide better control for earnings growth. We account for possible serial correlation by computing Huber-White standard errors. In the presence of overidentifying restrictions it is sometimes useful to obtain a more efficient estimator when serial correlation may be present by applying the Generalized Method of Moments (GMM) conditions (Hansen 1982). Since our 2SLS with robust standard errors is $\delta\epsilon\phi\alpha\chi\tau\sigma$ a GMM estimator we need not conduct separate GMM estimation as this may generate only small additional gains. Moreover, GMM suffers from small sample bias. Given that we are dealing with a small sample, using GMM would not seem appropriate.¹⁴

4. Data and Descriptive Statistics

Quarterly skilled-based immigration data for the period 1980-2006 were obtained by special request from the ABS. The net immigration rate is expressed as the total number of immigrants in a given quarter per one thousand adult (15-64 years of age) Australians in that quarter. It represents the movement of migrants who have been granted the right to live permanently in Australia.¹⁵ Measuring skilled migrant

¹³ In this paper the term IV and 2SLS are not interchangeable. We refer to 2SLS estimate when we use multiple instruments, and to IV estimate in the case of a single instrument.

¹⁴ One problem with our specification in equation (3) is that we might be estimating short-run effects as opposed to long-run effects of immigration since there is a short period of time (a quarter) between the earliest and latest observations and differencing eliminates the long-run effect. Many authors (e.g., Pischke and Velling 1997, Friedberg 2001) have estimated the same type of equation for examining the labour market impact of immigration. An additional problem with level of wage as opposed to change in wage as the dependent variable is that variables with high persistence over time (such as weekly wage) will have very low correlation between flow variable (immigration rate) and the level variable (wage). This problem of weak instruments can lead to substantial bias in finite sample.

¹⁵ This definition usually applies to persons born outside Australia but may also apply to a small number of persons born inside Australia to parents who are foreign nationals. Note that the migration rate used here differs from the 'net migration' rate as the data did not include individuals departing Australia. According to the Productivity Commission report (2006), there has been a significant movement of people from Australia on a long-term basis in recent decades. But this proportion is relatively small for the Australian-born population. A significant share of emigrants consists of former permanent settlers and overseas visitors returning overseas. Moreover, a large number of Australian residents are also returning home every year. So, net Australian-born emigration is relatively low. Casual observation suggests that many Australian-born high skilled workers emigrate because of the relatively compressed domestic wage structure. However, to the extent that Australian-born and other permanent residents are emigrating in response to the inflow of

flows is problematic because the Department of Immigration and Citizenship (DIC) in Australia records measures inflows by visa type, which may not reflect the usually defined general skills. The DIC defines skilled migrant workers as those people who have skills in particular occupations that are *πεθυιρεδ* in Australia. These occupations are identified in the skilled occupation list. The demand list contains a list of domestic occupations and specialisations for which there is an continuing national shortage. Unlike immigration Australia, we measure skill by the occupation of immigrants as stated in the landing card of the permanent visa category of immigrants at their first entry in Australia. Since most of the visas granted by immigration Australia under the skilled category fall under the general skill stream there is substantial agreement between the two definitions. Our practice reflects a preference for defining skill in terms of generic attributes of migrants rather than temporary labour market requirements in the host country. The migrant attributes provide a better guide to the extent of human capital inflow into the host country. See Appendix note on the definition of the skilled immigration in our data.

The unemployment rate is the percentage of the labour force that actively seeks work but is unable to find work in a particular quarter. Nominal wage data include average weekly compensation paid during the calendar quarter to all employees in Australia, regardless of when the services were performed. Since time series data for wages of native skilled and unskilled workers is not available for Australia, we use aggregate wages as the dependent variable in our regression. Labour productivity is defined as GDP (at constant prices) per hour worked. The measures of labour productivity we use are presented as indices and as rates of change.

Table 1 provides descriptive statistics for the key variables of interest. The first two columns provide the mean and standard deviation of the whole sample. Average weekly wages of all workers have increased significantly over the observation period while unemployment has been declining. The average unemployment rate in recent years (2000-2006) is below the corresponding average over the entire observation period. The average change in the unemployment rate from its immediately preceding quarter is negative. Productivity is increasing over time. However, the average change in productivity, or productivity growth, of a given quarter compared to its immediately preceding quarter has slowed in 2000-06 compared to 1990-99. The immigration rate is relatively volatile (Figure 2). It declined from a relatively high level of 2.5 in the initial period to 1.8 in 1990-99.

permanent migrants into Australia, our estimates will provide an upward bound of the true effects of immigration. For more details about composition of the emigrating population and the reasons for emigrating from Australia see Productivity Commission (2006).

However, the number and proportion of new immigrants has increased again in recent years to an average rate of 2.0 though the rate is yet to match its 1980 level (Table 1). The proportion of skilled migrants has increased continuously over the observation period. On average, Australia received 2.3 skilled migrants for every unskilled migrant. That ratio has increased almost threefold over the observation period, rising from 1.4 in the 1980s to 3.4 in the 1990s and to 4.1 in the most recent period. Immigrants who were not of working age or did not adequately describe their occupational status at the time of arrival were not classified as either skilled or unskilled but were included in the total immigration rate.

Figure 3 shows a positive but not very strong relationship between earnings growth in Australia and the immigration rate. Bi-variate regression analysis confirms that it is statistically insignificant. In the next section we will determine whether this apparent relationship represents any causal effect of immigration on wages or whether it is merely a correlation. Finally, before running the regression, we check if there is any trend or persistent component in the dependent and independent variables of interest. Since we are dealing with time series data, we need to ensure that our specification is not contaminated by spurious relationships. Figure 3A in the appendix plots all the variables that are of interest in our regressions. It is apparent that there is no time trend or persistent component in the data that can potentially harm the results. By differencing the variables we have, in fact, removed any drift or time trend.

5. Estimation Results

5.1 Ordinary Least Squares Regression

The top Panel of Table 2 reports the ordinary least-squares (OLS) results from regressing growth of weekly wages on the immigration rate, with and without controlling for changes in the unemployment rate and productivity growth.¹⁶ In Columns 1, 4, and 7 we consider the immigration rate as the sole covariate. Columns 2, 5, and 8 control for the change in the unemployment rate but exclude productivity. Columns 3, 6, and 9 report the results using the full set of covariates. Overall the results indicate that the immigration rate has a consistently significant positive effect on wages, irrespective of specification. The first three columns show that total immigration exerts a highly significant (1% level) impact on wages in the Australian labour market. A one unit change in the immigration rate changes the

¹⁶ We examine changes in wages as opposed to the perhaps more natural log specification because changes in wages between quarters are sometimes zero. In a log specification, the results can be fairly sensitive to how we deal with zero values.

growth of the quarterly weekly wage by AD\$1.55-\$1.67. In terms of percentages, a 10 percent increase in the immigration rate is associated with 1.9-2 percent rise in the average wage of all workers.¹⁷ The following two sets of three columns show that this qualitative finding applies to both component groups, skilled and unskilled migrants. The magnitude of the effect is consistently larger (approximately double) for skilled migrants than for all migrants, but the level of significance is lower (columns 4-6). The effect is even stronger in the case of unskilled migrants, and statistically as significant as for all migrants (columns 7-9). Note also that in all three alternative specifications the magnitude of the coefficient of the immigration rate diminishes as we control for both changes in the unemployment rate and productivity growth. But the coefficients and the sign of the relationship remain stable and significant.

5.2 First-stage Estimation

We examine the first-stage of IV regressions with the immigration rate as the dependent variable. Equation (5) describes the relationship between the current and past immigration rates (immigration policy) and the past unemployment (labour market outcomes) rate in reduced form.

$$\Delta(I/P)_t = \phi_0 + \phi_1 \Delta(I/P)_{t-6} + \phi_2 \omega U_t + \phi_3 \omega U_{t-6} + \phi_4 \times \Delta prod_t + \mathcal{G}_t \quad (5)$$

where (I/P) , U and $prod$ are defined as above. The residual \mathcal{G}_t captures other factors that are correlated with the immigration rate and may be correlated with $\Delta \epsilon$ in equation (3). Table 3 reports the OLS results for equation (5) with different specifications using the total immigration rate as the dependent variable.¹⁸ Columns 1-4 show that both instruments, the past immigration rate and past unemployment rate, are statistically significant at the one percent level. Columns 5 and 6 indicate that both instruments are also statistically significant individually. Thus, both the past immigration rate and past unemployment rate appear to carry good explanatory power for the current immigration rate while the change in the unemployment rate is not a particularly reliable estimator. This suggests that the selected instruments are not weak, and that their use carries no potential bias. Although these findings are not conclusive, they are indicative and corroborate the usefulness of our instruments.

¹⁷ Since we are using level as opposed to log of the change in wages as the dependent variable, we need to divide the coefficient estimates by the mean value of the dependent variable to get the results in terms of percentages.

¹⁸ The results for skilled and unskilled immigration rate similar to that of results reported here. So we not report those results for brevity.

5.3 Reduced Form Estimates

Based on our previous specifications, we run the following reduced form regression:

$$\Delta W_t = \alpha_0 + \alpha_1 \Delta(I/P)_{t-6} + \alpha_2 \omega U_{t-6} + \alpha_3 \Delta U_t + \alpha_4 \times \Delta prod_t + \zeta_t \quad (6)$$

The reduced form estimation illustrates the causal effect of the instrumental variable(s) on the outcome of interest - growth of average weekly earnings. Concerns about weak instruments can be readily mitigated by looking at the reduced form equations. These estimates are unbiased, even if the instruments are weak. The results presented in Table 4 produce a fairly strong relationship between instrument and changes in wage. The first two columns of the Table suggest that the past immigration rate and past unemployment rate each have statistically significant effects on wages growth, and that the instruments are not weak. The sign of the coefficient estimates suggest that past immigration rate has a positive effect, while the past unemployment rate has the opposite effect on wage growth. This indirectly supports the conjecture about the endogeneity of immigration with immigration policy and labour market outcomes as potentially prominent drivers of the migration process. When we use both instruments in the reduced form equation (last column, Table 4), the past immigration rate yields a statistically insignificant positive effect for the changes in wage (t-ratio=1.44). This implies that, once past unemployment rate is controlled for, past immigration rate becomes less important in determining current wage growth. Though the magnitude of the immigration rate coefficients becomes less than half, they remain at an economically significant level. However, the reduced form estimates in columns 1 and 2 are each statistically significantly different from zero, and therefore they support the presumption that the immigration rate without the controls does exert a systematic influence on changes in wages in Australia (see Angrist and Krueger 2001).¹⁹

5.4 Instrumental Variable Estimates

Instead of treating the immigration rate as exogenous we now assume that it is endogenous. Panel B of Table 2 reports the results of IV estimations when the past

¹⁹ In general, there need not be any relationship between significance of the reduced form and the significance for 2SLS estimates. However, we need a strong first-stage to ensure that we are not using a weak instrument. The standard IV/2SLS estimator, $(z'x)^{-1} z'y$, with dependent variable with regressor x , and instrument z , breaks down when $z'x$ is near singular while it does not when $z'y$ approaches zero.

immigration rate – a proxy for the policy variable - is used as an instrument. The identification strategy here is that the past immigration rate does not directly influence the current growth of weekly wages in the Australian labour market. Since we are using the six-quarter lagged immigration rate as the past immigration rate there is no $\alpha \pi \rho \iota$ reason to think that such lagged immigration is likely to cause the growth of current wages. However, we allow the past immigration rate to affect current wages growth through its effects on the current immigration rate.

The IV estimates presented in panel B of Table 2 display some qualitative similarities with the OLS estimates in panel A. One notable difference is that the sign of the unemployment rate when explaining the effect of skilled migrants changes sign in the IV estimates. The magnitude of the coefficients of the total immigration rate and unskilled immigration rate is significantly larger in the IV estimations (columns 1-3 and columns 6-9). We reject that they are the same using standard Hausman Test (i.e., the difference in coefficient estimates using OLS and IV are systematic). The coefficients of skilled migration rate become statistically insignificant. The results indicate that the endogeneity bias is more important in the case of skilled migration and the bias is quantitatively important in case of unskilled and total migration rates.

Panel B shows that the current immigration rate has a positive and statistically significant (at the 5% significance level) impact on current wages growth as does the rate of unskilled immigrants. However, the explanatory power of the IV estimates deteriorates sharply when the effect of skilled immigration on wages growth is estimated. None of the three specifications shows a statistically significant effect of the rate of skilled immigrants on domestic wages growth. Overall, the evidence suggests that skilled immigration does not exert a robust influence on wages growth in the Australian labour market. This result also indicates that we need to take the endogeneity of the immigration rate into account.

5.5 Two Stage Least Squares Estimates

We now consider both instruments, the past immigration rate and past unemployment rate, simultaneously. The first stage involves regressing the immigration rate on all predetermined variables (equation 5). The estimates are presented in panel A of Table 5. The exclusion restriction is that the instruments do not appear in equation (3).

2SLS estimates do not generate any sound evidence that the immigrant flows exert a systematic effect on domestic wages growth. The current total immigration rate is statistically significant (at the 10% level) in the first two specifications (columns 1 & 2). But its explanatory power vanishes in the full covariate specification of the wage equation, i.e. when both, the change in the unemployment rate and in productivity growth, are included in the estimation. Estimates with the unskilled immigration rate display a statistically significant effect on wage change while none of the skilled immigration rate specifications generate any statistically significant effects. The coefficient estimates of the unskilled migration rate indicate that a 10 percent increase in the immigration rate will result in wage growth of about 6 percent.

IV and 2SLS estimators are popular and have been used extensively in the literature. Even though they may be consistent, several recent studies (e.g., Bound *ετ αλ.* 1995; Staiger and Stock 1997) point out that the finite sample properties of both estimators can be very poor especially when the sample size is very small or the instruments are weak. Often very large samples are needed for the asymptotic properties to yield good approximations. Both IV and 2SLS estimates are biased towards the probability limit of OLS estimates. This bias is due to the use of the $i-\tau\eta$ observation in constructing the optimal instrument for the $i-\tau\eta$ observation and therefore can generate misleading results (Angrist, Imbens and Krueger 1999).

6. Robustness Check

6.1 Jackknife Instrumental Variable Estimates (JIVE)

The 2SLS estimator can also suffer from bias that is exacerbated when the instruments are only weakly correlated with the endogenous variables and when many instruments are used. In such situations JIVE (proposed initially by Angrist, Imbens and Krueger 1999) performs better than 2SLS. JIVE estimators eliminate the correlation between the first-stage fitted values and the structural error term that causes the traditional 2SLS estimator to be biased. Though it has the same finite sample properties as limited information maximum likelihood (LIML) estimators, Angrist *ετ αλ.* have shown that under certain forms of misspecification the JIVE estimator may have less bias. It is also a useful alternative in applications when there is concern about the number of instruments.

The computational requirements for JIVE are of the order of those required for weighted least squares. Suppose we have the following relationship:

$$y = \beta x + \varepsilon$$

$$x = \pi' Z + v$$

In the case of 2SLS, the instrument for x is $Z'\hat{\pi}$ and the i -th row of the estimated instrument can be written as:

$$Z'_i \hat{\pi} = Z_i (Z'Z)^{-1} (Z'x)$$

JIVE removes the dependence of the constructed instrument $Z'_i \hat{\pi}$ on the endogenous regressor for observation i by using $\tilde{\pi}_i$, which is calculated from the sample with the i -th observation omitted.

The constructed instrument for JIVE turns out to be

$$Z'_i \tilde{\pi}(i) = Z_i \frac{(Z'Z)^{-1}}{1 - Z'_i (Z'Z)^{-1} Z_i} (Z'x - Z'x_i)$$

$$= \frac{Z_i \hat{\pi} - h_i x_i}{1 - h_i} \quad (\because h_i = Z'_i (Z'Z)^{-1} Z_i)$$

Thus JIVE can be estimated with two passes through the data.²⁰ It involves computing $\hat{\pi}$ and the leverage, which we denote by h_i , in the first stage. The second-stage involves removing the influence of the i -th observation. Then we calculate (using $\tilde{\pi}_i Z$ as an instrument)

$$\hat{\beta}_{JIVE} = (\hat{X}'_{JIVE} X)^{-1} \hat{X}'_{JIVE} y$$

where, $\hat{X}'_{JIVE,i} = Z'_i \tilde{\pi}(i)$

Panel B of Table 5 shows the results obtained with JIVE. While the signs of the immigration rate in all three variants are same to those obtained from 2SLS estimates, the overall immigration variables lack explanatory power. The coefficient estimates corresponding to the skilled and total immigration rates are statistically insignificant. The results from JIVE estimators indicate that there is no robust evidence that skilled immigration affects wage growth in Australia, positively or adversely. Unskilled workers continue to exert a statistically significant positive effect on wage growth while the skilled immigration rate does not have any robust influence. The magnitude of the coefficients for the unskilled migration rate is similar to those obtained using 2SLS estimate. The point estimates suggest

²⁰ Angrist, Imbens and Krueger (1999) propose two types of JIVE: JIVE1 and JIVE2. Monte Carlo simulations suggest both estimators typically perform similarly. Our results also confirm this. We therefore report the JIVE1 estimator here. Blomquist and Dahlberg (1999) suggest two other JIVE estimators. Again Monte Carlo evidence indicates that Angrist $\varepsilon \propto \lambda$. JIVE estimators are preferable.

that a 10 percent rise in the immigration rate increases Australian wages by about 2.2 to 2.5 percent.²¹

6.2 Tests for Validity of Instruments

An important concern with an IV approach is the possible use of weak instruments, which tends to bias 2SLS estimates toward OLS estimates and may weaken standard tests for endogeneity. The existing econometric literature defines weakness of instrument based on the strength of the first-stage equation (e.g., Staiger and Stock, Stock and Yogo 2004). Accordingly, we test the relevance and validity of the instruments. Specifically, we test whether the IVs are correlated with the endogenous regressor and orthogonal to the error process. We test the first condition by examining the fit of the first stage reduced form regression of the immigration rate on the full set of instruments - both included and excluded instruments for the 2SLS. We use the F-test of the joint significance of the excluded instruments in the first stage regression. The F-test rejects the null that the instruments are jointly insignificant (Table 3). This test for weak instruments implies that our first stage has good power, and that our instruments are not weak. The instruments are both individually significant as is evident from the first stage reduced form regression coefficient estimates and the corresponding standard errors shown in Table 3.

We further check the relevance of instruments using a “partial R^2 ” measure proposed by Shea (1997) that takes intercorrelations among the instruments into account. We also use a commonly used statistic (recommended, e.g., by Bound $\epsilon\tau\alpha\lambda$. 1995), the partial R^2 of the regression of endogenous variables on the excluded set of instruments. When we have a single instrument Shea’s partial R^2 and the usual partial R^2 measures should be the same. But with multiple endogenous variables the two statistics should be different (Baum, Schaffer and Stillman 2003). Shea’s partial R^2 ranges from 0.25 to 0.31 in our four models. Thus, our instruments pass both the criteria recommended by Bound $\epsilon\tau\alpha\lambda$. (1995) and Shea (1997).

It is possible that there are weak instruments even if, in the first stage, each instrument is significant at the conventional level of significance. Staiger and Stock (1997) suggest a rule of thumb which applies to our single endogenous variable case, that an Φ -statistic below 10 is a cause for concern. All of our four models

²¹ We also experiment with GMM estimates. The results are qualitatively similar to those of JIVE and 2SLS estimates. The results are available on request.

pass this operational criterion as well since the values of the Φ -statistics are well above 10 in all cases (see Table 3).

We now ascertain instrument independence from the observable error process. Since there are more instruments than the number of endogenous variables the equation is overidentified. We can test the orthogonality conditions of instruments with that of the error process. We test the overidentification problem through the common \mathcal{J} -statistic of Hansen (1982). Under the null hypothesis of orthogonality we cannot reject it in all cases (Table 3). This confirms that the instruments are truly exogenous. The results are also confirmed by Sargan's (1958) statistic which is a special case of Hansen's \mathcal{J} under the assumption of conditional homoskedasticity. We also adopt the general Hausman (1978) test of endogeneity. Under the null hypothesis that OLS is an appropriate estimation technique, we reject the null and conclude that the immigration rate is truly endogenous (Table 3).

6.3 Discussion and Interpretation

The results that correct the endogeneity of immigration rate reveal the following (by comparing OLS estimates with that of 2SLS and JIVE): (1) the coefficient estimates using later methods are lower (but statistically insignificant) in case of skilled migration rate;²² (2) OLS estimates of unskilled migration rate coefficients are downward biased. As a robustness check, we also experiment with a specification that includes both skilled and unskilled migration rates as covariates in the same equation using full set of instruments. The resulting coefficient estimates capture the partial effect of each skilled category of migrant. The results, not reported here, are similar. While the magnitude of the coefficients becomes slightly smaller than 2SLS/JIVE reported in Table 5, they remain larger than the OLS estimates. For the skilled migration rate the coefficient estimates become positive (t ratio = $+2/2.8=0.71$) but OLS estimates still remain upward biased.²³ So, our conclusion

²² The results for skilled migration rate using single instrument are different (in terms of both sign and magnitude) from those obtained with multiple instrument 2SLS and JIVE estimates. This is not unusual in the IV literature. For example, Friedberg (2001) finds that the effects of immigration, once the immigration rate is instrumented, are opposite to those of OLS estimates. The divergence of the results using single and multiple instruments, respectively, for skilled migration is probably a combination of weak instrument and small sample problems. In particular, skilled migrants are probably less likely to be induced to take migration decision by looking at past immigration policy. Rather they look at the labour market characteristics. So we argue that the endogeneity issue, especially for skilled migration, is better dealt with using 2SLS/JIVE. We therefore focus on the OLS, 2SLS and JIVE estimates.

²³ We also conduct the Wald test of the equality of coefficients between skilled and unskilled migration rates, and reject the null hypothesis.

regarding 2SLS/JIVE also holds here. For skilled migrants, we conclude that OLS estimates tend to overestimate the effects of immigration. Once the endogeneity is taken into account skilled immigrants do not have any influence on wage growth in Australia. The results for the unskilled migration rate do not change either - OLS continues to underestimate the true effect.

Even though the results are not unusual, it is particularly helpful to understand why and how this might be the case. Since OLS estimates are lower than the estimates that take endogeneity into account skilled migration is subject to positive selection. If high ability individuals are migrating to Australia, then the omitted ability characteristic affects both earnings capacity and the immigration decision. Once such endogeneity is taken into account the IV estimates should be smaller than the OLS estimates. Hence, our results conform to the theoretical prediction. The positive selection implies that skilled immigrants can choose to enter high wage occupations (since skills are classified by occupation). This implies that there might be a positive correlation between earnings potential in Australia, general talent and skilled migration. This could also imply that there are shortages of skilled workers in Australia and, therefore, skilled workers can get the job. This then implies also that immigrants with very high expected returns to skill are likely to migrate to Australia if the skills in the source country are correlated with skills valued in Australia. These results could also hold if more skilled workers get jobs in the skilled labour market while relatively less skilled migrants switch to unskilled professions or out-migrate from Australia.

The estimation results for unskilled migrants suggest negative selection since OLS estimates are lower than the instrumented migration rate coefficients. Negative selection implies that there is a negative correlation between the exogenous component of wage growth and unskilled migration flow into Australia. The difference between OLS and IV estimates is, therefore, due probably to immigrants entering disproportionately into unskilled occupations. This can happen for many reasons including the case that the host country is relatively attractive to low earning workers.²⁴ The results imply that immigrants with best expected or realized unskilled labour market outcomes choose to migrate to Australia as unskilled migrants. This could happen, for example, moderately skilled immigrants may choose to migrate to Australia as unskilled migrants if they can expect above

²⁴ Wu et al. (2007) find that immigrants to Australia, especially those coming from non-western regions, are channeled into inferior jobs post migration. Chiswick and Miller (2007) document that the limited international transferability of human capital skills results in immigrants being channeled into relatively low status occupations when they first enter the Australian labour market.

average labour market outcomes, or labour market outcomes that are superior to those available in other potential destination countries. This would also imply that there exists a considerable earnings premium in Australia for unskilled migrants. Given the high relative minimum wage in Australia compared to similar other immigrant receiving countries (e.g., US and Canada) this seems plausible. The wage structure in Australia 'subsidizes' low skilled workers, attracting low skilled workers from abroad. In other words, low skill workers want to migrate to take advantage of the 'insurance' provided by Australia, and by migrating to Australia rather than elsewhere they receive an 'earnings premium'. The possibility of the coexistence of earnings premium with negative selection has been raised by Kugler and Sauer (2005) in the context of occupational choice by immigrants in Israel.²⁵

In fact there are other possible explanations of these results. For example, measurement errors in OLS estimates that could be attributable to misclassification by DIC of immigrants into the unskilled category. Or skilled migrants work as unskilled workers after migrating to Australia because of onerous labour market requirements for skilled workers or, for that matter, language and other barriers or because the wage structure favours unskilled workers. They might choose to work as unskilled worker to avoid stringent labour market qualifications or to avoid large investments to acquire relevant skills. This happens because of the existence of outside (unskilled sector) earnings potential. So the difference may be attributable to the fact that OLS estimates do not correct biases caused by measurement errors while 2SLS estimate does. However, the measurement error alone is unlikely to account for the entire difference in the estimates.²⁶ The divergence between OLS and 2SLS/JIVE estimates may therefore largely be attributed to the endogeneity bias argument.²⁷

Our results, however, suggest that the effect of immigration on wages can vary substantially depending on the type of migrant labour. That is, there is

²⁵ Anecol, Cobb-Clark and Trejo (2003) argue that for many reasons (stronger labour unions, higher minimum wage, national health insurance and welfare systems), workers in the lower end of income distribution are generally better off in Australia and Canada than in the United States. Since the minim wage in Australia is very high compared to Canada while both countries have similar welfare and health systems it is likely that the Australian labour market favors unskilled workers more than the Canadian labour market.

²⁶ For example, Card (2001b) examines 11 quasi-experimental studies conducting 2SLS and OLS estimates of returns to schooling, and finds that measurement error can account for at most a 10 percent difference between the OLS and 2SLS estimates.

²⁷ Given the nature of the data, it is not generally possible to conduct a direct test of the above theoretical conjecture. However, if one uses micro data, some of the implications can be tested, $\alpha\lambda\beta\epsilon\tau$ indirectly.

heterogeneity in the labour market outcome of the effects of skilled and unskilled migration.²⁸

The absence of a negative overall impact of immigration on wage growth might be explained by highly inelastic domestic labour supply or highly elastic labour demand in Australia. Our findings suggest the possibility of complementarity between Australian-born workers and immigrant workers. This complementarity is stronger in the case of unskilled workers. We have not found any evidence to suggest that skilled migrants are either substitute or complements to native workers. It is possible, for example, that assignment of unskilled immigrants to relatively basic jobs or supportive roles releases Australians to work on the more productive aspects of the job. For example, Friedman (2001) and Kugler and Sauer (2005) point out that in Israel Russian doctors - even those with considerable prior experience and earnings - filled positions at the lower end of the job ladder, pushing Israelis up the ranks into more supervisory, high-paying roles. Anecdotal evidence supports this adjustment in the context of Australia. Informal observation, for example, of retail workers, hospitality service workers, office clerks, and others reveals that many unskilled immigrants often perform lower-level work, with Australian-born workers are concentrated in more supervisory roles.

7. Conclusion

The large and growing scale of cross-border migration imparts a crucial role to immigration policy in potential host countries. National policymakers need to resolve the potential conflict between improvements in national growth and economic performance on the one hand and deterioration in labour market outcomes for native workers on the other. Neither economic theory nor empirical investigation provides consistent support for the widespread perception that immigrants take jobs or wages, or both, from native workers. Even if it is conceded that labour market outcomes need not be harmful concern about adverse sectoral labour market effects remain in the public domain. The general presumption is that the inevitable mismatch between the composition of the

²⁸ One notable limitation of 2SLS estimates is that it uses only a part of the variation in immigration rates that is induced by the instrument(s) (those who decide to migrate to Australia on the basis of its immigration policy or labour market outcome) whereas OLS estimates use all variation (Imbens and Angrist 1994). If the marginal effects of immigration vary between those induced by the instruments and those who are not, then the estimated average effect of immigration will differ. However, as noted above, 2SLS estimates are an improvement over OLS estimates as we take the selection bias into account in the former. Moreover, IV estimates are consistent while OLS estimate may be biased.

native labour force and immigrant flows creates sectoral market imbalances which can be removed only through price (wage) and quantity (employment) adjustments. The progressive reorientation of Australia's immigration policy from family unification to skill acquisition tends to fuel those apprehensions of native workers.

Accordingly, the present paper explores systematically the impact of immigration on labour market opportunities and the assimilation of immigrants into the domestic labour market in Australia. Specifically, we recognize the heterogeneous nature of the pool of immigrants and the recent thrust of Australian immigration policy to support skill-intensive migrants. From the many differentiating characteristics of migrants we emphasize the distinction between skilled and unskilled labour qualifications. Not only does that distinction capture the thrust about Australia's immigration policy, it also recognizes, albeit in a qualitative way, the augmentation of the host country's stock of human capital that is generated from the influx of migrants.

The concrete empirical exercise involves estimating the impact of skilled immigrants on wages in the host country, Australia. The potential problem of endogeneity due to selection and self-selection of immigrants is addressed by using various instrumental variable approaches that exploit antecedent immigration policy and labour market outcomes. The multiple instrument 2SLS estimates capture both the Australian government immigration policy and self-selection by immigrants. Given the smallness of the present sample, the robustness of the results of the 2SLS estimation is verified by an alternative IV estimator, JIVE, which is suitable in our context. The JIVE estimator can simultaneously take care of the small sample bias problems in 2SLS. JIVE is also better suited if weak instruments are used.

We demonstrate the validity of the selected instruments on the basis of theoretical considerations and subject this choice to empirical testing. These tests support the suitability of the instruments and, hence, the analytical soundness of our results. The contrast between OLS and different versions of the instrumental variable suggest that the immigration rate is not independent of the unobserved determinant of wages. In fact, overestimation in OLS regressions of the effects of immigration on wages provides evidence of negative selection for unskilled migration. We also find evidence of positive selection in the case of skilled migrants supporting the fact that they can choose to go to relatively high wage occupations. However, there are other possible explanations in support of our results (e.g., measurement error) and more research is needed to resolve these

issues. Unfortunately, limitations of our available data prevent us from pursuing such investigations. In future, we attempt to address the selection issue using more comprehensive data.

The core finding is that there is no robust evidence that immigration exerts discernible adverse consequence on wages in the Australian labour market. This basic finding holds whether the immigration rate is specified in aggregate form or whether it is decomposed into the two main subsets of skilled and unskilled immigrants. In fact, there is some evidence that overall immigration may exert positive effects on wages in Australia.

One obvious limitation of the present investigation is the failure to explicitly allow for international movements of capital. Australia is a small open economy (SOE). Insofar as immigration affects relative factor returns it will elicit a capital account response. Typically, in simple aggregate SOE models, the induced capital flows will tend to re-establish relative factor returns with the net result that both the stock of the domestic labour force and capital have been augmented in response to immigration. The capital flow response becomes significantly more complex as multiple categories of labour and capital are recognized with potential complementarity and substitutability relations between the various components of each factor group. The consequence of this increasing complexity is that analytical results become more equivocal while the available data for empirical testing cease to match the analytical constructs. Furthermore, there is little evidence to suggest that any labour market disturbances that may be induced by migrant flows are likely to create relative factor price changes of sufficient magnitude to drive large-scale cross-border capital movements. The analytical limitation of the present study is, therefore, not necessarily empirically debilitating.

References

Addison, T., and C. Worswick. 2002, 'The Impact of Immigration on the Earnings of Natives: Evidence from Australian Micro Data', *Economic Record*, vol.78, p. 68-78.

Altonji, J., and D. Card. 1991. 'The effects of Immigration on the Labour Market Outcomes of Less-Skilled Natives', in John M. Abowd and Richard B. Freeman, eds., *Immigration, Trade, and the Labour market*. Chicago: University of Chicago press, p. 201-234.

Angrist, J., G. Imbens and A. Krueger. 1999. 'Jackknife Instrumental Variables Estimation', *Journal of Applied Econometrics*, vol. 14., p. 57-67.

Angrist, J., G. Imbens and D. Rubin 1996. 'Identification of causal effects using instrumental variables', *Journal of the American Statistical Association*, vol. 91, No.434, p.444-455.

Angrist, J., and A. Kugler. 2003. 'Protective or Counter-Productive? Labour Market Institutions and the Effect of Immigration on EU Natives', *Economic Journal*, Vol. 113, June, p. F392-F331

Angrist, J., and A. Krueger. 2001. 'Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments', *Journal of Economic Perspectives*, Fall, p. 69-85

Antecol, H., D. Cobb-Clark, and S. Trejo. 2003. 'Immigration policy and the skills of immigrants to Australia, Canada, and the United States.' *Journal of Human Resources*, 38, no.1, p. 192-218.

Baker, B., and D. Benjamin. 1994a. 'The Performance of Immigrants in Canadian Labour Market' *Journal of Labor Economics*, vol.12, No.3, p.369-405

Baker, B., and D. Benjamin. 1994b. 'The receipt of transfer payments by immigrants to Canada' *Journal of Human Resources*, vol.30, No.3, p.650-676.

Baum, C., M. Schaffer and S Stillman. 2003. 'Instrumental Variables and GMM: Estimation and Testing', *Stata Journal*, vol.3, No.1, p.1-31

Blomquist, S., and M. Dahlberg. 1999. 'Small Sample Properties of LIML and Jackknife IV Estimators: Experiments with Weak Instruments', *Journal of Applied Econometrics*, vol. 14. p. 69-88.

Borjas, G. 1987a. 'Immigrants, Minorities, and Labour Market Competition', *Industrial and Labor Relations Review*, vol. 40, No. 3, April, p. 382-392.

Borjas, G. 1987b. 'Self-Selection and the Earnings of Immigrants.' *American Economic Review*, vol.77, no.4, p. 531-53.

Borjas, G. 1995. 'Assimilation and Changes in Cohort Quality Revisited: What Happened to Immigrant Earnings in the 1980s?', *Journal of Labor Economics*, vol.13, No.2, p.201-245.

Borjas, G. 2003. 'The Labour Demand Curve is Downward sloping: Reexamining the Impact of Immigration on the Labour Market', *Quarterly Journal of Economics*, November, p. 1335-1374

Borjas, G. 2006. 'Immigration in the High-Skill Labour Markets: The Impact of Foreign Students on the earnings of Doctorates', National Bureau of Economic Research, Working paper, no. 12085

Borjas, G., R. Freeman, and L. Katz. 1996. 'Searching for the effects of immigration on the Labour Market', *American Economic Review*, vol.86, May p. 246-251

Borjas, G., R. Freeman, and L. Katz. 1997. 'How Much Do Immigration and Trade affect Labour Market Outcomes?', *Brookings Paper of Economic Activity*, p. 1-67

Bound, J., D. Jaeger, and R. Baker. 1995. 'Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak', *Journal of the American Statistical Association*, vol. 90: p.443-450.

Butcher, K. and D. Card. 1991. 'Immigration and Wages: Evidence from the 1980s', *American Economic Review*, vol. 81, p.292-6.

Card, D. 1990. 'Impact of the Mariel Boatlift on the Miami Labour Market', *Industrial and Labor Relations Review*, vol. 43, p. 245-257

Card, D. 2001a. 'Immigrant Inflows, Native Outflows, and the Local Labour market Impacts of Higher Immigration', *Journal of Labor Economics*, vol. 19, p. 22-64.

Card, D. 2001b. 'Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems.', *Econometrica*, vol. 69, no.5, p. 1127-60.

Card, D. 2005. 'Is the New Immigration Really So Bad', *Economic Journal*, vol. 115 no.507, p. F300-F323.

Chang, H. 2004. 'The Impact of Immigration on the Wage Differential in Australia', *Economic Record*, vol. 80, p.49-57.

Chiswick, B., and P. Miller. 1995. 'The Endogeneity between Language and Earnings: International Analyses', *Journal of Labor Economics*, vol.13, no.2, p. 246-88.

Chiswick, B., and P. Miller. 2007., 'Occupational Attainment and Immigrant Economic Progress in Australia', *Proceedings of the Australian Conference of Economists*.

Harry, C., and Y-K Ng. 1993. 'Immigration and Economic Welfare: Resource and Environmental Aspects,' *Economic Record*, vol. 69, no.206, p. 259-73.

Cobb-Clark, D. 2003. 'Public policy and the labour market adjustment of new immigrants to Australia', *Journal of Population Economics*, vol.16, no.4, p. 655-81.

Cohen, S., and C. Hsieh. 2000. 'Macroeconomic and Labour Market Impact of Russian Immigration in Israel', November, working paper.

De New, J., and K. Zimmermann. 1994. 'Native Wage Impacts of Foreign Labour: A Random Effects Panel Analysis', *Journal of Population Economics*, vol.7, p.177-192

Dustmann, C., F. Fabbri, and I. Preston. 2005 'The Impact of Immigration on the British Labour Market,' *Economic Journal*, vol. 115, November, p. F324 -F341.

- Dustmann, C., and F. Francesca, 2003. 'Language Proficiency and Labour Market Performance of Immigrants in the UK,' *Economic Journal*, vol.113, p.695-717
- Friedberg, R. 2001. 'The Impact of Mass Migration on the Israeli Labour market', *Quarterly Journal of Economics*, vol. 116, p. 1373-1408
- Friedberg, R., and J. Hunt. 1995. 'The Impact of Immigrants on Host Country Wages, Employment and Growth', *Journal of Economic Perspectives*, vol. IX, Spring, p. 23-44.
- Grossman, J. 1982. 'The Substitutability of Natives and Immigrants in Production', *Review of Economics and Statistics*, November, vol.64, p.596-603.
- Hatton, T., and M. Tani, 2005. 'Immigration and Inter-Regional Mobility in the UK, 1982-2000', *Economic Journal*, vol. 115, no.507, pp. F342-F358, November.
- Hansen, J., and M. Lofstrom. 2003. 'Immigrant Assimilation and Welfare Participation: Do Immigrants Assimilate into or out of Welfare?'. *Journal of Human Resources*, vol. 38, no.1, p. 74-98.
- Hansen, L. 1982. 'Large Sample Properties of Generalized Method of Moments Estimators', *Econometrica*, vol. 50, no.3. p.1029-1054.
- Hausman, J. 1978. 'Specification Tests in Econometrics', *Econometrica*, vol. 46, no.3, p.1251-1271.
- Imbens, G., and J. Angrist. 1994. 'Identification and Estimation of Local Average Treatment Effects', *Econometrica*, March, p.467-475.
- Islam, A. 2007a. 'Immigration and Unemployment Relationship: Evidence from Canada', *Australian Economic Papers*, vol.46, No.1, March, p.52-66
- Islam, A. 2007b. 'The Substitutability of Labour between Natives and Immigrants in Canada', *Journal of Population Economics*, forthcoming.
- Kugler, A. And R. Sauer, 2005. 'Doctors without Borders? Relicensing Requirements and Negative Selection in the Market for Physicians,' *Journal of Labour Economics*, vol. 23, No.3, p.iv-29, July.
- LaLonde, R., and R. Topel. 1997. 'Economic Impact of International Migration and the Economic Performance of Migrants', *Handbook of Population and Family Economics*, M. R. Rosenzweig and O. Stark, eds. (Amsterdam: Elsevier Science B. V., 1997), p. 799-850.
- Parasnis, J., D. Fausten and R. Smyth 2005, 'The Impact of Immigration on Native Workers in Australia', *Proceedings of the Australian Conference of Economists*
- Pischke, J., and J. Velling. 1997. 'Employment Effects of Immigration to Germany: An Analysis Based on Local Labour Markets', *Review of Economics and Statistics*, vol. 79, no.4, p. 594-604.
- Productivity Commission. 2006. 'Economic Impacts of Migration and Population Growth.', Position Paper, January.
- Sargan, J. 1958. 'The estimation of economic relationships using instrumental variables', *Econometrica*, vol. 26, no. 3, p. 393-415.

Scheve, K., and M. Slaughter. 2001. 'Labour Market Competition and Individual Preferences over Immigration Policy', *Review of Economics and Statistics*, vol. 83, no.1, p. 133-45.

Shea, J. 1997. 'Instrument relevance in multivariate linear models: A simple measure', *Review of Economics and Statistics*, vol. 79, no. 2, p.348-352.

Staiger, D., and J. Stock. 1997. 'Instrumental variables regression with weak instruments', *Econometrica*, vol.65, no.3, p. 557-86.

Stock, J. and M. Yogo, 2002. 'Testing for Weak Instruments in Linear IV Regression,' NBER Technical Working Papers 0284, National Bureau of Economic Research, Inc

Withers, G. and D. Pope. 1985., 'Immigration and Unemployment', *Economic Record*, vol.61, p.554-563

Wu, W., M.Harris, and X. Zhao. 2007. 'Occupational Transition and Country-of-Origin Effects in the Early Stage Occupational. Assimilation of Immigrants: Some Evidence from Australia', *Proceedings of the Australian Conference of Economists*.

Table 1: Descriptive Statistics of the Key Variables

Variables	1980-2006		1980-1990		1991-1999		2000-2006	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Average weekly wages per quarter	683.4	208.3	457.5	71.2	694.5	68.0	956.4	84.9
Quarterly Unemployment Rate	7.71	1.58	7.84	1.28	8.80	1.23	5.99	0.61
Immigration rate per 1000 Australian	2.1093	0.5166	2.505	0.5822	1.8235	0.343	2.0144	0.2705
Skilled immigrants	0.666	0.162	0.641	0.197	0.611	0.106	0.772	0.101
Unskilled immigrants	0.294	0.162	0.458	0.132	0.179	0.023	0.187	0.040
Productivity	83.87	10.19	73.28	1.69	83.68	5.05	97.70	2.86
Growth of weekly wage of all	8.21	3.21	7.92	1.89	6.19	2.47	11.48	2.87
change in unemployment rate	-0.038	0.288	-0.032	0.355	-0.026	0.294	-0.061	0.166
Change in productivity	0.342	0.424	0.194	0.451	0.492	0.316	0.316	0.467

Notes: Skilled and unskilled migration rates represent the share of each migration category in total migration. A large number of immigrants did not reveal their occupation at their country of origin during their first entry into Australia, so skilled and unskilled immigration rates do not add up to the total migration rate.

Table 2: OLS and IV Estimates of the Effects of Immigration on Unemployment

Panel A: Ordinary Least squares Estimates (OLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Total immigrants			Skilled immigrants			Unskilled immigrants		
Net immigration rate	1.66 (0.39)*	1.67 (0.39)*	1.55 (0.40)*	3.6 (1.77)**	3.55 (1.78)**	3.18 (1.75)+	4.22 (1.30)*	4.27 (1.30)*	3.89 (1.38)*
Change in unemployment rate		-0.093 (0.970)	0.011 (0.963)		0.116 (1.038)	0.23 (1.017)		0.572 (0.877)	0.635 (0.875)
Change in productivity			-0.477 (0.297)			-0.566 (0.297)+			-0.537 (0.312)+
R-squared	0.1	0.1	0.12	0.04	0.04	0.07	0.06	0.06	0.08

Panel B: Instrumental Variable (IV) Estimates

Net immigration rate	2.65 (1.08)**	2.98 (1.23)**	2.91 (1.29)**	5.97 (3.66)	6.15 (3.89)	6.24 (3.78)	6.66 (1.97)*	6.06 (1.61)*	5.81 (1.71)*
Change in unemployment rate		-0.543 (1.134)	-0.476 (1.147)		-0.151 (1.193)	-0.096 (1.191)		0.61 (0.860)	0.668 (0.856)
Change in productivity			-0.32 (0.345)			-0.48 (0.334)			-0.479 (0.319)
R-squared	0.1	0.1	0.12	0.04	0.04	0.07	0.06	0.06	0.08

Notes: Each column in each panel represents a separate regression which also includes a constant term.

The migration rate in a given period is the number of immigrants per one thousand adult (15-64 years of age) Australian population for that period. Skilled and unskilled migration rates are the share of each migration category in total migration. A large number of immigrants did not reveal their occupation at their country of origin during their first entry into Australia, so skilled and unskilled immigration rates do not add up to total migration rate. Huber-White standard errors in parentheses, + significant at 10%; ** significant at 5%; * significant at 1%.

Table 3: First-Stage Regression: Immigration Decision

	(1)	(2)	(3)	(4)	(5)	(6)
Change in unemployment rate ¹		0.023 (0.161)		0.166 (0.146)	0.17 (0.16)	0.514 (0.133)*
Change in productivity ¹			-0.376 (0.097)*	-0.399 (0.095)*	-0.419 (0.096)*	-0.48 (0.114)*
Past immigration rate	0.539 (0.076)*	0.534 (0.099)*	0.518 (0.071)*	0.483 (0.089)*	0.389 (0.090)*	
Past unemployment rate ¹	0.116 (0.038)*	0.116 (0.038)*	0.112 (0.035)*	0.113 (0.035)*		0.056 (0.030)+
Hansen's J-Statistic (Overidentification Test)	[p=0.31]	[p=0.281]	[p=0.260]	[p= 0.33]		
F-test of Joint Significance of Instrument Set	[p=0.00]	[p=0.00]	[p=0.00]	[p=0.00]		
Shea's Partial R ²	0.2983	0.27	0.313	0.259		
Wu-Hausman F test	[p=0.061]	[p=0.076]	[p=0.109]	[p=0.092]		
Durbin-Wu-Hausman chi-sq test	[p=0.059]	[p=0.071]	[p=0.103]	[p=0.085]		
Sargan statistic (overidentification test of all instruments)	[p=0.368]	[p=0.358]	[p= 0.351]	[p=0.434]		
Value of F-statistic (for instruments)	24.3	14.5	25.7	13.9		
R-squared	0.3	0.3	0.39	0.4	0.33	0.21

Notes: Each column represents a separate regression which also includes a constant term. Past unemployment rate and past immigration rate are six-quarter lags of the respective variable. Huber-White standard errors in parentheses, + significant at 10%; ** significant at 5%; * significant at 1%.

¹ estimate coefficients are multiplied by 1000

Table 4: Reduced Form Estimates

	(1)	(2)	(3)
Change in unemployment rate	-0.338 (0.921)	-0.084 (0.848)	-0.484 (0.838)
Change in productivity	-0.613 (0.294)**	-0.631 (0.287)**	-0.594 (0.279)**
Past immigration rate	1.205 (0.431)*		0.576 (0.399)
past unemployment rate		-0.892 (0.150)*	-0.827 (0.158)*
R-squared	0.08	0.22	0.22

Notes: Each column represents a separate regression which also includes a constant term. Past unemployment rate and past immigration rate are six-quarter lags of the respective variable. Huber-White standard errors in parentheses, + significant at 10%; ** significant at 5%; * significant at 1%

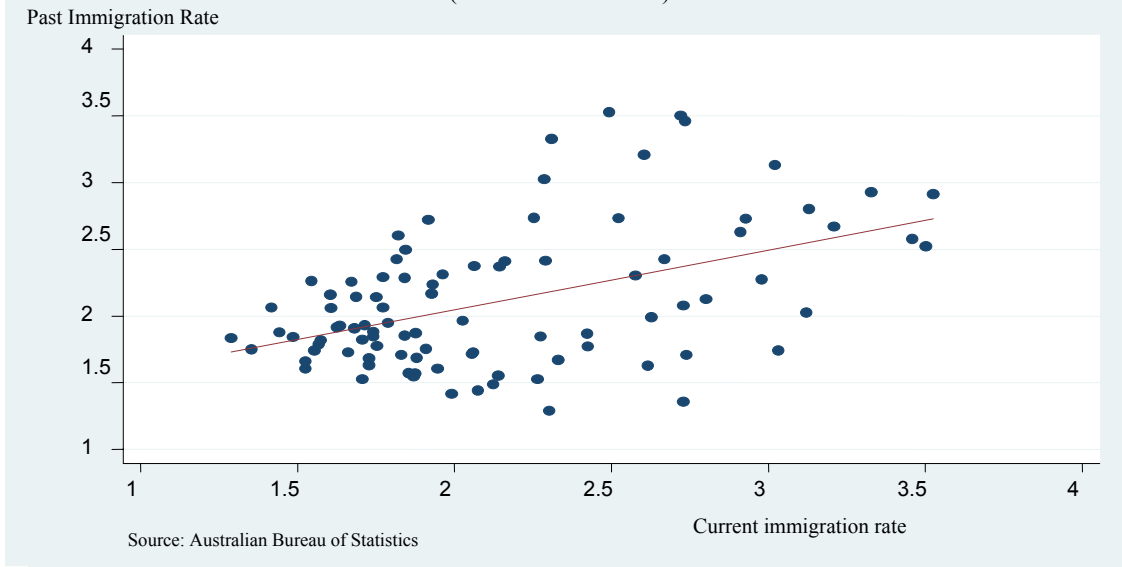
Table 5: 2SLS and JIVE estimates of the effect of Immigration

Panel A: Two Stage Least Square (2SLS)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Total immigrants			Skilled immigrants			Unskilled immigrants		
Net immigration rate	1.82 (1.00)+	1.9 (1.02)+	1.75 (1.07)	-0.49 (3.61)	-2 (3.98)	-1.94 (3.80)	5.14 (1.98)*	5.23 (1.62)*	4.95 (1.70)*
Change in unemployment rate		-0.171 (1.005)	-0.062 (1.007)		0.688 (0.934)	0.775 (0.919)		0.593 (0.856)	0.653 (0.848)
Change in productivity			-0.453 (0.319)			-0.711 (0.314)**			-0.505 (0.311)
R-squared	0.1	0.09	0.11	0.02	0.02	0.03	0.05	0.05	0.07
Panel B: Jackknife Instrumental Variable Estimates (JIVE)									
Net immigration rate	1.86 (1.14)	2.15 (1.32)	2.05 (1.52)	-1.3 (4.13)	-2.97 (4.99)	-3.26 (5.20)	5.2 (2.03)**	5.28 (1.65)*	5.02 (1.74)*
Change in unemployment rate		-0.258 (1.066)	-0.168 (1.102)		0.787 (0.966)	0.916 (0.969)		0.594 (0.856)	0.654 (0.848)
Change in productivity			-0.419 (0.345)			-0.748 (0.332)**			-0.503 (0.311)
Observations	106	106	106	106	106	106	106	106	106
R-squared	0.1	0.09	0.11	0.02	0.02	0.03	0.05	0.05	0.07

Notes: Each column in each panel represents a separate regression which also includes a constant term.

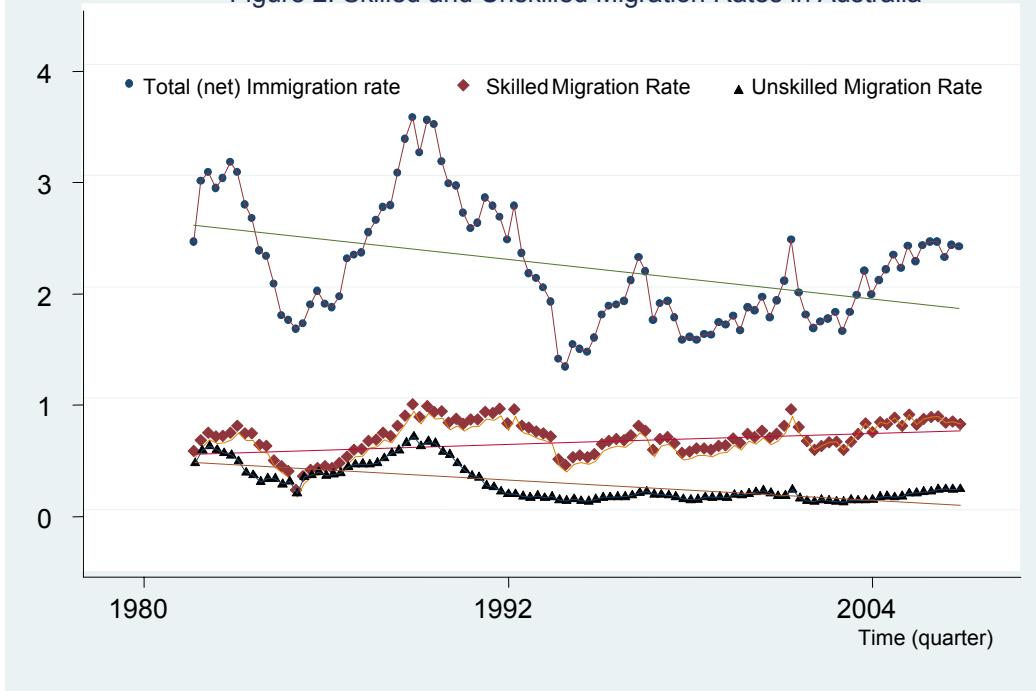
Migration rate in a given period is the number of immigrations per one thousand adult (15-64 years of age) Australian population for that period. Skilled and unskilled migration rates are the share of each migration category in total migration. A large number of immigrants did not reveal their occupation at their country of origin during their first entry into Australia, so skilled and unskilled immigration rates do not add up to total migration rate. Huber-White standard errors in parentheses, + significant at 10%; ** significant at 5%; * significant at 1%

Figure 1: Relationship between Past and Current Immigration Rate
(Australia: 1980-2006)



Notes: Current immigration rate is the number of immigrants per one thousand adult (15-64 years of age) Australian population at time t . Past immigration rate is the six-quarter lag of the migration rate.

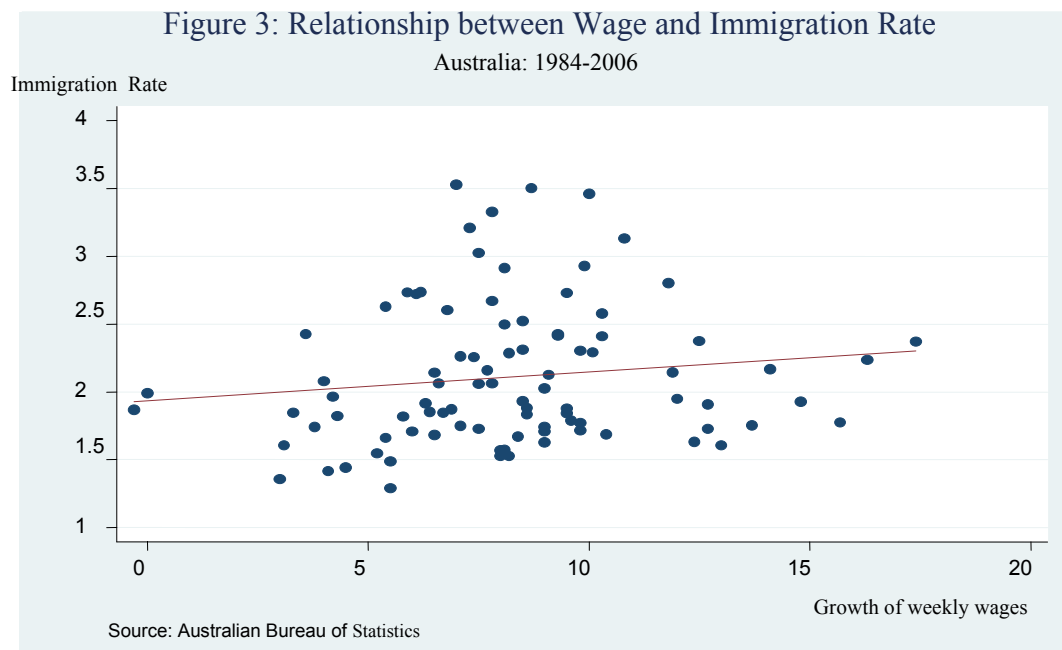
Figure 2: Skilled and Unskilled Migration Rates in Australia



Notes: Migration rate in a given period is the number of immigrants per one thousand adult (15-64 years of age) Australian population for that period.

Skilled and unskilled migration rates are the shares of each migration category in total migration. A large number of immigrants did not reveal their occupation at their country of origin during their first entry

into Australia, so skilled and unskilled immigration rates do not add up to total migration rate.



Notes: The growth of weekly wages is the change in the average weekly wage between adjacent quarters. The immigration rate is the number of all (skilled and unskilled) immigrants per thousand adult (15-64 years of age) Australian-born population.

Appendix:

Table 1A: Permanent immigrants entering settlement countries under skilled categories (Per cent of all immigrants)

Country	1991	1999	2001	2005
Australia	37	42	60	65
Canada	18	47	55	
New Zealand	-	47	68	
United States	18	22	17	

Source: International Organization for Migration (2005), Productivity Commission (2006).

Table 2A: Main Sources of Australian Immigrants (% of total)

Countries of origin	1949-50	1959-60	1969-70	1979-80	1989-90	1999-00
New Zealand	1.9	1.3	2.7	16.3	9.2	23.7
UK and Ireland	28.2	36.1	41.6	21.5	21.1	10.8
China*	0.8	0.4	0.2	1.6	2.5	7.4
South Africa	0.3	0.4	0.5	3.4	2	6.2
India	0.7	0.4	2.1	1	2.5	5
Former Yugoslavia	0.8	6	14.2	2.1	1.6	4.6
Philippines	n.a.	n.a.	0.1	2.5	5	3.5
Malaysia	0.4	0.2	0.5	2	5.3	1.9
Viet Nam	n.a.	n.a.	n.a.	16	9.2	1.6
Hong Kong +	0.3	0	0.2	1	6.6	1.6
Germany	34.6	9	2.2	1.5	0.9	0.8
Netherlands	1.7	8.9	1.5	1.5	0.4	0.5
Poland	3	1.8	0.3	1.7	1.4	0.2
Italy	9.3	15.4	5.6	1.3	0.3	0.2
Austria	3.7	1.9	0.5	0.3	0.2	0.1
Greece	1.1	5.9	5.9	1.1	0.3	0.1
Other	13.3	12.2	21.9	25.4	31.5	31.7

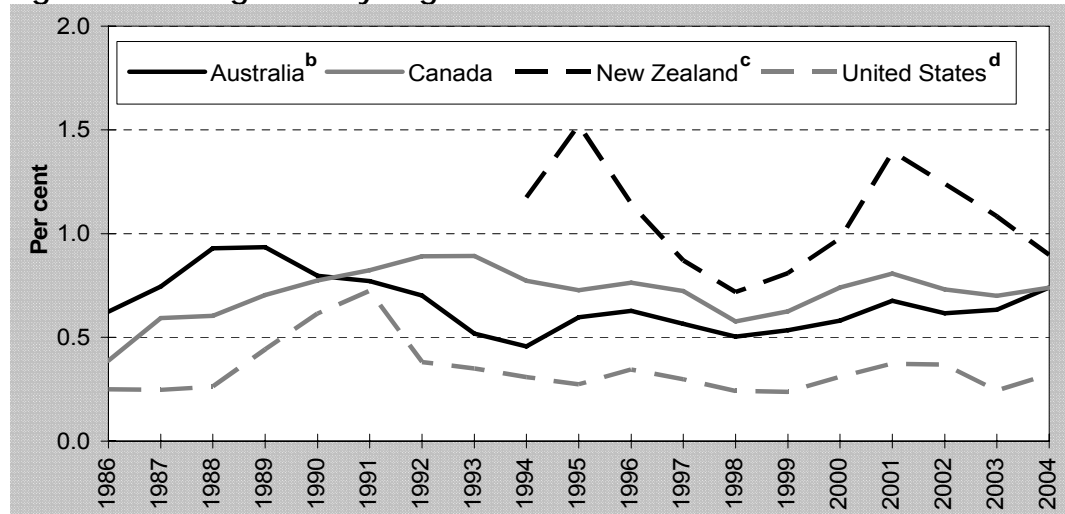
Notes: n.a. implies not available

* China (excludes SARs and Taiwan Province)

+ Hong Kong (SAR of China)

Source: Australian Bureau of Statistics 2006

Figure 1A: Immigration by Region of Birth



^a Data include settler arrivals as well as permanent residency visas granted onshore. Comparability across countries is limited by data collection processes, as detailed in appendix B.

^b Data refer to financial years (July to June of the year shown).

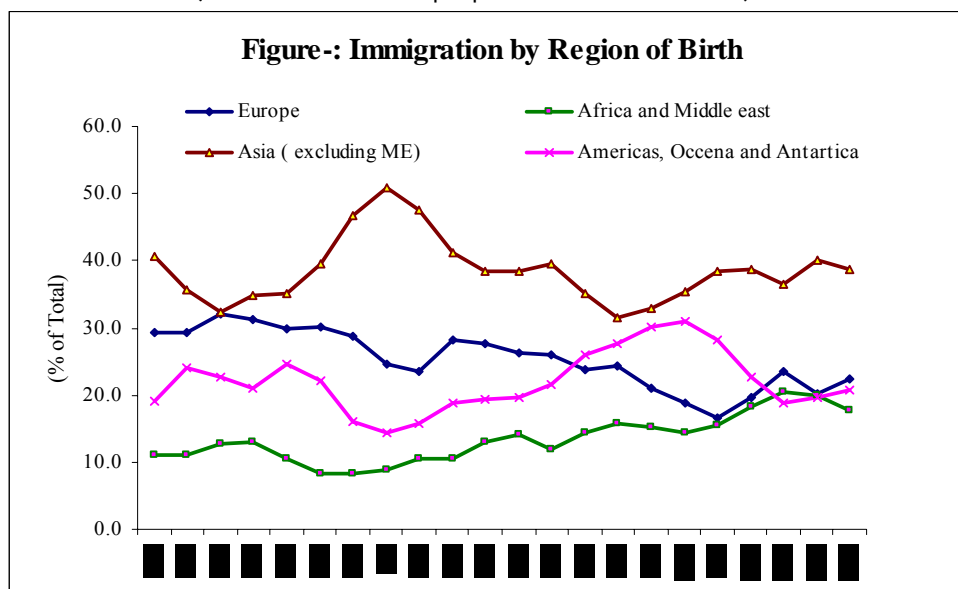
^c Data not available before 1994.

^d Data refer to financial years (October to September of the year shown).

Source: Productivity Commission Research Report, Australia, 2006.

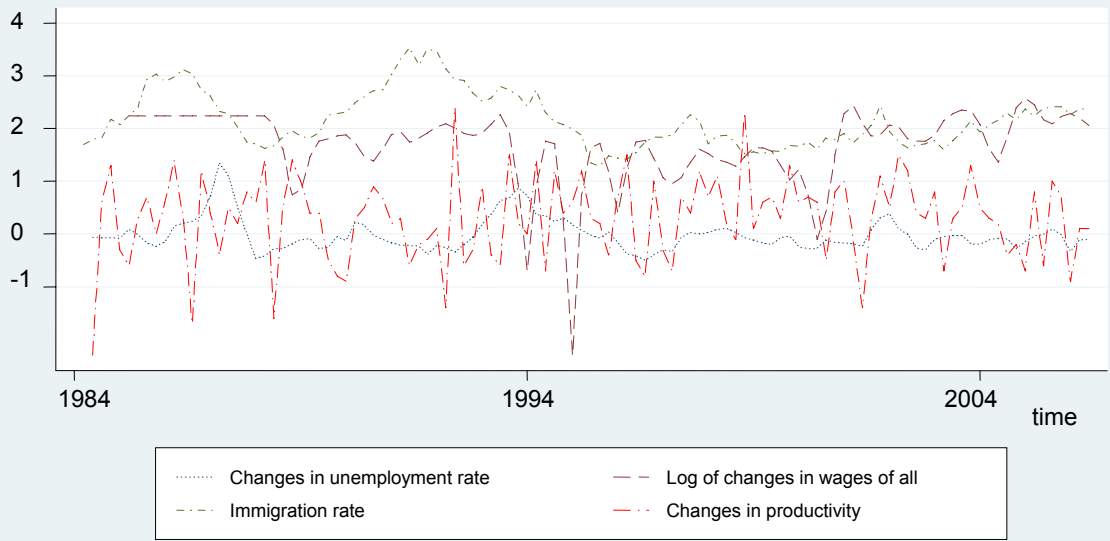
Figure 2A: Flows of Permanent Immigrants to Australia

(Percent of total population, 1986-2004)^a



Source: Australian Bureau of Statistics 2006.

Figure 3A: Trends of Key Variables
Australia: 1983-2006



Source: Australian Bureau of Statistics 2006

Notes for Immigration Data:

Skill characteristics of Permanent immigrants are recorded on Incoming Passenger Cards when immigrants land first at Australian airports (or sea ports).

There are five different skill levels defined in the *Australian Standard Classification of Occupations*, 2nd edition. They are based on the formal education, training and previous experience usually required for entry to the occupation.

Level 1

1 Manager and Administrators

2 Professionals

Most occupations in Major Groups 1 and 2 have a level of skill commensurate with a bachelor degree or higher qualification or at least 5 years relevant experience. In some instances relevant experience is required in addition to the formal qualification.

Level 2

3 Associate Professionals

Most occupations in Major Group 3 have a level of skill commensurate with an Australian Qualifications Framework (AQF) Diploma or Advanced Diploma or at least 3 years relevant experience. In some instances relevant experience is required in addition to the formal qualification.

Level 3

4 Tradespersons and Related Workers

5 Advanced Clerical and Service Workers

Most occupations in Major Groups 4 and 5 have a level of skill commensurate with an AQF Certificate III or IV or at least 3 years relevant experience. In some instances relevant experience is required in addition to the formal qualification.

Level 4

6 Intermediate Clerical, Sales and Service Workers

7 Intermediate Production and Transport Workers

Most occupations in Major Groups 6 and 7 have a level of skill commensurate with an AQF Certificate II or at least one year relevant experience. In some instances relevant experience is required in addition to the formal qualification.

Level 5

8 Elementary Clerical, Sales and Service Workers

9 Labourers and Related Workers

Most occupations in Major Groups 8 and 9 have a level of skill commensurate with completion of compulsory secondary education or an AQF Certificate I qualification.

For the permanent arrivals data, according to ABS, Levels 1, 2 and 3 are categorised as "skilled" and Levels 4 and 5 as "unskilled".