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The Economics of Canadian Immigration Levels

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Abstract

In the hope of addressing chronic labour shortages and sluggish economic growth, the Canadian government plans to increase immigration in the coming years to per capita levels not reached since the 1920s. We argue that economic immigration in the Canadian context should aim to boost GDP per capita in the full population including the newcomers. We then examine the potential for increases in Canadian immigration levels to achieve this objective. Our analysis suggests that Canada is not well-positioned to leverage heightened immigration to boost GDP per capita owing primarily to weak capital investment and quantity-quality tradeoffs in immigrant selection. We conclude by providing a framework for identifying the optimal level of economic immigration.

Keywords: Immigration, economic growth, human capital
JEL Classification: J61, F22, J24

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1 Introduction

When asked by pollsters, an overwhelming majority of Canadians agree with the statement: "Overall, immigration has a positive impact on the Canadian economy."[1] However, when asked whether Canada should limit the number of immigrants it accepts, a significant majority also agree.[2] These views reflect a broad and longstanding Canadian consensus that while immigration has the potential to boost average economic living standards in the population, there are limits to this potential. While nearly all Canadians believe a closed-door immigration policy is anathema to our economic well-being and national values, few support a true open-door policy.[3]

If immigration has the potential to boost the Canadian economy but must be limited to realize that potential, what is the optimal level? Between 2000 and 2017, Canada's annual immigration rate – the number of new permanent residents as a percentage of the population — fluctuated between 0.70% and 0.83%. In 2017, the government announced expasionary targets, which served to increase the rate over the following two years to 0.87% and 0.91%. While Covid-19 travel restrictions forced a reduction in 2020 to 0.49%, 2021 saw the rate increase to 1.12%, its highest since 1957. If the federal government's most recent targets are reached, the rate will reach 1.21% in 2024 and 1.24% by 2025. Canada has not seen consecutive years with rates above 1.2% since 1928-1929.

The policy challenge in achieving their targets is not in attracting enough new immigrants. As of January 2023, Immigration, Refugees and Citizenship Canada (IRCC) had a processing backlog of 521,552 applications for permanent residency[4] and an additional 239,415 principal applicants for economic-class immigration in its Express Entry pool.[5] Assuming three accompanying dependents per applicant on average, this implies a queue of nearly 2.3 million prospective immigrants. The Canadian reality is that the supply of prospective immigrants far exceeds current targets. While immigration rates above 1% are seen as ambitious, much higher immigration rates are attainable if entry requirements were sufficiently relaxed and investments in IRCC's application processing capacity were sufficiently increased.[6]

[1] Environics Institute poll conducted in September 2021, reported in Alec Regino, "New immigration minister inherits backlogs, migrant worker issues," Toronto Star, October 27, 2021.

[2] Results of a Leger poll from June 2019 reported in Teresa Wright, "Poll suggests majority of Canadians favour limiting immigration levels," CBC News, June 16, 2019.

[3] To be clear, we define a closed-door policy as one where no immigrants are admitted and an open-door policy as one where the sole requirement for obtaining permanent residency status is arrival in Canada.

[4] Retrieved on February 6, 2023 from `https://www.cicnews.com/2023/01/canadas-immigration-backlog-continues-to-gradually-decrease-0132394.html#gs.oo9hlr`

[5] In comparison, the number of applicants in the Express Entry pool was 71,087 on January 3, 2018, 94,950 on January 3, 2019, 141,281 on January 29, 2020, 146,495 on January 4, 2021, and 193,148 on January 4, 2022 (`https://www.canada.ca/en/immigration-refugees-citizenship/corporate/publications-manuals/express-entry-year-end-report-2019.html`.)

[6] The combined population of China, India, Pakistan, Nigeria, Bangladesh, Mexico, Ethiopia, Philippines, Egypt,

This means that Canada's immigration rate is a policy choice for which the federal government has wide discretion to adjust.[7] Whether 1% is too high or too low depends entirely on what the objective of immigration is. If it is to maximize our population or the overall size of the economy, perhaps in the hope of boosting Canada's geopolitical influence, limiting annual inflows to 1% would be sub-optimal. But if the objective is to leverage immigration to boost average economic living standards in the population, it is far less clear whether 1% is too low or too high.

While Section 3(1) of the *Immigration and Refugee Protection Act* (2002) lists twelve distinct objectives of immigration, economic rationales for immigration have over time come to dominate the Canadian discourse on immigration in the political, policy, and public spheres. Consistent with this shift, economic-class programs have accounted for a rising share of annual entries of new permanent residents. While economic-class programs never accounted for more than one-half of entries between 1980 and 1994, since 1995 they have never accounted for less than 50%, and by 2010 had reached two-thirds of all entries. The government's most recent immigration targets allot 57%, 58%, and 60% to economic-class programs in 2023, 2024, and 2025, respectively.

The growing emphasis on economic rationales for immigration is justified by more than wishful thinking. A growing body of evidence, mostly from the U.S., identifies beneficial effects of immigration on entrepreneurial activity (Azoulay, Jones, Kim and Miranda 2021), innovation (Kerr and Lincoln 2010; Hunt and Gauthier-Loiselle 2010), trade balances (Ortega and Peri 2014), and the wage rates of native-born workers (Ottaviano and Peri 2012). These studies have in recent years been leveraged by Canadian politicians and advocates of increased immigration levels to bolster public support for immigration. Unfortunately, failure to recognize the dependence of research findings on national context, especially the skill composition of immigration inflows, has led policymakers to infer that if some immigration is good for the economy, then more must be better. This thinking is evident in the current government's prioritization of increasing immigration levels at the expense of the skill levels of new immigrants.[8]

This article begins with an evaluation of what the economic objective of Canadian immigration should be. We then examine the potential for immigration to achieve this objective within the framework of standard theoretical models of economic growth. Having established a theoretical framework, we turn to the data to examine the historical link between Canadian economic growth

Vietnam, Congo, Iran, Kenya, Uganda, Sudan, Ukraine, Iraq, Afghanistan, Haiti is 4.4 billion. Attracting only 0.1% of this population every year would produce a Canadian immigration rate of 12 percent. Clearly, the policy challenge is not in attracting enough immigrants.

[7]For ease of discussion, we focus on the role of the federal government, but we recognize that immigration is a shared federal-provincial jurisdiction under the Canadian constitution, so a role for the provincial governments in setting these targets for Canadian immigration levels is important.

[8]This prioritization is most evident in IRCC's February 2021 decision to forego its Comprehensive Ranking System (CRS) for assessing and screening the labour market skills and earnings potential of economic-class applicants in order to reach its 2021 immigration target.

and immigration rates and conclude by providing a framework for quantifying an optimal immigration level. In order to make the analysis accessible to a broad audience, we avoid technical methods and jargon as much as possible. While the target audience are Canadian stakeholders, especially policymakers, the key ideas may be of value to immigration policymakers in other countries.

2 The economic objective

2.1 Immigration surplus

Defining an optimal immigration level is impossible without first defining what the policy objective is. The objective of Canada's economic-class programs is presumably economic in nature, but what exactly? Is the goal to boost the profits of Canadian businesses, lower business failure rates, maximize the employment rate, or increase the productivity and wages of Canadian workers? And is the goal solely about benefiting the population that is already here, or should the economic well-being of the newcomers also be considered?

The economic rationale for leveraging immigration to boost the economic well-being of the existing population is theoretically straightforward. Consider, in the simplest case, a stylized economy with perfectly competitive markets, neoclassical production, a fixed capital stock, and workers who are all identically productive.[9] The main effect of an increase in labour supply through immigration is to increase competition between workers for jobs, which are scarce because the capital stock is fixed. Since the skills and abilities that all workers bring to the market are identical, the only way workers can compete for jobs is to accept a lower wage rate than their counterparts, thereby putting downward pressure on the equilibrium wage rate. Depressed wages, in turn, incentivize employers to hire more workers, increasing the employment level and the amount of output produced.

In this case, any economic loss to workers from their lower wage is a gain in firm profits, assuming firms own their capital. The effect of immigration is, however, more than a zero-sum redistribution of income from labour to capital, since the expansion in output means the gain to firms exceeds the loss to workers. Borjas (1995) coins this net gain the "immigration surplus." If the surplus can be transferred from firms to workers at no cost, through corporate taxes for example, immigration has the potential to boost the economic welfare of everyone in the preexisting population.[10]

Of course, in the real world not all workers are perfect substitutes for one another in production. The immigration surplus is, however, robust to relaxing this assumption. To see this, suppose

[9] Neoclassical production assumes aggregate production function has constant returns to scale and convex technology. These concepts are explained in the following section. An inelastic capital stock can be thought of as a "short-run" period during which the capital stock is unable to adjust.

[10] Note that this result does not depend on the capital stock being strictly fixed. As long as supply of capital is not perfectly elastic, the capital-labour price ratio is permanently higher and and an "immigration surplus" exists.

the skills of native workers are identical, but the skills that immigrants bring to the economy complement natives' skills in the sense that they serve to boost their productivity in a similar way to how computer software improves an analyst's productivity. In technical terms, this means that immigrant and native labour are "Q-complements" in production which is usually captured by a CES production function in which the elasticity of substitution between immigrant and native labour is less than one.[11] Intuitively, relatively unskilled immigrant labour may, for example, free up native workers to focus on higher value-added tasks enabling natives to produce more and earn more. If we also relax the assumption of a fixed capital stock, and allow the capital stock to adjust fully to maintain the capital-labour ratio (capital supply is perfectly elastic), the immigration surplus goes entirely to native workers. If, on the other hand, capital adjusts at a cost to firms (capital supply is imperfectly elastic), the immigration surplus is shared by workers and firms, but once again, the economic well-being of everyone in the preexisting population is improved.

With a larger set of worker skill types, the distributional effects of immigration are more complex. In general, native workers whose skills are substitutes for those of newcomers face heightened pressure to compete for jobs, putting downward pressure on their wages (or equivalently weakened upward wage pressure in a tight labour market), while workers with complementary skills will experience productivity and wage gains. However, in recent work, Amior and Manning (2022) show that in the case where capital adjusts costlessly (is perfectly elastic), the *average* productivity of native workers must increase, except in the unusual case that the skill mix of immigrants exactly duplicates the skill mix in the existing population, in which case nothing happens to the average productivity of natives.[12] The resulting immigration surplus can, in theory, be redistributed within the preexisting population to compensate workers who have been adversely affected, thereby ensuring that nobody is any worse off as the result of immigration.

Real-world labour markets are, however, less than perfectly competitive. Finding new job opportunities and changing jobs is costly for workers. These costs give employers monopsony power in the sense that they can pay their employees less than their contributions to production without those workers responding by quitting their jobs. This means that the immigration surplus that would otherwise go to workers in the preexisting population may be captured by firms, even in the case where capital investments are costless. Using U.S. Census data, Amior and Manning (2022) show that the immigration-induced mark-downs in the wages of native-born workers exceed the average gain in their productivity from immigration. Moreover, their analysis suggests that the increase in firms' monopsony power is driven mostly by undocumented migrant workers who have

[11] This is necessarily the case with convex technology and two factors of production, since Young's Theorem ensures the second-order cross partial derivative of the production function must be positive.

[12] If capital does not adjust perfectly, part of the surplus going to native workers instead goes to firms.

the least ability to respond to wage mark-downs by quitting their jobs.

Nonetheless, despite the economic losses that some native workers experience from heightened mark-downs and competition that results from immigration, as long as immigration alters the mix of skills in the overall workforce, immigration must produce a net surplus within the preexisting population. If the heightened monopsony power of employers can be ameliorated through minimum wages or regularizations of undocumented workers, the redistribution needed to ensure nobody in the preexisting population is any worse off may be feasible. Of course, one may be concerned about the economic well-being of the newcomers, but as long as immigrants continue to arrive, despite the wage mark-downs they face, their migration choice is arguably evidence that they too are better off ("revealed preference"). From this perspective, it is difficult to see why anyone would be opposed to expansions in immigration levels on economic grounds.

2.2 GDP per capita

However, one need not think long about the policy implications of maximizing the immigration surplus to see the pitfalls. Maximizing the surplus rests on immigrants being engaged in tasks that complement the productive activities of workers in the existing population. For countries with highly educated workforces, like Canada, this implies optimal policy is to target admissions of lower skilled immigrants. As Basso, Peri, and Rahman (2022) show, downward pressure on wages in the low-wage service sector has the added benefit that it incentivizes native workers to move into relatively skilled jobs, thereby further boosting productivity and earnings in the native workforce. And if policymakers also seek to maximize newcomers' welfare gains from moving to Canada, targeting unskilled migrants from the poorest countries in the world will be optimal.

But what is the effect of mass inflows of unskilled labour in the overall population that includes the new immigrants? On the one hand, we expect occupational segregation and economic inequality to increase as skilled natives are pushed into high value-added professional and technical jobs while unskilled immigrants are concentrated in low-wage service tasks. Economics research suggests that interpersonal comparisons among the people we most closely associate matter more in determining satisfaction with one's personal income than comparisons with oneself in the past (Clarke, Frijters and Shields 2008). This suggests that with time in the host-country the *relative* deprivation of newcomers in the host country may be more important in determining their sense of economic well-being than their economic gain from migration. Consistent with this idea, longitudinal data reveals Canadian immigrants' self-reported health status tends to decrease with time since arrival in Canada (Fuller-Thomson, Noack and George 2011), as does their likelihood of reporting they would not make the decision to come to Canada if they had to make the decision again (Houle and

Schellenberg 2010).[13] The rise in economic inequality within the full population becomes especially concerning if it persists across generations. Using Canadian Census data, Aydemir, Chen and Corak (2009) identify immigrant source countries, mostly in the Caribbean, where the earnings disparities of immigrant fathers are evident in the adult earnings of their sons and daughters two decades later. Similarly, Skuterud (2010) finds evidence of persistent wage gaps across generations of black Canadians.

Not only is economic inequality likely to rise, but if the earnings disadvantages of immigrants are significant enough, average economic well-being in the full population may fall. In technical terms, if skilled and unskilled labour are complementary inputs in a CES aggregate production function, unskilled immigration may boost the wages of skilled natives, but a marginal increase in unskilled labour will necessarily lower output per capita in the population of all workers. This is true no matter how strong the complementarity between the skilled and unskilled labour inputs is. The intuition is that with one labour input fixed, adding more of the other labour type always runs into the diminishing marginal product of labour problem. The exceptional case is where the skilled and unskilled labour inputs must be combined in a fixed proportion to produce any output, but there is no evidence that this case is empirically relevant.[14]

A social welfare function (SWF) is a method of aggregating individual well-being in a population into a single number to evaluate the desirability of social policies. No reasonable SWF will imply immigration is socially optimal if it increases inequality in the population *and* makes the population poorer on average. What is too often overlooked in appeals to the immigration surplus is that it rests critically on the exclusion of immigrants from the host-country's SWF.[15] This might be justifiable in the context of a guest worker program, such as that in the United Arab Emirates, but it is in our view anathema to the ethos of Canadian immigration and egalitarianism and the reality that new Canadian permanent residents have full access to all the rights and privileges of individuals in the existing population, including citizenship.

[13] In their analysis of the social context of subjective evaluations of well-being, Helliwell and Putnam (2004, p. 1440) report "in our work as in many other studies, self assessed health status is the single most important correlate of subjective well-being."

[14] This is the case where the elasticity of substitution between skilled and unskilled labour is precisely zero (Leontief). A scarcity of unskilled labour input in this setting means that a pool of skilled workers cannot be employed because it does not have enough of the complementarity input – unskilled workers – to work with. When you add unskilled workers to this economy, you are essentially adding more skilled workers as well. While there may be some micro examples where this phenomenon is relevant, it is clearly not representative of aggregate production in Canada.

[15] Alternatively, one could argue that the newcomers should be included in the SWF both before and after their migration. But which prospective migrants should a country's policymakers include in its SWF? Without knowing who will arrive, ex ante, the only option is to include the world's population, but this, once again, implies that optimal policy is mass immigration from the world's poorest countries, since this is where the welfare gains from migration will be largest. This may be consistent with the objectives of a humanitarian class immigration program, but given the obvious implications for both economic inequality and average economic living standards in the host country, it is clearly not a sound objective function for an economic class immigration program.

While no single metric can capture social welfare perfectly, the advantages of targeting the national income of a country, measured by its gross domestic product (GDP), are well established. Differences in per capita income are strongly correlated with life satisfaction across countries and between individuals within countries (Easterlin 1995; Deaton 2008). More contentious is whether increases in per capita GDP within countries over time produce gains in average happiness. The proposition that increasing the incomes of everyone in the population does not increase happiness is known as the "Easterlin paradox," and is most often rationalized as reflecting the importance of social comparisons in determining our sense of well-being. Nonetheless, as longer time-series from more countries have become available, evidence is accumulating that economic growth, even within rich countries, is associated with increases in average levels of subjective well-being (Stevenson and Wolfers 2008). In addition, income growth has been shown to be associated with improvements in longevity, health, education, knowledge, and other beneficial outcomes for individuals and society, regardless of any effect on subjective well-being. And perhaps most significant in the immigration context, differences in countries' levels of per capita GDP have been shown to be highly influential in determining migrants' own choices about where they choose to settle (Mayda 2006; Ortega and Peri 2013).[16]

In the light of these considerations, our view is that the most reasonable economic objective of Canadian economic-class immigration is to boost per capita GDP in the full population. As the following section reveals, the economic benefit of immigration given this broader objective is less certain.

3 Growth and growth rates

For economists, economic growth refers to an increase in a country's GDP per capita over time. Unlike cyclical variations in unemployment and inflation rates, economic growth rates are what drive improvements in average living standards over decades and centuries. Economic inefficiencies arising from market frictions and various sources of worker and capital misallocation similarly matter more over short- to medium-term horizons but relatively little in the long run. Given this, the dearth of research focused on the effects of immigration on economic growth is surprising, and in our view likely contributes to a distorted view of economic immigration as primarily serving a

[16]We recognize the limitations of GDP as a social welfare metric, especially its neglect of non-market production and environmental destruction, and the existence of alternative measures of well-being, such as the UN's Human Development Index (HDI). Despite advances in the "beyond GDP" research, there remains much debate about the best alternative (Fleurbaey 2009; Jones and Klenow 2016; Jorgensen 2018) and correlations of alternative metrics with per capita GDP are consistently high. We also fully recognize that immigration may achieve many non-economic objectives, including humanitarian goals and increasing cultural diversity, but our analysis is concerned with optimal policy where the policy objective is economic.

role in meeting short-term labour market needs.

3.1 Growth rates and income levels

Perhaps the most compelling reason for caring about growth in per capita income is the well known fact that even seemingly small changes in growth rates, if sustained over time, have large effects on average income levels in the long run. To illustrate this, consider the lifetime evolution of average income in the Canadian population from the perspective of the cohort of Canadians born in 2022 when GDP per capita was $70,340 in current Canadian dollars.[17] Given a life expectancy of 83 years, we are interested in the growth of this value between 2023 and the year 2106.

To be sure, $70,340 exceeded the average income of most Canadians in 2022 because it includes payments to not only workers, but also the owners of Canada's capital stock, including all the machinery and equipment and factories, its natural resources, and its entrepreneurs. It is, perhaps, best thought of as the monetary value that would be go to every Canadian resident if the value of everything that is produced in Canada within a year were divided equally between everyone, including children.

A common criticism of using GDP per capita as a measure of economic progress is that people care about more than money, but nothing precludes Canadians from allocating the gains from economic growth to non-monetary activities, such as increased leisure activities or investments in arts and culture. Indeed, the fact that the average Canadian works many fewer hours today than they did 100 years ago, while enjoying a much higher standard of living, reflects the remarkable economic growth rates achieved over the past century. Similarly, there is nothing keeping Canadians from allocating the gains from growth to efforts to reduce economic inequality since who benefits most from growth can be influenced through, for example, tax and transfer policy choices.

To illustrate how small absolute differences in growth rates can have big effects on economic well-being in the long run, consider two growth scenarios. In the first, we assume a constant growth rate of 0.78% per year, which is the OECD's forecast for Canada's average growth rate in real per capita GDP between 2023 and 2060. This lacklustre growth rate drew much attention when the 2022 Canadian Federal Budget revealed it was the lowest among all 38 OECD member countries.[18] In the second scenario, we instead consider a constant growth rate of 1.17%, which is 50% higher than the OECD's forecast for Canada. This would put Canada in the 20th position in the OECD's ranking of 38 countries, slightly above Australia (1.14%) and below Hungary (1.18%).

[17] Based on expenditure-based GDP at 2012 constant dollars from table 36-10-0369-01, July 1 population from table 17-10-0005-01, and all-items annual average CPI from table 18-10-0005-01.

[18] See OECD, "The Long Game: Fiscal Outlooks to 2060 Underline Need for Structural Reform," 2021 (Table 1). Growth rates for a selected set of OECD countries was included in Chart 28 of the 2022 Federal Budget, "A Plan to Grow Our Economy and Make Life More Affordable." See Chart 28.)

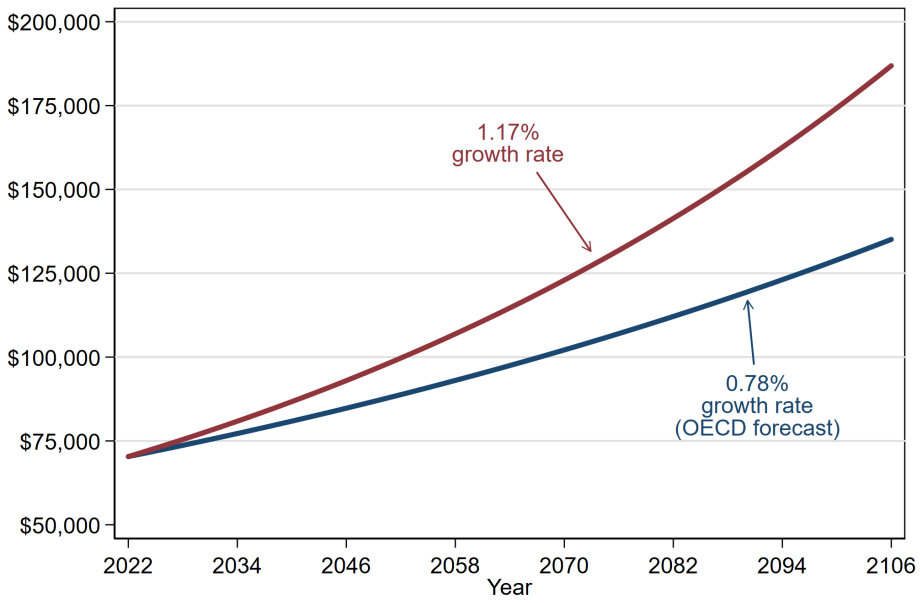

Figure 1: Projected per capita income (2022 constant CAD dollars)

Figure 1 illustrates the evolution of average incomes in the Canadian population over the lifetimes of the cohort of Canadians born in 2022 under these two scenarios. The blue line corresponds to the time path of per capita income when the growth rate is 0.78% – the OECD forecast – while the red line plots the time path of per capita income when the growth rate is 1.17%. If the OECD forecast is accurate, average income in the Canadian population will have grown by 10% when our cohort turns 12, by 25% when our cohort turns 29, by 50% at age 52, and by 92% by age 83. Through a single cohort's lifetime, average income in the population will have grown to $135,097 measured in today's dollars.

However, were Canada able to boost its growth rate to 1.17%, average income will have grown by 25% when our cohort turns 19, 10 years earlier than under the slow growth scenario. At a growth rate of 1.17%, income at age 52 will have grown by 83%. This increase would take until the age of 78 under the slow growth rate. Most impressive, at the higher growth rate, average incomes will have grown by 113% by age 65 and 165% by age 83. Our hypothetical cohort would experience these increases at ages 98 and 126, respectively, under the OECD forecast for Canada's growth rate. At the higher growth rate, the size of Canada's economy would be $186,874 per person in 2106, 38% higher than under the slow growth rate.

These simulations make clear that small absolute changes in growth rates matter a lot in the long run. To the extent that immigration has the potential to boost growth rates in GDP per capita,

say from 0.83% to 1.17%, policymakers would clearly be foolish not to leverage that potential.

3.2 Growth vs. level effects

A second reason for our focus on the effects of immigration on growth in per capita income is that it substantially narrows the number of explanatory factors worthy of consideration. To see this, it is useful to distinguish between factors that can cause a one time increase in per capita income, which we will call a *level effect* and factors that cause ongoing increases, which we will call *growth effects*. The number of factors that can cause a one time increase in per capita income is enormous. The number of factors that can cause per capita incomes to grow steadily over time is much smaller.

To illustrate the difference between level and growth effects of immigration, it is convenient to take the natural logarithm of income or, equivalently, to plot the levels against a log scale. The advantage of a log scale is that percentage changes in income levels will appear in the log scale graph as moving by the same vertical distance regardless of the income level we start from. For example, a 5% increase has the same vertical distance of 0.0487 whether the income level is $100 or $100,000 initially. This feature of log scales also implies that a series that grows at a constant rate is linear when plotted on a log scale. This makes it easy to see changes in growth rates.

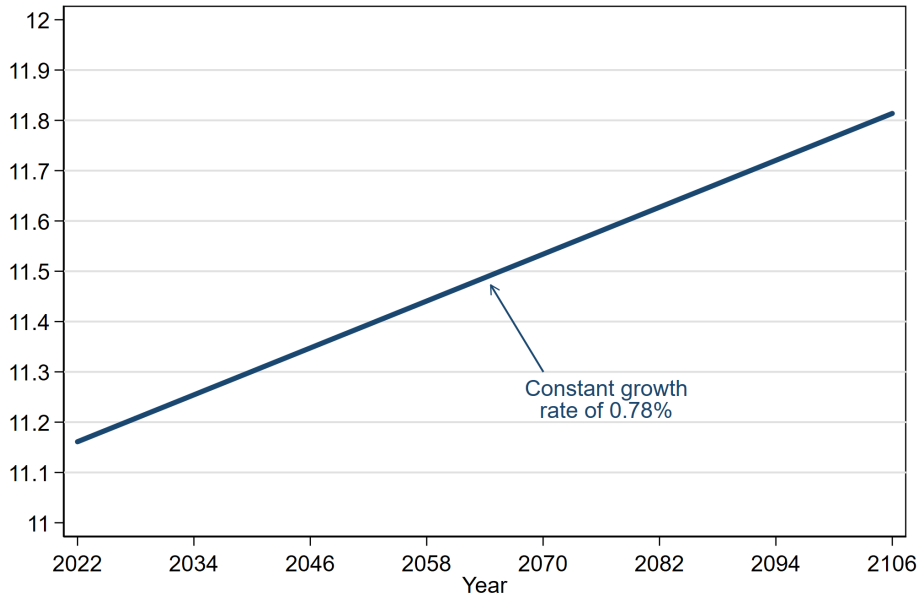

Figure 2: Per capita income on a log scale

Figure 2 plots the evolution of Canada's per capita income on a log scale using the OECD's forecast of 0.78%. The data plotted here is identical to the blue line in Figure 1 except here we use

log scale. Log income increases by exactly 0.0077 per year. The linearity reflects the assumption of a constant growth rate in per capita income of 0.78% per year.

We can use a log scale to plot the difference between level effects and growth rate effects. To do so, let us return to the hypothetical cohort of Canadians born in 2022 from the previous section. Rather than compare different but constant growth rates, consider the following scenarios.

In the first scenario, the growth rate is constant at the OECD forecast of 0.78% per year for the first 20 years of our cohort's life. In year 21, the economy experiences a boom, perhaps as the result of a one-time increase in the inflow of exceptionally talented and productive immigrants, and per capita income jumps by 10% in that year. However, in all following years the growth rate returns to its baseline of 0.78%. This is a level effect. In the second scenario, the growth rate is also assumed to be constant at 0.78% for the first 20 years of our cohort's life, but in year 21, the growth rate permanently increases to 1.13%, and remains at that higher rate in all following years. This change could, for example, reflect a permanent increase in the rate of business investment in research and development (R&D) activities. This is a growth effect.

The blue line in Figure 3 depicts the level effect. In this case, per capita income jumps up in year 21 of our cohort's life, but subsequently continues to grow at its original rate. The constant growth rate before and after year 21 is evident in the common slope of the blue line before and after 2042. Recall that in a log scale plot, a linear growth path implies a constant growth rate.

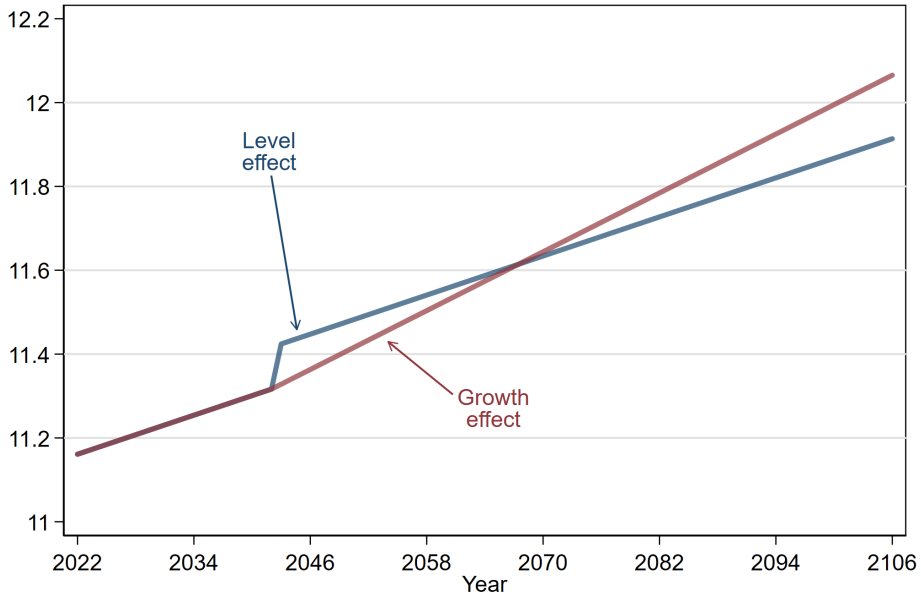

Figure 3: Level vs growth effect

The red line in Figure 3, on the other hand, depicts the growth effect. While there is no "jump" in the level, in this case, the growth rate of per capita income increases in year 21 and remains at its new higher level in subsequent years. The permanent change in the growth rate in year 21 is evident in the log scale graph as a steeper slope of the red line after 2042.

A 10% year-over-year increase in real GDP per capita has no precedent in post-war Canadian history. The biggest annual increase in Canada's per capita since 1960 was 5.7%, which occurred in 1973. Yet, despite this unrealistically big level effect, its effect on the level of GDP per capita by 2106 is much smaller than the more realistic growth effect. By the end of our 2022 cohort's lifetime, per capita income is 15 log points, that is roughly 15%, higher in the growth effect scenario. This, once again, reveals how small absolute differences in growth rates – 0.78% versus 1.17% – can have big effects on average economic living standards in a population in the long run. When the growth rate is maintained at 1.17% per year, growth in later years takes place on top of the growth that occurred in earlier years producing bigger annual gains.

4 A tour of growth theory

What is the potential for immigration to boost Canada's level of GDP per capita or its growth rate? Is it reasonable, for example, to expect that the federal government's decision to increase its annual immigration rate from 0.8% to 1.2% to boost per capita incomes, and if so, is the increase more likely to be a level effect or growth effect?

In this section, we provide a simplified theoretical framework to think about the economic consequences of immigration on the evolution of per capita income in the immigrants' destination country. Our framework is informed by the extensive literature on the theory of economic growth. Our exposition will be largely non-technical, though we provide references to the original literature for interested readers.

Growth theory has typically been studied via the formulation of mathematically intensive general equilibrium models. We do not present any such model here in the interests of making the ideas accessible to a broader audience. Our approach has the expositional advantage of being straightforward to work with. A consequence of this approach is that our framework, unlike a fully specified model, does not make predictions about the joint evolution of income and its various determinants, such as the physical capital stock, human capital, and productivity. While in some contexts this would be a disadvantage, for our purposes this shortcoming is acceptable because these interactions are not fully understood. Our approach remains agnostic concerning these responses, rather than coupled to the dynamics of a particular model.

The economics of immigration literature has made significant advances in the past two decades,

moving beyond the "immigration surplus" in a partial equilibrium setting to contemplating various "productive externalities" of immigration, such as beneficial effects on innovation and the production of new ideas and technologies that results from greater population density ("agglomeration effects") and ethnic diversity (Lewis 2013; Nathan 2014; Peri 2016). In what follows we seek to answer the following questions: what has the evolution of key variables looked like in Canada in recent years, and how does the evolution of these factors interact with immigration policy?

Since we are interested in the effect of immigration on growth, the first question to ask is: what factors of production can drive *ongoing* increases in *per capita* income? It turns out that, at a broad level, there is a small number of viable candidates. In order for a factor to influence medium to long-run growth rates in per capita income, the factor needs to: (i) affect output per worker; and (ii) be something that is itself reproducible. The first condition is necessary to raise per capita incomes, while the second is what makes it possible for a higher growth rate to persist in the long run. The list of possibilities typically includes labour; physical capital, including investments in information and communications technology; human capital; and innovations that increase the productivity of these inputs.[19]

Labour refers to the available workforce in a country, abstracting from issues related to human capital. Despite centuries of technological advancement, labour compensation accounts for roughly two-thirds of GDP in Canada today, roughly equal to its share 40 years ago. A country's available workforce can grow over time, either through natural increase (the difference between births and deaths), net immigration (the difference between new immigrants and emigrants), or increases in employment rates through, for example, greater labour force participation rates of women or seniors. Since the labour force can grow continuously over time, the accumulation of labour can, in principle, drive ongoing increases in total GDP but to the extent that the bigger labour force reflects a growing population, it may have little or no effect on GDP per capita, or may even decrease it.

Physical capital refers to private and public assets that allow workers to produce and earn income. It includes everything from commercial buildings, to the infrastructure that moves goods and powers buildings, to the machinery, tools, and equipment workers use on the job, to the intellectual property that drives innovation and productivity. Since capital goods are themselves produced by the economy, investment that results in capital accumulation is an ongoing process

[19] We have not included any discussion of natural resources. This is often omitted in standard growth theory, since natural resources do not provide a sensible explanation for why economies that had been stagnant for millennia began to grow continuously at the beginning of the industrial revolution. Resource extraction is, however, an important part of the Canadian economy and construction related to resource extraction is the only part of the non-residential capital stock that has been growing in recent decades. An important question is whether resource extraction is to what extent resource extraction of renewable resources, like forest productions, but excluding oil and gas, can be a source on ongoing growth.

which, in principle, can drive ongoing increases in GDP per capita.

Human capital refers to the skills and abilities of the labour force that enable workers to complete tasks. Analogous to investments in the physical capital stock, investments in human capital through education, training, or "learning by doing" on the job, allow the average worker in the workforce to complete more tasks per hour. If sustained year over year, the resulting continuous accumulation of the human capital stock per worker has, in theory, the potential to boost growth rates in perpetuity.

Finally, productivity refers to the level of output that is obtained from employing a particular combination of the factor inputs: capital, labour, and skills. This broader notion of productivity refers to the productive capacity of the full combination of all inputs, and is therefore referred to as *total factor productivity* (TFP). An economy with high TFP is able to produce more output than a low TFP economy using the same endowments of the factor inputs. It is, however, important to distinguish gains in per capita GDP that result from moving closer to a country's efficient frontier ("production possibilities frontier") versus outward shifts of the efficient frontier itself. The former types of productivity gains are a consequence of improvements in economic efficiency, which could result, for example, from a reduction in the underutilization of labour resulting from unemployment. These types of gains are more likely to reflect movements of the business cycle ("cyclical variation"). Longer term increases in economic growth rates, on the other hand, are more likely to reflect shifts of the frontier resulting from, for example, technological advances or non-technological improvements in the ways of organizing the economy's factors of production, such as process innovations like the assembly line.

Movements in labour, physical and human capital, and productivity feature centrally in all models of economic growth. These factors are sometimes referred to as the 'proximate causes of growth'. The deeper goal of growth theory is to understand what drives these 'proximate' causes. But regardless of the underlying deeper causes, increases in GDP per capita must reflect the relative movements of these factors. This is well understood by economists studying economic growth and is well established in textbook treatments of economic growth (see, for example, Weil (2012) at the intermediate undergraduate level, and Barro and Sala-i-Martin (2003) and Acemoglu (2009) at the graduate level). Economic growth and its proximate causes have not, however, featured prominently in the research literature and policy debate around immigration in Canada.[20]

[20] We would be remiss in the Canadian context to not also mention the the role of openness of trade policy in affecting growth. This could occur through, for example, the classical mechanism of comparative advantage. However, once these comparative advantages have been realized, no further increase is likely to happen, unless the larger market changes the evolution of factor accumulation or productivity growth, which brings us back to our smaller list of factors.

4.1 Production functions

The key object in our presentation is the aggregate production function. An aggregate production function is an abstract representation of how firms and governments in the economy collectively combine inputs to produce output. For simplicity, we treat all physical capital goods and workers as identical, thereby abstracting from the variety of jobs and tasks performed by workers. We also ignore the variety of different goods and services produced in an economy and treat output as singular. We view these abstractions as reasonable given our focus on growth as they correspond to the assumption that the economy deploys its heterogeneous factors of production efficiently, at least in the medium and long run. In other words, we are concerned with expansions of the efficient frontier, not movements to the frontier.

In our framework, the aggregate production function takes the form:

$$Y = AF(K, L)$$

where Y is output, K is physical capital, L is labour, and A is total factor productivity (TFP). The production function $F(\cdot)$ describes the relationship between inputs and output. To begin, we make the following standard neoclassical assumptions regarding the form of the production function: (i) it is always possible to make small upward or downward adjustments in K and L in order to increase output; (ii) all marginal products are positive and diminishing; and (iii) the production function exhibits constant returns to scale (CRS).

The marginal product of a factor of production, be it K or L, is the additional amount of output produced when we increase the quantity of that input by one unit, holding all other inputs constant. While it is fundamental to the idea of a factor of production that its marginal product is sometimes positive, the assumption that the marginal products are always positive might not be reasonable for an individual firm. Adding additional workers with no increase in space or machinery might, for example, create enough additional congestion on a shop floor to reduce total output. However, for the economy as a whole it is more reasonable to suppose that if we add labour inputs that some firm somewhere will be able to use that labour to produce additional output.

It is also standard to assume that the marginal product of each factor is diminishing. That is, the additional output generated by further increases in any one factor holding all other factors constant gets gradually smaller as more is added. This implies, for example, that we could expect a large boost in output if we were to increase the labour input in a country where workers are scarce but machinery and equipment are plentiful. However, increasing the labour input where labour is already abundant, but capital is scarce, will produce a relatively small gain in output. The assumption of diminishing marginal products is typically justified by appealing to the *principle*

of low hanging fruit. The idea is that producers will first deploy factors of production to those uses where they are most productive. After the most productive uses of a factor have been exhausted additional units of an input will be used for less productive purposes. As ECON 101 students are told: "If the marginal product of labour did not diminish, we could grow all of the world's food supply in a flower pot."

The CRS assumption, on the other hand, captures the idea that if all inputs are scaled up proportionally, output increases by the same proportion. For example, if the labour and capital inputs are simultaneously doubled, the quantity of output produced will similarly double, and if factor inputs are tripled, output will exactly triple.[21] While diminishing returns and CRS both refer to what happens to output when inputs increase, there is an important difference. The former concerns what happens when a single factor of production is changed holding all other factors constant, while the latter concerns what happens when all factors are changed simultaneously and proportionally. It is entirely possible for an aggregate production function to exhibit both CRS and diminishing marginal products; these assumptions are by no means inconsistent.

Macroeconomists commonly assume CRS production functions for three reasons. First, in dynamic models of economic growth, CRS is required in order to match some of the long run features of the data, such as the fact that the share of output paid to labour is roughly constant over time in most countries. Second, empirical estimation of production functions for broad industries and the total private U.S. economy suggests aggregate production is roughly CRS (Basu and Fernald 1997). Third, and perhaps most compelling, over long time horizons all factors of production are variable, so it should always be possible, in theory, to replicate existing production activities to achieve CRS (Romer 1994).

We begin Section 4.2 by examining the interaction between immigration and economic growth according to theories in which the aggregate production function exhibits CRS. CRS is, however, not the only possibility. Increasing returns to scale (IRS) exists if a proportional increase in all the inputs produces a bigger proportional increase in output. For example, doubling the labour and capital inputs serves to triple the quantity of output produced. [22] Several strands of the literature on the theory of economic growth examine the implications of IRS for the potential for countries to increase economic growth rates over time. We will examine the interaction between immigration

[21] Mathematically, CRS production functions exhibit the following property: $F(\gamma K, \gamma L) = \gamma F(K, L)$, where γ is an arbitrary scaling factor.

[22] Analogously decreasing returns to scale (DRS) exists if a proportional change in the inputs produces a smaller proportional change in output. Production functions exhibiting DRS are rarely used in growth theory. The main reason is that DRS makes it difficult to generate ongoing growth, because when the economy scales up its productive inputs, the additional output produced declines. The reality is that ongoing growth is the experience of nearly all countries in the world over the past century. DRS also implies it is impossible to replicate existing economic activity, which is difficult to rationalize theoretically.

and economic growth according to these theories in Section 4.3.

As a final consideration, note that our production function allows different mixes of inputs allowing one factor to be substituted for another while maintaining a constant level of production. This is a critical feature of modern growth theory but has not always been. Early growth models, such as the well known Harrod-Domar model (Harrod 1939; Domar 1946), employed a production function in which expansions in production have to increase inputs in a fixed ratio, such as two unskilled units of labour for every skilled unit of labour. This is consistent with popular notions that some types of labour are "essential" to production. These models led to a view of growth dominated by 'investment gaps' – the idea that scarcity of one or more factors is what constrains growth. More problematic is that this view of production implies economies will exhibit perpetual growth of unemployment or idle machinery, neither of which are consistent with real-world data of any country (Barro and Sala-i-Martin 2003). The real-world importance of labour-saving technological changes in many sectors of the economy is also inconsistent with the fixed proportions view of production.[23]

4.2 Factor accumulation

Economic growth ultimately reflects the accumulation of factor inputs but how that accumulation affects growth in per capita income depends critically on what we assume about the production technology. As described above, the assumption of neoclassical growth theory, which has its origins in the work of Ramsey (1928), Solow (1956), and Swan (1956), is that the production function is CRS and that the marginal product of each factor is diminishing. Moreover, the standard neoclasssical model treats productivity (TFP), as well as any productivity growth, as exogenous in order to determine to what extent long-run growth is driven by factor accumulation. In other words, these models do not attempt to explain productivity growth, but take it as given. Following this approach, we will first discuss the case where the only factor that can be accumulated is physical capital. We will incorporate the literature on human capital accumulation in Section 4.2.3.

4.2.1 Physical capital accumulation

The central growth mechanism of neoclassical growth theory is that savings finance physical capital accumulation, which in turn determines the size of the capital stock and the output level. In this setup, the size of a country's population and workforce has no deterministic relation to its per capita income. If a 10% increase in the population is combined with a 10% increase in the capital stock,

[23]It is worth noting that Domar later disavowed the Harrod-Domar growth model in favour of the Solow model with a neoclassical production function. He apparently intended his work to be part of a theory of business cycles and he did not view it as an appropriate framework with which to study long run growth.

the CRS assumption ensures that output also increases by exactly 10% and output per worker stays exactly the same. This property of the neoclassical setup is appealing because we know empirically there is no tendency for bigger countries to be systematically richer or poorer than smaller countries. Indeed, World Bank data from 187 countries in 2019 reveals that the correlation between national population and GDP per capita is -0.052 (expressed in log-levels, the correlation is -0.214). Many big countries are poor, and many small countries are rich.

What matters for a country's GDP per capita in this framework is not the size of its population or its labour force, but the amount of physical capital available for each worker to utilize in production. An economy with low per capita output is one that has a low level of physical capital per worker while an economy with a high level of output per capita is one that has a high level of physical capital per worker. To see why this is the case, consider what happens to an economy when its population, and in turn labour input, increase while its capital stock is fixed. The diminishing marginal product of labour ensures that each additional worker contributes less to increasing the output level than the previous worker did, which means that the average output per worker must decrease.

An obvious limitation of this analysis is the assumption that the capital stock is fixed and does not increase in response to the increase in the labour force. This is too restrictive. Standard neoclassical growth theory suggests that capital will increase proportionally with the increase in labour because capital becomes scarce relative to labour which raises its marginal product. As each worker has less capital to work with, small investments in new physical capital for workers to utilize have the potential to produce big output gains which can be used by investors to increase their consumption, to replace depreciating capital, or to invest in new capital. In short, when the economy's capital-to-labour ratio is low, there is a strong incentive to accumulate more capital.

To understand how per capita output responds to a population increase through immigration, it is critical to recognize the tendency for economies in the neoclassical growth framework to converge to a "steady state" in the long run. The term steady state is used to describe a situation where the per capita quantities of capital and output, or the rates that they increase at over time, are constant. We refer to the former as a steady state in levels and the latter as a steady state in growth rates. The tendency for economies to converge to steady states is a consequence of the diminishing marginal product of capital. When the ratio of capital to labour is low, capital is scarce and the marginal product of capital is high. In this situation, the economy is not only able to accumulate capital rapidly, but the incentive to do so is high. Increased capital accumulation brings the capital-labour ratio back to a balanced long-run value. On the other hand, when capital is abundant relative to labour, its marginal product is low and additional investments in capital produce only enough

additional output to cover the cost of replacing the depreciation of the existing capital stock. In this situation, there is no tendency for further capital accumulation, and consequently capital becomes less abundant over time, bringing capital back into balance with the level of labour.

In the case where TFP is assumed to be constant, an economy that grows through capital accumulation will necessarily converge to a steady state in the level of output per worker. However, in the more reasonable case where productivity grows over time, capital accumulation may be ongoing because the growth in productivity offsets the decrease in the marginal product of capital that normally disincentivizes capital investments. In the case in which productivity grows at a constant rate over time, all per capita variables – capital and output – will grow at the same constant rate in the long run.

Given this model of economic growth, we can evaluate the impact of an increase in the population through immigration, incorporating the dynamic response of the capital stock. The short run response of a population increase is a reduction in the capital-labour ratio – the amount of capital each worker has to work with – and, in turn, a reduction in the marginal product of labour. However, the abundance of labour increases the marginal product of capital and incentivizes new capital investments. In the long run, the capital stock increases proportionally with the population, and given that aggregate production function is characterized by CRS, output increases by the same proportion. Consequently, nothing happens to per capita output in the long run so that immigration has neither a beneficial or adverse effect on average living standards.

Note, however, that a one-time increase in the population size is not the same as a permanent increase in the population growth rate that results, for example, from an increase in the Canada's annual immigration from 0.8% of the population to 1.2%, as the federal government is currently planning. With a higher population growth rate, we have to take into account an additional mechanism known as *capital dilution*. A higher population growth rate means that a larger proportion of the economy's output most be allocated to saving, that is new capital investments, in order to maintain the existing capital-to-worker ratio. The permanently higher savings rate reduces the amount of output available for consumption in each period, resulting in a reduction in the steady-state level of per capita income.

In summary, neoclassical growth theory does not provide a channel through which population increases cause increased growth. However, population increases also do not adversely impact economic growth, although it may lower the *level* of per capita income in the long run. The key lesson, which is a general feature of economic growth models, is that the evolution of complementary factors of production, such as the capital stock, serve to mediate any effects of population growth. Formal models of economic growth tell us something about how quickly the capital stock adjusts

in response to a population increase. The "adjustment path" of capital to an increase in the immigration rate is a question of substantial practical importance in the Canadian context. In section 6.1, we examine the empirical evidence on the evolution of Canada's per capita capital stock.

4.2.2 Work intensity

In the previous subsection, we saw that policies aimed at increasing the population are unlikely to impact economic growth in models of factor accumulation. The critical consideration is the response of other factors of production, in particular the physical capital stock, to the increase in the size of the labour force. This result does not mean, however, that changes in the composition of the labour force resulting from immigration cannot beneficially impact per capita incomes.

To this point we have assumed that all members of the population, including new immigrants, contribute equally to the labour input. But, of course, in the real world workers are heterogeneous, not only terms of their skills, talents and ambitions, but also in terms of the intensity of their contribution to the labour input. In this subsection, we explore the potential for differences in immigrants' relative work intensity to boost per capita incomes in the overall population. In the following subsection, we consider the effect of their human capital contribution.

Extending our previous analysis to allow for variation in the intensity of work across members of the population is straightforward. The following simple decomposition of per capita output helps focus the analysis. Let Y equal aggregate output, N be the population, and L be aggregate hours worked in the population in a year. We can then write:

$$\frac{Y}{N} = \frac{Y}{L} \cdot \frac{L}{N}$$

which, in words, means that per capita output equals output per hour of labour (Y/L), which we can think of as a measure of labour productivity (distinct from the TFP term A in equation (1)), multiplied by the average annual work hours in the population (L/N), which we can think of as average work intensity.

Growth theory focuses on the determinants of labour productivity (Y/L) because it seeks to explain why so many countries, including Canada, have been able to experience ongoing growth in per capita income for more than 100 years. The work intensity of a population (L/N), however, tends to decrease with its per capita income. The reason is that one of the first things people do when their incomes rise is to buy back some of their time spent working. This effect of income, known as an "income effect," is evident in the persistent decline in the length of the average workweek in Canada over the past 100 years. It is also evident in the tendency for people in rich countries, like Canada, to spend a larger share of their lifetimes in full-time education and

retirement. Consequently, a smaller proportion of the age distribution is working at any point in time in higher income countries. For both reasons, average work hours tend be inversely related to labour productivity so that work intensity cannot account for ongoing economic growth. Growth theorists have therefore looked to labour productivity differences to explain the facts.

However, it is possible that immigration has the potential to raise average work intensity in the population. Immigrants might, for example, spend a larger share of their lives working, at least while living in Canada. Since all immigrants spend less than their entire childhoods in Canada, there is at least one reason to believe this is true. Immigrants may also work higher average annual hours during their Canadian working years, either because their average weekly hours are higher or because they work more weeks per year. They may also be entitled to fewer vacation days or choose to take fewer vacation days. Or they may retire at older ages, on average. If the work intensity contribution of immigrants is higher, an increase in the share of the population that are immigrants could offset any decrease in Y/L resulting from diminishing marginal product of labour and, in turn, raise the level of per capita income in the steady state. It would not, however, have any effect on the rate of economic growth in steady state, unless the work intensity of subsequent arrival cohorts of immigrants were continually increasing. But this is infeasible because there is an upper limit to what share of one's lifetime can be spent working.

A popular view is that immigration can address the deleterious effects on the economy of an aging population by mitigating increases in dependency ratios (the share of the population not working). Is this view correct if immigrants are younger than the existing population on arrival, but their retirement behaviour and average life expectancy are identical? There may, indeed, be a short-run demographic dividend to boosting labour force participation rates through immigration, but immigrants age too and eventually retire. Leveraging this demographic dividend to produce ongoing growth would require a Ponzi-type strategy of continually increasing the immigration rate to undo the increasing size of the retirement-age population. But, of course, this population growth strategy would continually exacerbate the capital dilution effects discussed in the previous subsection. This implies that boosting economic growth through the work intensity channel requires more than a short-run demographic effect of immigration; it requires that immigrants' average work hours while in Canada exceed non-immigrants' work hours and that this difference continuously increase with every subsequent cohort of new immigrants. Clearly, there is no reason to believe such a strategy is feasible.

4.2.3 Human capital accumulation

By treating all workers as identical, Section 4.2 abstracted from a different dimension of factor accumulation. Two features of physical capital are that: (i) it is a productive input, in the sense that it raises the output of the economy's labour input; and (ii) it can itself be produced. The skills and talents of a country's labour force share these features. Like physical capital, workers' labour market skills increase the quantity (and perhaps also quality) of the output they produce. And just as business owners can reinvest a portion of their profits to increase their physical capital stock, workers can allocate a portion of their earnings to training and educational investments to raise their productivity. Since investments in people are similar to investments in machines, the collection of attributes that raise a worker's productive capacity is referred to as *human capital*.

Since the composition of the labour force is directly affected by immigration policy (unlike physical capital), it is worth examining whether there is any scope for immigration to affect growth via its influence on the human capital stock. To do this, we will maintain the assumptions of diminishing marginal products, CRS, exogenous productivity, and that all workers work with the same intensity. Exogenous productivity means that human capital affects output through enhancing labour productivity directly (Y/L in the previous section) rather than through effects on ideas, discoveries, and innovation that increase TFP. We will discuss links between human capital and TFP in Section 4.3.

For the sake of clarity, it is helpful to write the aggregate production function as:

$$Y = AF(K, hL).$$

Here, h is the average level of human capital in the labour force. The main effect of an increase in h is to increase the effectiveness of the labour input in producing output. Like K, the average level of h in the economy can increase over time via investments. In the context of immigration, this includes investments in immigrant settlement programs, such as publicly-financed language training that improve newcomers' workplace communication skills. It also includes immigrants' own educational investments after arrival in Canada, such as recredentilization and retraining to address imperfect transferability of skills across countries. However, immigration policy can further impact the average level of h in the economy by screening and selecting immigrants who bring high levels of human capital. This is the logic of the "points system" that has underpinned Canada's economic-class immigration program for the past 50 years.[24]

Some key results from Section 4.2 still hold when we introduce human capital into our model

[24] We are thinking in particular of the Comprehensive Ranking System that is used to rank and select economic-class immigrants in the Express Entry applicant pool as well as the point system that determines selection of Principal Applicants under the Skilled Worker Program.

of economic growth. In particular, an increase in the population and labour force (L) that leaves other factors unchanged, including average human capital in the population (h), will result in decreased per capita output (Y/L) due to the diminishing marginal product of labour. However, as in the previous section, standard theory suggests that as the population increases, the economy will accumulate more of the complementary factors – physical capital, in particular – so that in the long run there is no decline in per capita income.

However, the incorporation of human capital into the model introduces a new channel through which immigration policy can affect per capita incomes. In particular, by selecting immigrants who have a high level of human capital relative to the domestic population, immigration can increase the average level of human capital in the economy at the same time as it increases the population size. This upskilling of the labour force serves to offset the tendency for the marginal product of labour to diminish. This means that an inflow of immigrants with a higher average level of human capital than the domestic population can, in principle, generate increases in per capita income even in the absence of physical capital accumulation.

There are, however, limits to the potential for human-capital oriented immigration to generate ongoing growth in per capita income. First, this channel requires that, on average, immigrants have a higher level of human capital than the domestic population. However, as people with higher human capital levels are continuously added to the population, the average human capital of the population continuously increases. Hence, increasing the average human capital of the population requires an immigration policy that becomes increasingly selective over time. This may be infeasible or may conflict with other goals of immigration policy, such as international obligations to meet humanitarian objectives. Second, since adding human capital does not, in itself, scale up the production side of the economy, in the long run the diminishing marginal product of human capital will inevitably cause any growth to ebb.

4.3 Productivity growth

As seen in the previous section, the idea that aggregate production functions exhibit CRS in physical inputs, in particular capital and labour, implies that factor accumulation alone cannot drive long-run growth in per capita incomes.[25] If, for example, doubling all physical inputs, including the labour input, leads to a doubling of output, then per capita output remains constant. If we, instead, double the non-labour inputs, then the marginal increase in output will tend to decrease as the

[25]The idea that aggregate production functions might directly exhibit increasing returns to scale (IRS) in physical inputs is not thought to be an important driver of long-run growth. However, there is a literature in which new discoveries or innovations are a byproduct of factor accumulation. In this case, production can exhibit IRS due to the additional output produced by the innovation that results from factor accumulation. Since the fundamental driver of growth in those settings is productivity improvements, we will discuss that literature in section 4.3.1.

stocks of those other factors gets large, as outlined in the previous section.

In fact, neoclassical growth theory, as summarized in Sections 4.1 and 4.2, suggests that factor accumulation alone cannot generate long-run growth. This is because diminishing returns to factor accumulation tend to cause growth rates to dwindle over time. Instead, long-run growth in those frameworks must stem from improvements in productivity. These gains feed back into capital accumulation, because productivity improvements offset the tendency for the marginal product of capital to diminish making it beneficial to accumulate more capital. Long-run factor accumulation occurs in those frameworks, and does impact per capita output, but is more of a consequence of productivity improvements than an independent driver of long-run growth. Consequently, an important result from growth theory is that, over the long run, growth is primarily driven by ongoing productivity increases.

Given this key result, it is worth providing an overview of the idea of productivity. Most abstractly, productivity is about the capacity of an economy to produce output given its factor inputs. If a country produces more output by increasing the work hours of its labour force, we can explain the increase in output without reference to improvements in production processes. It may well be that, in terms of producing output, the country just kept doing the same things as before but did more of them. But if an economy produces more output without changing the work hours of its labour input, then something must have changed on the production side of the economy. Those things constitute productivity improvements.

It is important to distinguish two common notions of productivity. Labour productivity is about how much output is produced per unit of labour input. A simple measure of labour productivity is just output per worker, though we might also think in terms of output per labour hour. This is an important measure because, in the absence of changes in the dependency ratio or work intensity, output per worker tracks output per person in the population. TFP, on the other hand, controls for all factors of production, not just labour. TFP, or what we refer to simply as 'productivity', is about how much output the economy produces, conditional on its labour input, as well as its capital, resources, and other inputs.

An important difference between these two notions of productivity is that labour productivity is affected by the accumulation of other factor inputs. An economy that experiences a surge in its accumulation of new capital, for example, is expected to see an improvement in output per worker, even if there is no increase in the efficiency of its production methods or any technological progress. Providing workers with more equipment to work with allows them to produce more output. TFP, by contrast, does not increase when other inputs (e.g. physical and human capital stocks) increase if the additional output produced is fully accounted for by the increase in these other factors. TFP

only increases if the increase in output exceeds what the increase in inputs is expected to provide. How much output an economy 'should' be able to produce is, however, not directly observed in the data, so measuring a country's TFP presents a number of practical challenges.

To this point we have not discussed the mechanisms through which productivity (TFP) improvements might occur. This is an important omission. If economic growth in the long run is primarily driven by productivity gains, then it is important to consider whether there are mechanisms through which immigration might influence productivity growth. We, therefore, now review what we know from the economic growth literature on the underlying mechanism through which countries make productivity gains.

In thinking about the possibilities it is helpful to distinguish two conceptually distinct types of productivity improvements. We will refer to the first type as *ideas, discoveries, and innovation.* These type of improvements correspond to the case where new ideas, which might be scientific or technological, but could also concern the organization of productive inputs, such as process innovations like the assembly line, enable the economy to produce more. It could be that productivity gains allow a country to produce goods and services (final, capital, or intermediate) that it was not able to produce before, or that it enables it to combine inputs in ways that it could not do before. We can think of these types of productivity improvements as causing expansions of the economy's efficient frontier.

However, productivity improvements may instead reflect *efficiency gains.* The idea here is that an economy with a given set of factor inputs (physical and human capital, labour, resources, etc.) and ideas (science, technology, organizational knowledge, etc.) may not be fully utilizing the productive capacity of its inputs and ideas. In the visual display of this concept presented to ECON 101 students, the economy might be producing *inside* inside its efficient frontier. In this case, it is possible for an economy to increase output without adding additional inputs or discovering new ideas. Such increases in output, which can be thought of as movements towards the efficient frontier from the interior, will also appear in the data as productivity improvements.

In the following subsections, we examine each type of productivity improvement in turn.

4.3.1 Ideas, discoveries, and innovation

A common interpretation of the growth theory results is that in the long run, economic growth in per capita incomes is largely driven by the fact that new ideas, discoveries, and innovations increase our ability to produce and distribute goods and services within an economy. Productivity growth is believe to be central to ongoing economic growth because: (i) there is widespread evidence of ongoing technological progress over the past 200 years; (ii) the diminishing marginal product

problem associated with factor accumulation makes it difficult to explain long-run growth through factor accumulation alone; and (iii) that innovation does not suffer the same diminishing returns as factor accumulation seems plausible.[26] The ideas, knowledge, and innovation channel is particularly important for economically developed countries, as these countries typically already have high stocks of physical and human capital.

While the determinants of productivity growth are many and complex, from an immigration perspective, the central questions are: (i) whether immigration can affect productivity growth; and (ii) if so, what kinds of immigration policies are likely to be most efficacious.

To answer the second question, we first need to understand how new discoveries and innovations occur. The growth literature has largely focused on two broad, and not mutually exclusive, channels. The first channel is innovation that arises from purposeful R&D investments, resulting in either new types of products being created, improvements in the quality of existing products, or new methods of production.[27] This type of R&D could be commercial research conducted by private businesses in the pursuit of profits, or public research done either directly by governments or by non-profit institutions, such as universities. R&D could occur both as 'basic research' and as commercially applicable research. In practice, it is likely that these types of R&D are complementary.

This channel suggests that one way for immigration to affect growth in per capita incomes is via the contributions of immigratns to innovation. The critical ojbective here would be attracting immigrants who are likely to contribute to R&D activity. An immigration policy focused on attracting scientists, inventors, and entrepreneurs would seem most likely to increase innovation, discoveries, and, consequently, productivity growth.

A second channel that has received significant attention is innovation that arises as a byproduct of other economic activity.[28] This mechanism is sometimes referred to as "learning by doing." The central idea is that new discoveries arise in the process of producing goods and service, during the construction of new capital goods, or as households and individuals acquire human capital through training and/or education. For example, during the production of new capital goods, the producer of a piece of machinery learns how to build better equipment. Under this view, innovation is a side effect of some other economic activity rather than its own distinct and directed activity.

The implications for immigration policy of this second innovation channel are slightly different. In particular, since innovation is a byproduct of other activity, there is less need to focus on scientists and researchers in the immigrant pool. The key issue would be to induce more of whatever activities generate innovation. For example, if Canadian innovation is believed to be primarily a byproduct

[26]This last point is not without critics. For example, see Jones (1995) and Jones (2021)
[27]See, for example, Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992).
[28]See, for example, Romer (1986) and Lucas (1988).

of the production of manufactured goods, then an economy with higher manufacturing production will experience faster productivity growth than an economy with lower production.

One problem with the learning-by-doing channel is that it suggests that large economies, and in particular economies with larger populations, grow faster than smaller ones. If innovation, and therefore productivity growth, are the consequence of economic activity, then economies with more economic activity will have higher productivity growth, and therefore higher economic growth. All else equal, economies with larger populations will engage in more of every type of economic activity, and hence bigger countries will grow faster. This is the well known 'scale effect' that arises quite naturally in productivity-driven growth models. In practice, however, we do not observe scale effects in the data, at least not at the national level.[29]

While the above discussion suggests that there is scope for immigration policy to influence productivity growth via increasing the rate at which new discoveries are made, there is an important caveat to keep in mind. The key issue is that discoveries and ideas share some of the properties of public goods. In particular, ideas are non-rival in consumption. In other words, the fact that one person, business, or country is using an idea does not inherently preclude any other person, business, or country from using it. In this respect, the generation of discoveries is different than purely private goods, such as capital goods, since a given piece of equipment can only be used by one person, business, or country at a time.

In addition, ideas are fundamentally information, and information crosses national boundaries relatively easily. This, along with the non-rivalrousness of ideas, suggests that it is not correct to think of Canadian productivity growth to be closely tied to Canadian rates of innovation. In fact, Canada is highly integrated into both the North American and global economies and has a highly educated work force and a well developed system of universities, and therefore has access to the global pool of new ideas and discoveries. This further implies that domestic productivity growth in Canada is likely to depend more strongly on the global than the domestic rate of innovation. As Jones (2021) argues: "We do not believe that Luxembourg or Singapore grows only because of ideas invented by the researchers in those small countries. Instead, essentially all countries eventually benefit from ideas created throughout the world."

The potential for immigration to influence Canadian productivity growth of the type that results in outward shifts of the efficient frontier is uncertain at best. Not only is Canada well-positioned to absorb and benefit from new ideas that are generated elsewhere in the world, but it is also small relative to the rest of the world. This means that the impact of Canadian innovation on the growth

[29] Jones (2021) discusses the scale effect in the context of forecasts for future global growth. The 'unified growth theory' of Galor (2005, 2011) emphasizes the scale effect as an important driver behind the transition to ongoing growth in the modern era at the global level.

rate of the global pool of ideas and discoveries is likely to be low. The effect of immigration policy is likely to be even smaller because its contribution will be the consequent change in Canadian innovation, which is itself an even smaller component of global innovation.

4.3.2 "Efficiency"

The previous section focused on productivity improvements that shift the efficient frontier outwards. These types of productivity improvements, which are driven by discoveries, new ideas, and innovation, are critical in expanding our capacity to produce goods and services over time. However, the efficient frontier, also known as the production *possibilities* frontier, describes what *can* be produced with given inputs. This is not the same as what *is* produced. New discoveries, ideas, and innovations do not contribute to productivity improvements unless they are employed by economic agents, such as firms and governments. It is entirely possible that the Canadian economy is at any point in time producing a vector of goods and services that lies inside its efficient frontier. The economy may, for example, fail to employ new technologies that are available to it, or the factors of production may be misallocated across productive tasks or underutilized.

Underutilization of human capital is an issue that has received much attention in the Canadian immigration policy discourse, and is often put forward as an explanation of the ubiquitous and persistent wage gaps experienced by Canadian immigrants. However, skill underutilization implies employers are "leaving money on the table," in the sense that equally productive immigrants can be recruited at lower wages than their native counterparts. In competitive labour markets, this implies a profit opportunity, which should intensify recruitment of immigrant labour, putting upward pressure on their wages and closing their wage gaps. The fact that sizable immigrant wage gaps persist in Canada despite decades of policy efforts to address credential recognition issues and employer discrimination in recruitment suggests immigrant skill underutilization may be exaggerated.

Indeed, the empirical evidence that exploits direct measures of immigrant skills provides no evidence that underutilization of immigrant skills in Canada is a quantitively important phenomenon. For example, studies show that the return to workers' measured literacy skills in Canadian labour markets is no different for immigrants than native workers (Ferrer, Green and Riddell (2006); Clarke and Skuterud (2016)). Credential recognition issues also cannot account for the lower academic achievement of international students (Chen and Skuterud 2020) or the labour market challenges of immigrants with Canadian postsecondary educational credentials (Chen and Skuterud 2018). Last, skill underutilization explanations appear inconsistent with the absence of comparable wage gaps among skilled immigrants from the same origin countries (eg. India and China) who are employed

in the United States (Clarke, Ferrer, and Skuterud (2019)).

There is also a popular belieft that greater public investments in immigrant human capital following their arrival in Canada can close their earnings shortfalls. Unfortunately, there is a dearth of evidence of this potential, owing in large part to government reluctance to do credible evaluations of the settlement services they provide newcomers, in particular language training. Many government departments in Canada have embraced the "credibility revolution" in their policy evaluations; IRCC has not. Client surveys asking newcomers whether they believe the language training they received was helpful are not informative about the causal effects of these programs. To identify causal effects, we need to know what the labour market outcomes of newcomers would have been if they had not received the services they did. Identifying these "counterfactual" outcomes requires employing experimental or quasi-experimental research designs. If the goal of economic immigration is to boost GDP per capita, credible evaluation is needed to identify where investments in settlement services are most effective.

Finally, it is worth emphasizing that improved utilization of immigrant skills may have potential to raise per capita incomes over the short to medium run, but it cannot generate increases in growth rates.

5 Evidence on immigration and growth

Our tour of the neoclassical growth theory emphasizes two main channels through which immigration may impact growth rates in per capita GDP in the short run. On the one hand, sluggish capital investments are expected to depress the per capita capital stock thereby dampening economic growth rates. On the other hand, immigration may increase the average human capital stock, thereby boosting average labour productivity and potentially TFP. To gauge which of these channels tends to dominate in the short run, in this section we turn to the Canadian experience and examine whether higher immigration rates have historically coincided with higher growth rates in GDP per capita.

In Figure 4, we plot Canada's immigration rate and real GDP per capita between 1961 and 2022. Per capita GDP grew year-over-year in 53 of the 61 years in this period, averaging 1.8 percent per year, resulting in a tripling of average economic living standards over the six decades. Growth rates were highest in the early 1960s and early 1970s, and turned most negative in the recessionary years of 1982 (4.4 percent), 1991 (3.2 percent), and 2009 (4.2 percent), and at the onset of the COVID pandemic in 2020 (5.7 percent).

Figure 4 also plots Canada's annual immigration rates. The data reveal large fluctuations between 1961 and 1989 in large part reflecting deliberate government efforts to curtail inflows in

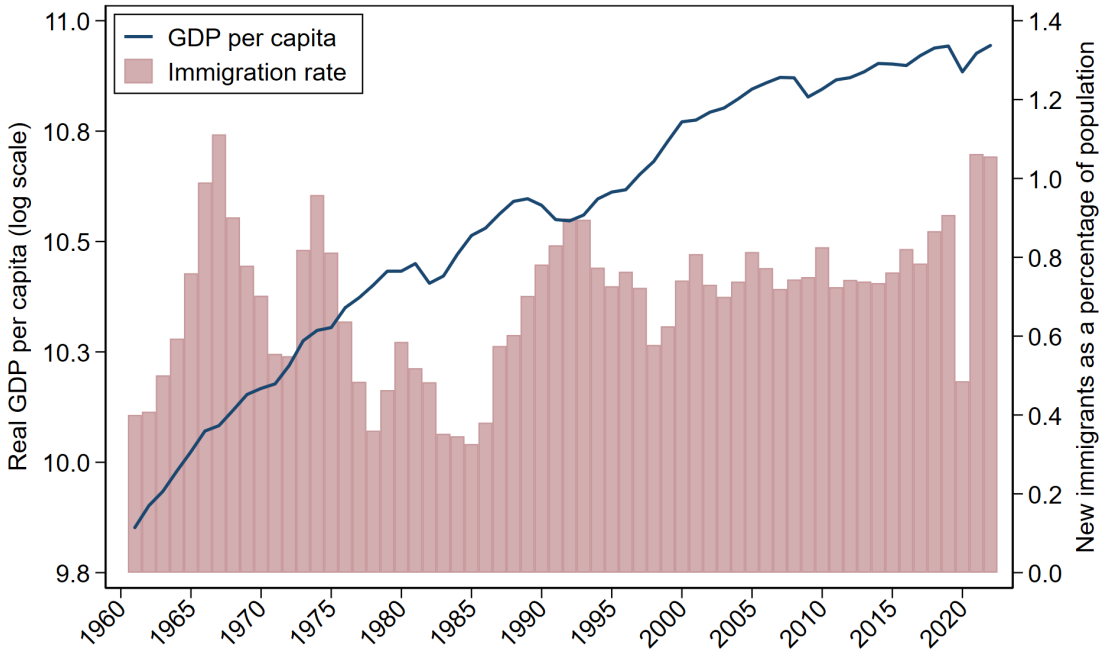

Figure 4: GDP per capita and immigration rate, Canada, 1961-2020

years with high unemployment rates. This "tap-on tap-off" approach to immigration ended in the 1989-1992 period, when the Mulroney government opted to increase Canada's immigration rate from 0.7% to 0.9% even while the national unemployment rate rose from 7.5% to 11.2%. This untying of immigration inflows and the business cycle has been followed by every Canadian government since. Indicative of this policy change, the correlation between Canada's immigration rate and its national unemployment rate in the previous year was -0.799 between 1961 and 1989, but -0.005 between 1990 and 2019.

The significance of "tap-on tap-off" immigration rates is that periods with low immigration rates will coincide with periods of low economic growth, while periods with high immigration will coincide with economic expansions, but one would be wrong to interpret the resulting positive correlation between immigration and growth as a beneficial *causal* impact of immigration. In fact, immigration rates will tend to be procyclical, even in the absence of "tap-on tap-off" inflows, if Canada becomes more attractive as a destination for migrants when higher economic growth is anticipated and governments avoid buildups of application backlogs by increasing admissions in periods with more applications for permanent residency. But again, causality is running from changes in economic conditions to immigration rates, not vice-versa.

To explore the empirical relation between marginal changes in Canada's immigration rates and

growth rates in GDP per capita, we estimate the equation:

$$\log\left(\frac{gdp_t}{gdp_{t-1}}\right) = \alpha + \beta m_{t-1} + f(t) + \varepsilon_t \tag{1}$$

where gdp_t is Canada's real GDP per capita in year t; m_{t-1} is its immigration rate in the previous year; $f(t)$ is a potentially nonlinear time trend; and ε_t is random error with variance σ_t^2 and first-order serial correlation ρ. The parameter of interest β identifies the effect a marginal increase in the immigration rate on the growth rate in GDP per capita in the following year.

We first estimate β by OLS using the full 1961-2019 time series.[30] From the residuals of this regression, we estimate $\hat{\rho} = 0.24$ implying some persistence in economic growth rates across years. A Breusch-Godfrey (BG) test is, however, unable to reject the null hypothesis that $\rho = 0$ at the 10% significance level. Nonetheless, given the limited power of our BG test, we also estimate β using a Cochrane-Orcutt (CO) estimator that models the ε_t series as an AR(1) process. Last, we estimate equation (1) using a finite distributed lag (FDL) model with two additional lags of m_t to examine the possibility that impact of immigration inflows on the economy may take more than one year to be realized.

Finite sample unbiasedness of the OLS, CO and FDL estimates of β rests on the assumption that ε_t is strictly exogenous, that is that deviations of growth rates from trend are mean independent of the immigration rate in all periods. As we have argued, a "tap-on tap-off" policy and procyclical application rates for permanent residency are likely to create a positive correlation between ε_t and both contemporaneous and future values of m_t which will bias estimates of β upwards if exogenous shocks in ε_t are persistent ($\rho > 0$). Intuitively, above-trend growth between years $t-1$ and t may boost the immigration rate in years t or $t+1$, but because above-trend growth rates persist across years, growth between t and $t+2$ is likely to also be above trend, thereby producing a positive correlation between economic growth and the lagged immigration rate despite the direction of causality running from growth to immigration.

Since 1978 the federal government has announced targets on an annual basis for the immigration intake in the following calendar year. In setting the targets, the government is required by legislation to take into consideration labour market conditions and broader demographic trends (Veugelers and Klassen 1994). To further assure us that the variation in m_t in the Canadian data is policy driven and therefore, if anything, procyclical, we also estimate equation (1) by two-stage least squares (2SLS) using the shorter 1979-2019 time-series where we instrument m_{t-1} using the policy target that was announced in $t-2$. Given that governments will, if anything, limit immigration when economic downturns are most expected, the 2SLS estimates are even more likely be upward biased.

[30] We drop the 2020-2022 data because COVID had a profound effect on both economic growth rates and immigration rates.

Table 1: Effect of immigration rate on growth rate in real GDP per capita

	1961-2019			1979-2019		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	CO	FDL	OLS	CO	2SLS
m_{t-1}	-0.023*	-0.024	-0.032	-0.079***	-0.064*	-0.088**
	(0.013)	(0.019)	(0.038)	(0.025)	(0.034)	(0.036)
m_{t-2}			-0.003	–	–	–
			(0.060)			
m_{t-3}	–	–	0.021	–	–	–
			(0.041)			
$trend/10$	-0.013**	-0.013	-0.015	0.040*	0.048	0.043*
	(0.005)	(0.009)	(0.006)	(0.021)	(0.028)	(0.025)
$trend^2/1000$	0.015*	0.014	0.016	-0.045*	-0.055	-0.048*
	(0.009)	(0.014)	(0.010)	(0.024)	(0.034)	(0.028)
constant	0.057***	0.057***	0.054***	-0.014	-0.040	-0.015
	(0.010)	(0.019)	(0.018)	(0.040)	(0.048)	(0.041)
$target_{t-1}$	–	–	–	–	–	0.936***
						(0.115)
R^2	0.203	0.116	0.191	0.178	0.111	0.176
Observations	58	57	56	41	40	41

Notes: CO is the Cochrane-Orcutt estimator and FDL is a finite distributed lag model. Heteroskedasticity-consistent standard errors in parentheses. *,**, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

The results of estimating equation (1) as described above are reported in Table 1. Despite our predilection for estimating a positive relation between immigration rates on economic growth, all the point estimates are negative. The OLS estimate in column (1) suggests that a 0.1 percentage point increase in the immigration rate, say from 0.8% to 0.9%, is expected to lower growth in GDP per capita in the following year by 0.23 log points or roughly 0.23%. This could be the difference between an annual economic growth rate of 1% and 0.8%, a small absolute difference, but one which we have seen can have a substantial impact on average living standards in the long run. However, while the OLS estimate is significant at the 10% level, the CO estimate is not.

The FDL model estimates in column (3) are similarly not inconsistent with a zero effect. While a permanent 0.1 percentage point increase in the immigration rate is associated with a 0.32% decrease in economic growth in the following year, that negative effect falls to 0.14% after 3 years. This is consistent with a sluggish adjustment in the physical capital stock in the short run. The point estimates are, however, all poorly identified.

Finally, column (6) reports the 2SLS estimates using the policy targets to instrument the immigration rate. Contrary to our expectation, the estimate is negative and nearly four times bigger in magnitude. However, the increase overwhelmingly reflects the shorter time-series, since the OLS and CO estimates using the same sample are also larger. A bigger adverse effect is consistent with the evidence of a significant deterioration in the labour market earnings of new

immigrants through the 1980, 1990s, and into the 2000s. Also, the 1990-1992 recession, which was exceptionally large in Canada and occurred following five years of expanding immigration rates, is given more weight in the smaller sample. It is tempting to waive off the influence of the 1990s immigration-growth correlation as spurious, but of course there is no way to know if and to what extent high immigration may have contributed to the depth of Canada's recession.

In summary, Canada's historical record provides no evidence that higher immigration rates can be expected to boost growth rates in per capita GDP in the short run. If anything, the estimates are more consistent with declining growth rates consistent with a short-run dilution effect of higher immigration rates on the physical capital stock per worker.

6 Evidence on the determinants of growth

A key message of our tour of growth theory is that the effect of immigration on economic growth is heavily mediated by the responses of the other determinants of growth to the increase in labour, especially the adjustment of the physical capital stock and potential human capital externalities on productivity. In this section, we examine the evolution of Canada's capital stock per capita and TFP using published data from Statistics Canada's national accounts. While the previous section was focused on the short run impact between immigration and growth, our objective here is to shed light on the possible longer term effects of Canada's current immigration expansion.

6.1 Capital accumulation

As a reminder, in standard neoclassical growth models, an increase in the population through immigration reduces the capital-labour ratio which, in turn, raises the marginal productivity of capital. This induces additional saving and investments in new capital formation thereby bringing the capital-labour ratio into balance. The critical question is what are the dynamics of this adjustment process. Does heightened investment happen quickly or are capital investments sluggish to respond to short-run declines in the capital-labour ratio? The answer is critical in gauging the expected "growing pains" of Canada's heightened immigration rate.

In the theoretical models with perfectly competitive capital markets, capital-labour ratios adjust instantaneously, but real-world capital markets are not perfectly competitive. An especially important source of capital market friction is imperfect information in the risk facing lenders. Uncertainty is likely especially important where borrowers are immigrants with foreign credit and earnings histories. More generally, capital investments face regulatory environments that result in lags in capital adjustments. The contribution of regulatory hurdles facing home builders in Canada's worsening housing crisis is an important example. To what extent these frictions should be of concern in the

current environment of accelerating population growth is ultimately an empirical question.

Estimating the overall size of a country's capital stock on a regular basis, which includes everything from the value of a country's housing stock to the value of intellectual property underlying new products and services, is infeasible. Instead, national accounts rely on information on capital investment activity, which when combined with estimates of capital depreciation can be used to infer growth rates in the capital stock and, given an initial value, the current size of the capital stock. By examining the recent trajectory of investment activity and the per capita capital stock, we can gauge Canada's economic capacity to absorb the acceleration in population growth it is planning.

We begin by examining a measure of investments in physical capital known as gross fixed capital formation (GFCF), which the OECD publishes annually on a comparable basis for their member countries. GFCF includes new capital formation and the replacement of depreciating capital stock by corporations, households, and governments in dwellings, other buildings and structures, machinery and equipment, information and communication technology equipment, and intellectual property. In Figure 5 we graph the level of annual real GFCF per capita in Canada and the United States. The data reveal four distinct periods. Levels of Canadian and U.S. investment per capita were similar through the 1970s and 1980s. However, with the onset of the recession of the early 1990s a Canadian shortfall opened which grew continuously throughout the 1990s, peaking in 2000. The gap subsequently began to close such that by 2010 per capita investment levels were higher in Canada. However, Canadian and U.S. investment has diverged dramatically since 2010. While real per capita investment in the U.S. increased by 39% between 2010 and 2021, Canadian investment has been flat.[31] Regardless, of what accounts for Canada's weak investment activity in the past 15 years, the absence of any growth, or perhaps even a decrease, portends concerning absorptive capacity challenges.

Statistics Canada categorizes Canada's non-residential capital stock into four main asset groups: (i) building construction, including plants and offices, as well as schools and hospitals; (ii) engineering construction, such as roads, bridges, dams, railway lines, oil and gas pipelines, communications network cables and lines, and airport runways; (iii) machinery and equipment, including tools, information and communications technology, transportation equipment, and turbines; and (iv) intellectual property. Non-reproducible assets such as land, mineral deposits, and natural resources are not included in the capital stock since they are inputs into the production of goods and services. Of particular interest are the growth rates in the stocks of machinery/equipment and intellectual property, since these two asset groups are believed to be the most important determinants of

[31] We are not the first to document Canada's lacklustre investment record of the past decade. See, for example, the recent analysis of Canadian business investment by Robson and Wu (2021).

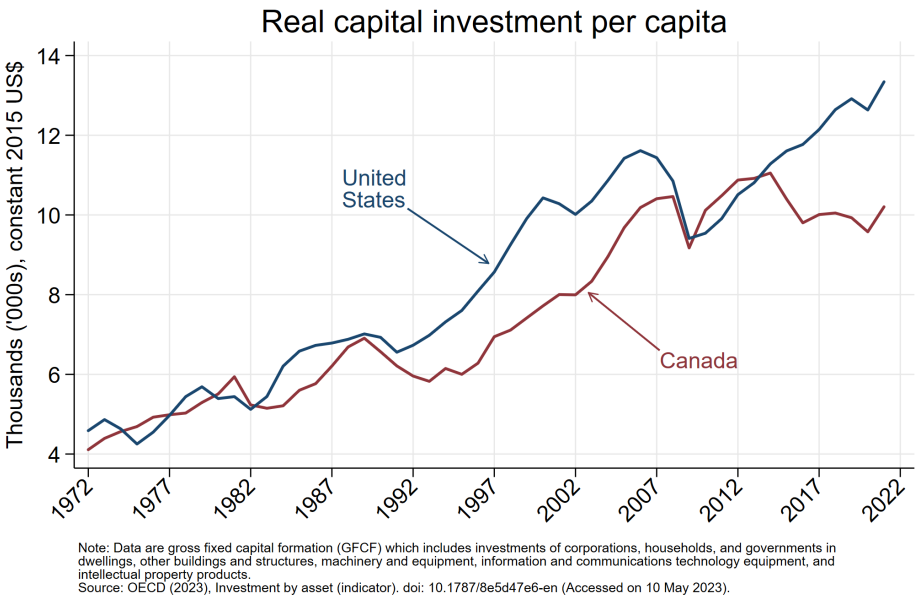

Figure 5: Real investment in Canada and the United States

innovation and future productivity growth.

In Figure 6, we graph the levels of Canada's non-residential capital stocks on a log scale between 1971 and 2021. Both privately and publicly held assets are included, and we divide the stock by the size of the labour force, rather than the population, since we are interested in its productive capacity. Recall that a linear profile when we use a log scale is evidence of a constant growth rate, and a steeper slope is evidence of a higher growth rate.

All asset groups in Figure 6 show evidence of per worker growth from the early 1970s through to the mid-1990s. The growth rates in intellectual property and machinery/equipment are especially impressive. Beginning in 1995, however, building infrastructure per worker began to decline. More troubling, both the machinery/equipment and intellectual property stocks per worker show clear downward trajectories beginning in 2014, just as Canada's immigration rate began to climb. The decline in these critical productive asset groups per worker line up remarkably well with what appears to be a downward trajectory in investment per capita in Figure 5. The only asset group to show signs of ongoing growth is engineering construction. However, removing the oil and gas sector from the data (dashed line) reveals that much of the growth here is concentrated in the development of oil and gas resources in Alberta and Saskatchewan.

Combining the four asset groups, the overall capital stock per worker grew up to 2016, but has since been flat. The simple reality is that Canadian non-residential investments, most notably in

the areas most closely associated with productivity growth, are not keeping pace with population growth. While the influence of population growth on Canada's housing crisis is now widely recognized, its influence on Canada's non-residential capital stock is receiving little attention. Our analysis of recent movements in Canadian capital accumulation do not paint a picture of an economy that is able to produce sufficient complementary inputs to mitigate the adverse effects of increased immigration rates on average economic living standards in the population.

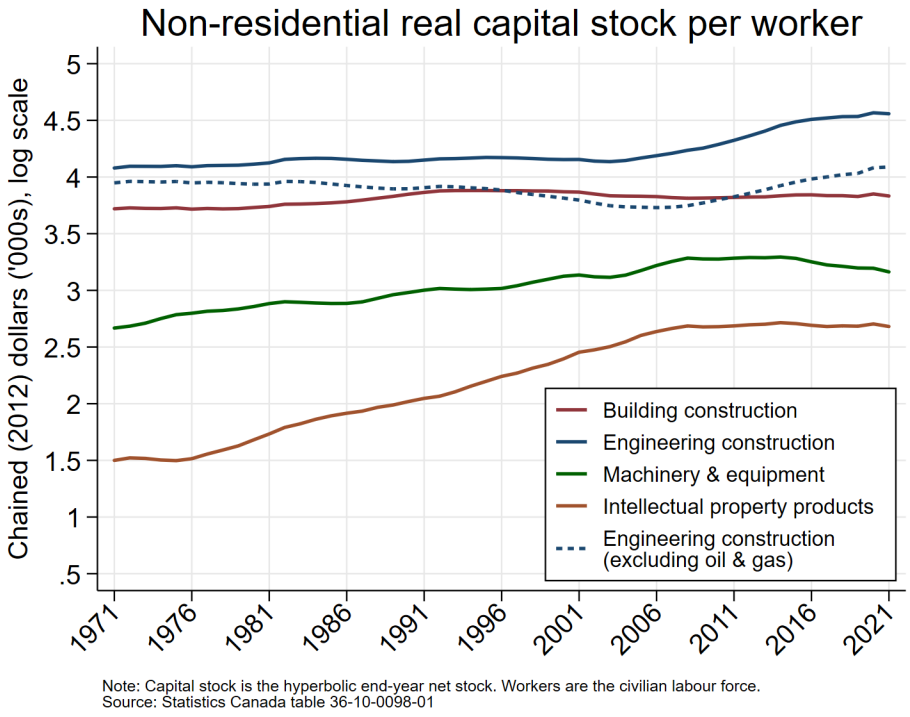

Figure 6: Real capital stock per worker, Canada, 1971-2021

6.2 Productivity growth

The potential for immigration to have growth effects, as opposed to level effects, on GDP per capita, rests on its potential to cause outward movements of the efficient frontier. Intuitively, shifts of the frontier require new and better ways of combining and organizing factor inputs to produce more output. The process of achieving these gains is fundamentally about the creation of ideas. However, ideas are not private goods in the way that machines or an education is. In some cases, ideas can be patented, but patent protection is temporary and imperfect, so ideas, particularly those with the greatest commercial potential, inevitably spill across national borders.

If ideas are mostly public goods, then an open question is whether and to what extent domestic

innovation is what determines domestic productivity growth. This is a different issue than whether a country is able to adopt and implement innovations that occur elsewhere. The latter is an important consideration in models that seek to explain north-south differences in economic growth rates, and why some poor countries appear stuck in low growth ruts. But adoption hurdles are unlikely to be an issue for well connected industrialised economies like Canada. This raises the possibility that all industrialised countries grow at the growth rate of the global efficiency frontier. To what extent that is true is a difficult question which growth economists continue to explore.

Recent research examining U.S. data from the late 18th and early 19th centuries and German data in the period after WWII finds evidence linking immigration-driven population growth and growth in GDP per capita that appears driven by the creation of new ideas and expansions of the efficient frontier (Arkolkais, Lee and Peters 2020; Peters 2021). More relevant, analyses using up-to-date U.S. data on the patents created per capita provides evidence of the potential of local inflows of skilled immigrants to raise local innovation activity, suggesting expansion of the U.S. efficient frontier (Hunt and Gauthier-Loiselle (2010)). Moreover, Kerr and Lincoln (2010) provide evidence that the skilled immigration inflows driving these gains are coming through the H-1B employment visa program, which allows U.S. employers to cream-skim the foreign talent pool in the country's top universities.

However, evidence for other countries is much less clear. Using data for Canada, Blit, Skuterud and Zhang (2020) find that increasing the university-educated immigrant share has only modest effects on patenting rates and any effect is clearly smaller than the impact of skilled immigrants on patenting activity in the USA. They do find evidence of larger effects of Canadian immigrants with STEM degrees, but this effect is limited because only one-third of Canadian STEM-educated immigrants are employed in STEM jobs. In contrast, two-fifths of the Canadian-born and one-half of U.S. immigrants have STEM educational degrees and are employed in STEM jobs.[32] STEM skills are, of course, widely believed to be central to innovation and productivity growth (Council of Canadian Academies (2015)). We interpret these findings as indicating that expansions of economic immigration under the current selection system are unlikely to have a significant impact on Canadian productivity. However, it is possible that with a greater emphasis on STEM education in selection that this effect could be present in the future. However, even if the shift in field of study were achieved, it remains unclear to us that the benefits in terms of productivity would be significant for the reasons outlined above.

From the national accounts data of their member countries, the OECD produces and publishes annual estimates of TFP going back to 1985. Their publication describes TFP as the component

[32]Picot and Hou (2019) examine the weaker earnings performance of STEM-educated workers in Canada and U.S. immigrants in detail.

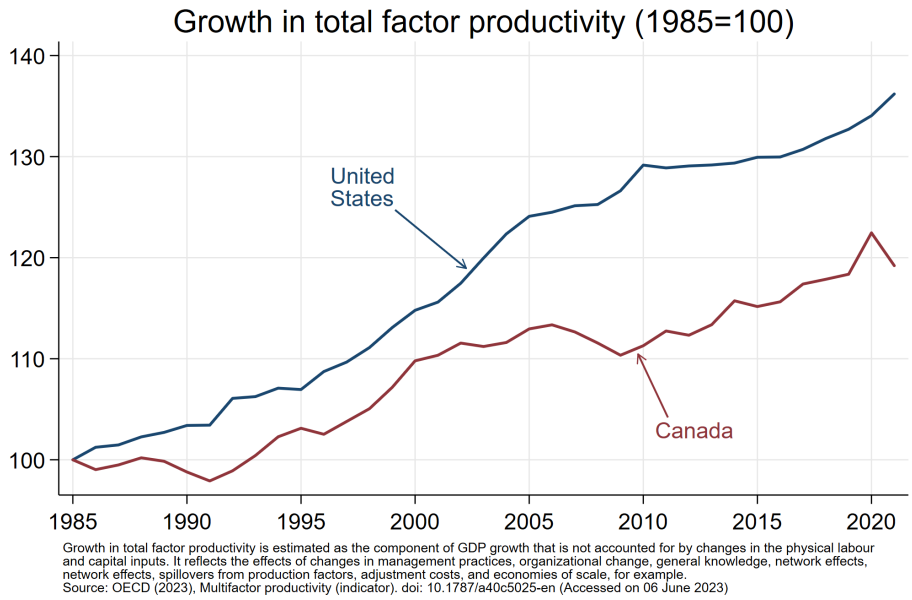

Figure 7: Total factor productivity growth, Canada and the United States, 1985-2021

of GDP growth that is not accounted for by changes in physical labour and capital inputs, such as the effects of management practices, organizational change, general knowledge, network effects, spillovers from production factors, adjustment costs, and economies of scale. In Figure 7 we graph growth in Canadian and U.S. TFP since 1985. Canadian TFP growth averaged 0.53% over the 37-year period, while U.S. TFP growth averaged 1.01%. The shortfall in Canadian productivity growth was especially large over the period from 2001 to 2011, a period during which Canada's annual immigration rate was on average more than twice as high as the U.S. immigration rate. In fact, the Canadian immigration rate exceeded the U.S. rate in every year between 1985 and 2021 and was more than twice as high as the U.S. rate in 31 of the 37 years. There remains much unknown about the underlying causes of Canada's sluggish productivity performance, but these data do not provide us with much confidence that simply increasing Canada's immigration rate is a tonic to Canada's ongoing productivity challenge.

7 Optimal immigration

The Canadian 'points system', introduced in 1967, has always prioritized candidates with high levels of education – an important proxy of human capital – while also rewarding characteristics, such as language fluency, that are seen as influencing the likelihood that immigrants will have their human capital fully utilized and remunerated in Canadian labour markets (Beach, Green, and Worswick

(2011)). A key objective of the point system when it was introduced was to provide a mechanism for processing the greatly increased number of eligible applicants as discriminatory country preferences were eliminated from the selection system. The point system's introduction resulted in a large shift in the source countries of Canadian immigrants from Europe to Asia that continued through the 1970s and 1980s. This increase was commensurate with a significant and persistent deterioration in the labour market earnings of Canadian newcomers (Baker and Benjamin (1994); Aydemir and Skuterud (2005)).

In response to the labour market integration challenges facing new immigrants, the point system was re-structured in the 1990s by further prioritizing candidates with postsecondary education. One can think of this as a shift from one human capital selection model to another with the latter model placing greater weight on postsecondary credentials. This led to an inflow of economic-class immigrants with substantially higher education levels. However, in the weak labour market of the mid 1990s, many of these highly educated immigrants struggled to find jobs that matched their education (Aydemir and Skuterud (2005)). Consequently, the system was further augmented in the 2000s towards a greater emphasis on mandatory pre-migration language testing and a greater role for employers in selecting immigrants. This raised much debate about the best way to select immigrants in Canada, which mirrored similar debates in other countries over the use of a points system versus employer nomination systems for selecting economic immigrants (see, for example, Papademetriou and Sumption (2011)). The most recent analysis available suggests these reforms have been successful as recent years are seeing improvements in the relative of new Canadian immigrants (Crossman, Hou, and Picot 2021).

As we have seen, there is good reason to prioritize human capital selection if the objective of immigration is to increase GDP per capita. Entries of newcomers with levels of human capital above the average in the preexisting population will necessarily pull up the existing average by changing the skill composition of the labour force. High human capital immigrants are also more likely to produce beneficial externalities on productivity via their contributions to the creation of ideas, discoveries, and innovation. Our tour of the growth theory emphasized the importance of this channel in leveraging immigration's potential to increase economic growth rates, as opposed to just the level of GDP per capita.

This implies a policy rule for the optimal level of economic immigration – rank applicants in the applicant pool by their levels of human capital and admit candidates whose human capital exceeds the average in the existing population. The obvious implementation challenge is that human capital is multidimensional and many dimensions, such as an individual's work ethic and social skills, are not easily measurable. The solution is to rank candidates by their expected labour

market earnings, which provides a measure of the Canadian market valuation of their human capital and their individual contribution to national GDP.

7.1 Administrative data

In this subsection, we examine whether Canadian economic immigration admissions appear consistent with this policy rule using published earnings data obtained from individual income tax records.[33]. We focus on immigrants who have been in Canada for 10 years to limit the influence of short-run job search and credential recognition challenges. We focus on the year 2016 due to limitations of the available data for more recent years. Specifically, we compare the 2016 earnings of immigrants who arrived in Canada in 2006 to the annual earnings of all residents of Canada in 2016. The results are reported in Table 2.

The first row reveals that mean earnings for all Canadians age 25 to 54 with positive wages and salaries was $58,100 in 2016. Not surprisingly, mean earnings of principal applicants (PAs) admitted in the economic-class categories had somewhat higher mean earnings at $62,500. This implies that the average human capital level of admitted economic-class PAs was 7.6% higher than the average human capital level of the full population. Comparing median earnings instead similarly reveals an immigrant advantage – $50,800 compared to $48,300 in the population. This suggests that economic-class PAs admitted in 2006 had a small positive compositional impact on the average level of human capital in the Canadian population 10 years later.

However, these results also imply that restricting the level of economic immigration could have raised average human capital in the population since since median earnings of economic-class PAs at $50,800 were considerably lower than mean earnings of Canadians at $58,100. This indicates that more than 50% of the economic-class PAs admitted in 2006 had earnings below the Canadian average 10 years later. Consequently, stricter human capital selection in 2006 could have led to a smaller intake of economic immigrants and potentially higher average human capital level of the immigration inflow. The higher average human capital level of the entries would be expected to raise GDP per capita in the population.

Table 2 also presents earnings data separately for men and women. In both cases, mean earnings in the full population exceed median earnings of economic-class PAs. Restricting attention to the subset of PAs who entered through the Federal Skilled Worker or Skilled Trades Programs reveal mean and median earnings that are slightly higher than among all economic-class PAs. However, in the full sample and for men, median earnings continue to fall below mean earnings in the full

[33]The data come from Statistics Canada's Longitudinal Immigration Database, which is a linkage of administrative immigration records, in particular the landings records of new permanent residents, with their T1 income forms, obtained from the Canada Revenue Agency. We rely on published statistics from the IMDB.

Table 2: Annual earnings comparison of the 2006 landing cohort and all Canadian residents, 2016

Full population							
		Earnings from wages and salaries			Self employment earnings		
		All	Females	Males	All	Females	Males
All (25-54)	mean if positive	58,100	46,700	68,700	19,900	16,500	22,800
	median if positive	48,300	40,000	57,700	9,900	7,400	12,00
	% with income	79.7	76.7	82.7	12.2	11.5	12.9
All (35-44)	mean if positive	61,700	50,400	72,500	19,700	17,100	21,700
	median if positive	52,300	42,700	62,500	10,000	8,800	11,500
	% with income	79.5	76.2	82.9	13.4	11.8	15.0
2006 immigrant landing cohort							
All	mean if positive	40,700	32,900	48,400	13,600	11,400	15,300
	median if positive	31,700	26,400	38,300	7,800	6,000	9,400
	% with income	67.4	63.7	71.7	14.2	11.6	17.1
Economic	mean if positive	62,500	50,200	69,400	15,300	12,400	16,600
immigrant, PA	median if positive	50,800	43,600	56,900	,200	4,900	8,500
	% with income	75.8	79.0	74.1	17.2	16.1	18.3
Skilled worker and	mean if positive	65,300	54,100	70,400	14,800	13,400	15,400
skilled trades, PA	median if positive	54,800	47,700	59,300	6,800	5,000	7,500
	% with income	77.3	77.5	77.2	17.5	16.1	18.2
Economic immigrant,	mean if positive	32,600	30,400	35,700	12,200	11,500	13,200
spouse and dependent	median if positive	25,200	23,800	28,100	6,000	5,300	6,800
	% with income	69.4	66.3	74.3	11.7	11.0	12.7
SW and ST	mean if positive	33,700	31,600	37,100	12,300	11,400	13,600
spouse and dependent	median if positive	25,500	24,800	27,000	5,800	5,200	6,800
	% with income	70.1	68.0	73.6	11.9	11.0	13.4

Sources: Statistics Canada Tables 43-10-0010-01 and Table 11-10-0239-0.

population. Last, we report earnings of spouses and dependents under both the overall economic-class immigrant category and the Skilled Worker and Skilled Trades subset of that category. Median earnings are now consistently below mean earnings in the full population, and by wide margins. This is important to note because we tend to focus on the outcomes of the PAs who are being directly assessed under economic-class selection criteria and do not always factor in that the accompanying spouses and dependents are not directly selected and their labour outcomes tend to pull down the average of the economic-class category overall.

The last row of each section of Table 2 indicates the percentage of individuals with positive earnings from wages and salaries. These data reveal that the immigrant groups consistently have lower fractions with positive earnings than in the full population, with the sole exception of women who were PAs in the skilled worker and trades programs. This provides some evidence that the gaps between median immigrant earnings and mean earnings in the overall population would only be exacerbated by including individuals with zero earnings in the comparisons.

A case can be made that our comparison of a particular cohort of immigrants to the population of all Canadians age 25-54 is misleading because the latter group could be older on average with more years of work experience. To investigate this possibility, we also report mean and median earnings of Canadian residents age 35 to 44 which is an age range which is likely to capture the average age of economic-class immigrants admitted 10 years earlier. The data reveal that average earnings in this younger population is actually somewhat higher – $61,700 compared to $58,1000 – and our conclusion that more restrictive immigrant selection could raise average earnings in the full population continues to be true.

A caveat in our interpretation of these data is that economic-class immigrants may be disproportionately self-employed, and their self-employment earnings may be high. The three columns on the right-hand-side of Table 2 suggest this is not the case. While immigrants are more likely to report self-employment earnings, the differences tend to be small. More important, the average earnings of self-employed immigrants fall consistently below the population average. Moreover, median self-employment earnings of immigrants are consistently less than half of the population mean of $22,800. This again implies that a more selective set of selection criteria would raise GDP per capita by boosting the average human capital of the population.

In summary, administrative on immigrant earnings 10 years after landing suggest that economic-class selection criteria and admission levels circa 2006 were not effective in boosting the average human capital level of the Canadian labour force. While the the 2006 immigrant cohort undoubtedly contributed to expanding total GDP, they appear unlikely to have caused an increase in GDP per capita, at least through their effect on the composition of the labour force. However, the high mean

earnings of PAs selected through the Skilled Worker and Skilled Trades programs – $65,300 versus $58,100 – points to the potential for a more restrictive set of criteria for immigrants admitted under this program to raise GDP per capita.

7.2 Census data

While the estimates in Table 2 suggest that a more selective immigration policy could raise average earnings of newcomers, the analysis does not tell us how much smaller the intake of economic immigrants should be if the goal is to maximize GDP per capita. To answer this question, we need data with earnings at the individual level. We now turn to the 2016 Canadian Census Public Use Microdata Files (PUMFs) to draw out more specific guidelines on how to set economic-class immigration targets to maximize the potential for immigration to boost per capita GDP.

The 2016 Census is the first Canadian census to identify immigrants' admission category. This information enables us to identify the earnings of foreign-born individuals who entered Canada through an economic-class immigration program.[34] In what follows, we explore what happens to the average earnings of the 2006 arrival cohort if particular individuals within that cohort are excluded through a hypothetical selection rule that is more restrictive and/or better at predicting which individuals in the cohort had above-average earnings 10 years after landing.

The first row of the two sections of Table 3 reports mean annual earnings (wages and salaries) in 2015 (the income reference year for the 2016 Census) in the full populations of Canadian men and women. The following rows compare those values to economic-class immigrants who arrived in Canada 10 years earlier (the 2005 landing cohort). Immigrant average earnings are consistently lower – $65,525.27 compared to $66,761.25 for men and $44,012 versus $45,086 for women. As with the administrative data, this points to potential for improved selection policy.

Next, we consider what would happen if the 2015 earnings of everyone in the 2005 landing cohort were known with certainty when they were in the applicant pool and applicants with earnings below the 2015 population mean were excluded. The second rows of Table 3 indicate that mean earnings among men in the 2005 landing cohort would be $110,442.50 and among women would be $74,728, a 69% improvement for men and 70% improvement for women. The size of the 2005 cohorts would, however, be substantially smaller – 60% smaller for men and 61% for women (see weighted counts). This is a large difference representing a much smaller intake of economic immigrants, but it is consistent with the policy objective of ranking and selecting applicants in a way that maximizes the contribution of newcomers to raising average earnings in the Canadian population.

Implementing this crystal-ball selection strategy of predicting immigrants' earnings 10 years

[34]The 2016 Census is also the most up-to-date Census PUMF available at the time of writing this paper.

Table 3: Hypothetical mean annual earnings of 2005 landing cohort in 2015

Sample	Mean earnings ($)	N	Weighted	% of cohort	% Δ in mean
Men					
all	66,761	152,783	5,658,579	–	–
2005 cohort	65,525	623	23,073	100	–
2005 cohort, earnings ≥ mean	110,443	250	9,259	40.1	68.5
2005 cohort, 2001 prediction ≥ mean	72,585	450	16,666	72.2	10.8
2005 cohort, 2016 pred. ≥ mean	76,669	308	11,407	49.4	17.0
2005 cohort, 2016 pred. (field of study)	78,492	322	11,926	51.7	19.8
Women					
all	45,086	149,469	5,535,860	–	–
2005 cohort	44,012	619	22,925	100	–
2005 cohort, earnings ≥ mean	74,728	240	8,888	38.8	69.8
2005 cohort, 2001 pred. ≥ mean	46,421	519	19,221	83.8	5.5
2005 cohort, 2016 pred. ≥ mean	52,545	297	10,999	48.0	19.4
2005 cohort, 2016 pred. (field of study)	54,934	275	10,185	44.4	24.8

Source: 2001 and 2016 Canadian Census Public Use Microdata Files

after they have been selected is, of course, impossible in practice. How well can policymakers predict the future earnings of prospective immigrants in the applicant pool? To provide a more realistic sense of the potential, we instead estimate a standard linear regression model that predicts immigrant earnings in 2015 with a basic set of selection criteria entering the model as explanatory variables. We then implement our selection rule based on individual predicted earnings from the regression model. To make the simulation as realistic as possible, the prediction model is estimated using data from the 2001 Census PUMF. In this way, we are predicting immigrant earnings based on the performance of previous cohorts of immigrants, which would be feasible in practice.

More specifically, we extract the sample of immigrant men age 25-54 from the 2001 Census PUMF and estimate a simple human capital earnings model where the dependent variable is the individual's earnings in 2000 and the explanatory variables include key human capital proxy variables that have historically been included as selection criteria in the Canadian 'points system.' This includes: current age, level of education, and self-reported fluency in English and French. We also control for immigrant arrival cohort using the categories in the 2001 PUMF to try to absorb any variation in immigrant selection rules across time. The model and estimates are presented in the first columns of Table A1. The R^2 statistic from this regression tells us that our model predicts

16.6% of the variation in the 2000 earnings of our sample of immigrant men.

Using this model, we predict the 2000 earnings of the sample of economic-class immigrants in the 2005 landing cohort who appear in the 2016 Census PUMF, and then drop individuals with predicted earnings below the 2000 mean earnings in the full population, which is $28,011.[35] Applying this selection criterion produces mean 2015 earnings of $72,584.96 for the 2005 landing cohort, which is 10.8% higher than the actual mean earnings of this arrival cohort. However, the size of the cohort drops from 23,070 to 16,666, which is a 38% decline in the immigration level.[36] These gains are impressive, especially given how parsimonious our prediction model is. Including a richer set of predictors, such as language test scores instead of binary indicators of self-reported fluency, could substantially improve the R^2 and predictive accuracy of the model, which could simultaneously increase realized mean earnings *and* the size of the optimal 2005 entry cohort.

To demonstrate the potential of a richer set of predictors, we exploit information in the Census on the field of study of respondents with postsecondary credentials. Fields of study (e.g. arts, humanities, mathematics, engineering, science) have been shown to be important determinants of immigrant earnings (Sweetman and McBride (2004)). Unfortunately, consistent field of study codes are not available in the 2001 and 2016 Census PUMFs. Instead, we use the 2016 Census data to estimate the model of immigrant earnings and predict the earnings of the 2005 landing cohort. The regression model estimates are reported in Table A1 using the same broad set of controls (age, language, education and arrival cohort) used in the 2001 PUMF analysis. We continue to focus on individuals age 25-54, but we also restrict the sample to economic immigrants who were 25 or older at the time of landing in the hope of making the sample more representative of economic-class PAs.[37]

Before including the richer set of predictors, we estimate the model that does not include the field of study variables using the 2016 Census PUMF, and then drop individuals in the 2005 landing cohort whose predicted 2015 earnings fall below the 2015 population average. The results are reported in the second last rows of the two sections of Table 3. The estimates show mean earnings for immigrant men of $76,669 and $52,545 for women. These values are 17% (men) and 19% (women) higher than the actual mean earnings of the 2005 cohort sample. Excluding immigrants with the lowest predicted earnings, reduces the size of the 2005 landing cohorts by 51% (men) and

[35] One may be concerned that the $28,011 threshold is too low because restricting immigration would raise average earnings in the population in future years. We expect this effect would be small for any immigrant arrival year since a single landing year of immigrants represents a small share of the total population.

[36] We ignore possible attrition due to non-random out-migration from Canada after arrival. This could be important but is beyond the scope of our analysis. It is hard to know how differential selection to leave Canada might affect our estimates, but it is an important consideration for future analysis of these issues.

[37] Unfortunately, the 2016 Census PUMF identifies the broad immigration class of foreign-born respondents who are permanent residents, but not whether they were the PA.

52% (women). In other words, our policy rule implies that the actual 2005 landing cohort was roughly twice as big as what was optimal.

Finally, we extend the regression model to exploiting immigrants' field of study to predict their future earnings. The estimates are presented in the third column of Table A1. Including field of study in our prediction of immigrants' earnings and excluding immigrants from the 2005 landing cohort with predicted earnings below the population men, we obtain mean earnings of $78,492 for men and $54,934 for women. Once again, by improving the quality of the predictions we are better able to select those immigrants whose earnings do more to raise average earnings in the population 10 years after landing. However, the result for men provides a critically important lesson – using higher quality predictors of immigrants' future earnings can simultaneously increase the mean earnings *and* size of the landing cohort under our optimal selection rule. This is evident in the fact that adding the field of study information to the prediction model increased the average earnings of the 2005 landing cohort – from $76,669 to $78,492 – and its size – from 11,407 to 11,926. While we do not get an equivalent result for women, we expect that employing more predictors would.

In summary, our analysis of immigrant earnings using Census data suggests that economic immigration circa 2005 was not consistent with the goal of maximizing GDP per capita. If we superimpose this criterion of only admitting immigrants with expected earnings above the population mean, we find that the average earnings of the 2005 landing cohort rise in our preferred model for predicting earnings by 20% for men and 25% for women, while the size of the admitted cohort decreases by 48% for men and 56% for women.[38] However, as we have emphasized, with a richer set of predictors to rank candidates in the application pool, it should be possible to simultaneously increase the optimal immigration level and the average earnings of those admitted.

It is worth noting that Canada's 2005 landing cohort were not all selected using a ranking system similar to the Express Entry System that was introduced in January 2015. Consistent with the methodology of our policy rule, this system ranks economic-class applicants using a 'points system' known as the Comprehensive Ranking System (CRS). The criteria and weights in the CRS were originally informed by the immigrant earnings regressions in Bonikowska, Hou, and Picot (2015).[39] Roughly every two weeks, IRCC cream-skims the Express Entry applicant pool by setting a CRS cutoff score and provides applicants with scores above the cutoff with an invitation to apply for permanent residency. Increasing the number of admissions necessarily implies reaching deeper into

[38]Note that we do not observe PA status in the Census PUMFs, but given that men are more likely to be the PA in the economic category, we see the results for men as being closer to what we would see if we were able to restrict our data to PAs. Future research could explore the sensitivity of our findings using the IMDB longitudinal data on earnings of immigrants in Canada.

[39]Boinikowska, Hou and Picot (2020) provides updated estimates.

the applicant pool, which necessarily means setting a lower CRS cutoff. This is the crux of the quantity-quality problem facing policymakers as immigration rates are expanded. In other words, given a CRS ranking, it is impossible to simultaneously increase both the size and average expected earnings of immigrant entries. Policymakers must either target the immigration rate or the CRS cutoff; they cannot target both.

Our policy rule makes clear that the policy target should not be the number of immigrants admitted, but rather the CRS cutoff that corresponds to expected immigrant earnings equal to average earnings in the full population. While our simulations here suggest doing so might require a 50% drop in the immigration level, there is reason to believe that implementation of our policy rule coupled with a richer prediction model (set of CRS criteria) would require a much less drastic reduction in entries. Over the past decade, Canada has seen a significant shift towards "two-step immigration," in which migrants arrive initially in Canada with a temporary work or study permit and subsequently apply for, and if successful, transition to permanent residency (Hou, Crossman, and Picot (2020)). Two-step immigration provides policymakers with a richer information set to predict immigrants' future Canadian earnings. We know, for example, that the best predictor of immigrants' future earnings are their past earnings (Picot, Hou, Xu, and Bonikowska 2022), yet applicants' pre-landing Canadian earnings levels are not used in the current CRS calculator.[40] As for foreign students, information on the post-landing earnings of former international students who graduated from the same Canadian post-secondary institution could be used. If the data shows, for example, that STEM graduates from University X consistently outperform Humanities graduates from University Y, we would want to exploit that information in the selection system.

All of this suggests that large potential gains in average immigrant earnings and potentially GDP per capita growth can be achieved without a fundamental change in the way economic immigrants are selected, but merely by imposing the restriction that economic immigrants admitted must be expected to have earnings 10 years after arrival that are at least as large as we expect earnings of the entire population to be in that year. However, note that there are limits to the economic growth potential of this policy rule. The compositional gains are likely to be level effects, not growth effects (see Figure 3 for reminder of this distinction). A growth effect would require ongoing improvements in the quality of the applicant pool, which would require that Canada become a more desirable destination for migrants over time, or that improved selection also produces greater human capital

[40]Interested readers can view the CRS criteria set and calculate their own scores using the online CRS calculator tool here: `https://www.cic.gc.ca/english/immigrate/skilled/crs-tool.asp`.

externalities and, in turn, ongoing productivity gains.[41][42]

8 Conclusions

In an egalitarian country like Canada, where new immigrants are de facto citizens, economic immigration should aim to maximize GDP per capita in the full population that includes the newcomers. To determine the potential for Canadian immigration to achieve this objective, we employ a neoclassical economic growth framework that allows for a role for human capital in production. This framework reveals that an economic immigration program that is designed to expand the labour force without raising the average human capital level of the population is unlikely to affect GDP per capita in the long run due to the fact that modern economies are likely to exhibit constant returns to scale in aggregate production.

We then examine the historical link between GDP per capita growth and Canadian immigration rates, as well as recent trends in capital accumulation and total factor productivity. The data do not suggest that Canada is well-positioned to leverage heightened immigration to boost growth rates in per capita GDP. We also examine data on the earnings of Canada's economic-class immigrants admitted in the early 2000s. The results suggest that a tighter screening policy that prioritizes applicants' human capital and expected Canadian earnings is a feasible channel through which Canada can raise per capita income, although the potential for this policy lever to produce ongoing increases in economic growth rates is limited.

We caution against large scale increases in economic immigration rates in the near term due to the absorptive capacity issues and concerns about adverse general equilibrium effects. Absorptive capacity can be thought of as how quickly the economy can expand private and public capital investments needed to ensure that there are not efficiency losses due to declines in the capital-labour ratio and public service provision. Quickly expanding the level of immigration may place excessive stress on highly regulated sectors such as healthcare, education, and housing, leading to welfare losses for residents. General equilibrium effects can also have large negative consequences, such as driving down the return to post-secondary education for individuals within the existing

[41] An important additional consideration is whether our policy rule is likely to improve or exacerbate earnings inequality in the population. We expect that admitting economic immigrants with the highest expected future earnings would tend to reduce earnings inequality because the supply of high human capital individuals would, if anything, tend to put downward pressure on wages at the top end of the earnings distribution. Also, the supply of low human capital workers would be smaller, which should serve to tighten low-wage labour markets and, if anything, put upward pressure on earnings at the bottom end of the earnings distribution.

[42] An argument that is sometimes put forward for high levels of economic immigration is that this will increase the chances of bringing 'superstar' entrepreneurs into Canada who will start the next great tech companies. We would argue that these people are extremely rare and if present are likely to be in the upper part of the human capital distribution of the pool of potential applicants for immigration to Canada and so should still be selected under the selection criteria proposed above.

population. In our view, a preferred approach is a gradual ratcheting up of immigration rates by starting with a high threshold level of expected immigrant earnings and gradually lowering it towards the overall population average. This would prioritize the top applicants in terms of human capital whose presence in the receiving economy are likely to have the largest positive impact.

By improving selection criteria in Canada's economic-class immigration system, there is potential to boost average earnings of new immigrants and, in turn, GDP per capita. However, doing so will likely require a reduction in the level of economic-class immigration. Nonetheless, if done well, the gains from improved earnings of immigrants admitted in the economic-class could allow the government to expand immigration under programs intended to achieve other non-economic objectives, such as French-language representation in the immigrant intake or humanitarian objectives. We see this as an especially important strength of our policy prescription.

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APPENDIX

Table A1: OLS regression estimates used to predict immigrant earnings 10 years after landing

	2001		2016					
	all immigrants		economic-class immigrants					
	coef	t-ratio	coef	t-ratio	coef	t-ratio	coef	t-ratio
age 25-29	-5,660	-8.86	-5044	-1.39	-5,290	-1.46	-5821	-1.61
age 30-34	-		-		-		-	
age 35-39	3,087	5.62	4659	2.03	5,090	2.22	5,801	2.52
age 40-44	3,538	6.34	8660	3.69	9,074	3.88	9,824	4.15
age 45-49	4,550	7.95	10571	4.32	11,102	4.54	11,953	4.82
age 50-54	4,825	8.17	3770	1.44	4,343	1.65	5,550	2.08
Speaks English	6,758	8.46	17010	6.69	16,697	6.58	16,837	6.63
Speaks french	-3,112	-6.91	-8439	-5.3	-7,760	-4.88	-8,026	-5.03
Education:								
less than high school	-3,500	-6.64	-5526	-1.16	-3,535	-0.74	-3,498	-0.73
trade certificate	3,837	6.53	7622	2.31	-5,468	-1.34	-1,884	-0.34
college diploma	6,447	12.26	7314	3.02	-3,832	-1.18	-3,642	-0.82
university bachelor's degree	15,040	28.98	18833	8.9	8,027	2.63	8,343	2.44
medical degree	34,933	19.06	44273	7.82	42,541	6.36	52,608	3.45
Master's degree	21,756	30.63	30748	13.4	20,256	6.38	28,066	7.3
PhD	28,729	25.48	53672	15.56	44,025	10.69	37,875	6.89
field - education					2,766	0.38	3,145	0.44
field - artscom					8,365	1.29	8,729	1.34
field - humanities					-6,508	-1.31	-6,312	-1.26
field - social sciences/law					10,520	2.7	10,690	2.72
field - business/public admin					11,931	3.91	11,946	3.86
field - agriculture/nat. sciences					-1,193	-0.19	-1,020	-0.16
field - architecture/engineering					18,579	6.42	18,673	6.29
field - health					4,100	1.04	4,118	1.03
field - physical/life sciences					10,206	2.62	10,354	2.62
field - mathematics/computer sci.					17,301	5.21	17,751	5.28
field - personal/protective/transp					10,898	2.16	10,896	2.14
PS ed outside Canada							-446	-0.16
FE*trade							-5,437	-0.87
FE*college diploma							105	0.02
FE*MD							-11,305	-0.71
FE*MA							-10,870	-2.77
FE*PHD							10,434	1.61
cohort before 1961	12,655	16.59						
cohort 1961-70	10,872	18.57						
cohort 1971-80	6,154	13.06						
cohort 1991-95	-5,076	-10.12						
cohort 1996-01	-13,000	-25.01						

cohort before 1955								
cohort 1955-59								
cohort 1960-64								
cohort 1965-69								
cohort 1970-74								
cohort 1975-79								
cohort 1980-84								
cohort 1985-89			51,041	5.51	49,296	5.33	48,176	5.2
cohort 1990			30,820	3.07	29,809	2.98	28,851	2.88
cohort 1991			16,662	1.59	17,321	1.65	16,216	1.55
cohort 1992			25,107	2.51	24,975	2.51	24,045	2.41
cohort 1993			17,913	2.06	17,942	2.06	16,918	1.94
cohort 1994			27,392	3.41	25,235	3.15	24,864	3.1
cohort 1995			24,708	3.45	22,523	3.15	21,330	2.98
cohort 1996			25,893	4.07	24,199	3.81	23,358	3.68
cohort 1997			19,856	3.47	17,905	3.13	16,946	2.96
cohort 1998			17,383	3.04	14,718	2.58	13,950	2.44
cohort 1999			18,139	3.47	15,959	3.06	15,404	2.95
cohort 2000			17,034	3.59	14,243	3.01	13,611	2.86
cohort 2001			13,431	2.94	11,346	2.49	10,558	2.31
cohort 2002			6,827	1.47	4,413	0.95	3,866	0.83
cohort 2003			8,901	1.85	6,696	1.39	6,406	1.33
cohort 2004			10,759	2.32	9,207	1.99	8,806	1.9
cohort 2005			2,331	0.52	1,139	0.25	694	0.15
cohort 2006			4,957	1.08	3,590	0.78	3,208	0.7
cohort 2007			4,106	0.9	2,379	0.52	2,031	0.45
cohort 2008			2,039	0.46	1,580	0.36	1,205	0.27
cohort 2009			1,432	0.33	560	0.13	354	0.08
cohort 2010			-1,729	-0.42	-2,584	-0.63	-2,569	-0.63
cohort 2011			-4,953	-1.18	-5,152	-1.23	-5,127	-1.23
cohort 2012			-5,837	-1.4	-6,147	-1.48	-6,139	-1.47
cohort 2013			-11,251	-2.67	-11,439	-2.72	-11,211	-2.66
cohort 2014			-6,635	-1.6	-6,993	-1.69	-6,722	-1.62
cohort 201516			-8,512	-2.13	-9,211	-2.31	-8,896	-2.23
Constant	24,839	25.18	22,514	4,665	21,031	4.51	20,443	4.37
adj. R-square	0.166		0.073		0.079		0.080	
N	29,527		13,312		13,312		13,312	